



Technical
University
of Crete

School of Production Engineering and Management

PhD Dissertation: Multidimensional Assessment of Entrepreneurial Ecosystems and Development of Typology

Stamati Dimitra

Dissertation submitted in partial fulfillment of the requirements for the degree of
Doctor of Philosophy in the School of Production Engineering and Management of
the Technical University of Crete, Greece, 2021

Αφιερώνεται στην οικογένειά μου
και ιδιαίτερα στη μητέρα μου



The research work for the years 2017-2020 was supported by the Onassis Foundation, with scholarship from the Onassis Foundation Scholarship Program.

Advisory Committee

Grigoroudis Evangelos (supervisor)
Professor, School of Production Engineering and Management
Technical University of Crete

Carayannis Elias (member of the advisory committee)
Professor, School of Business
George Washington University

Kitsios Fotis (member of the advisory committee)
Associate Professor, Department of Applied Informatics
University of Macedonia

Thesis Examination Committee

Zopounidis Constantin
Professor, School of Production Engineering and Management
Technical University of Crete

Matsatsinis Nikolaos
Professor, School of Production Engineering and Management
Technical University of Crete

Nikolaou Ioannis
Associate Professor, Department of Environmental Engineering
Democritus University of Thrace

Fouskas Konstantinos
Associate Professor, Department of Applied Informatics
University of Macedonia

Acknowledgements

First of all, I would like to thank my supervisor Professor Grigoroudis Evangelos who agreed to collaborate with me as well as for his guidance, patience, help and supervision throughout these years that helped me in the completion of this thesis.

Moreover, I would like to thank my co-supervisor and member of the advisory committee Professor Carayannis Elias for not only giving the opportunity to start my PhD studies as well as for his help in finding a scholarship. His comments and guidance have also helped me in the completion of this thesis.

I would like to express my deepest gratitude to the Onassis Foundation that gave me the opportunity to make my dream come true and funded my entire PhD research. I am honored to be able to say that I am one of the foundation's scholars.

In addition, I would like to express my deepest gratitude to my family, especially to my mother Dina, to my father Konstantinos and to my sister Vicky, who stood practically by me throughout my academic studies under difficult circumstances and especially under the preparation of this thesis. Without their love, support and encouragement I would not be where I am today.

I would like to thank my uncle Spyros not only for his financial support throughout the years of my academic studies but also for his encouragement to believe more in myself. Also, I would like to thank my aunt Zoe, who was always available to listen and discuss with me any matter.

Furthermore, I would like to thank my partner Nick, who came into my life the day the scholarship's results came out and has always been there for me not only in my happy moments but also in my most difficult moments. Our endless discussions have given me the courage and the support I needed to feel better and move forward. His practical love, support and encouragement helped me to complete this project and to see some things differently in life.

In closing, I would like to quote some of my favorite lyrics: "Just to be on the first step should make you happy and proud. To have come this far is no small achievement: what you have done is a glorious thing- Konstantinos P. Kavafis."

Ευχαριστίες

Πρωτίστως, θα ήθελα να ευχαριστήσω τον επιβλέποντα καθηγητή κ. Γρηγορούδη Ευάγγελο που δέχτηκε να συνεργαστούμε καθώς και για την επίβλεψη, καθοδήγηση, υπομονή αλλά και βοήθεια που μου προσέφερε καθ' όλη την διάρκεια εκπόνησης της διατριβής, τα οποία συνέβαλαν στην ολοκλήρωσή της.

Επιπροσθέτως, θα ήθελα να ευχαριστήσω τον καθηγητή κ. Καραγιάννη Ηλία, ο οποίος είναι συνεπιβλέπων αλλά και μέλος της συμβουλευτικής επιτροπής και μου έδωσε όχι μόνο την ευκαιρία να ξεκινήσω τις διδακτορικές μου σπουδές αλλά με βοήθησε και στην εύρεση υποτροφίας. Τα σχόλιά του και η καθοδήγησή του επίσης με βοήθησαν στην ολοκλήρωση αυτής της διατριβής.

Θα ήθελα να εκφράσω την βαθύτερη ευγνωμοσύνη μου στο Ίδρυμα Ωνάση που μου έδωσε την ευκαιρία να πραγματοποιήσω το όνειρό μου και χρηματοδότησε ολόκληρη την διδακτορική μου έρευνα. Νιώθω τιμή που είμαι μια από τις υποτρόφους του Ιδρύματος.

Επίσης, θα ήθελα να εκφράσω την βαθύτερη ευγνωμοσύνη μου στην οικογένεια μου, ιδιαίτερα στη μητέρα μου Ντίνα, στο πατέρα μου Κωνσταντίνο και στην αδερφή μου Βίκη, οι οποίοι στάθηκαν δίπλα μου έμπρακτα καθ' όλη την διάρκεια των ακαδημαϊκών μου σπουδών κάτω από δύσκολες συνθήκες και ιδιαίτερα κατά την εκπόνηση της συγκεκριμένης διατριβής. Χωρίς την αγάπη, την συμπαράσταση και την υποστήριξή τους δεν θα βρισκόμουν εδώ που είμαι σήμερα.

Θα ήθελα να ευχαριστήσω τον θείο μου Σπύρο όχι μόνο για την οικονομική του βοήθεια καθ' όλη την διάρκεια των ακαδημαϊκών μου σπουδών αλλά και για την ενθάρρυνσή του να πιστεύω περισσότερο στον εαυτό μου. Ακόμα, θα ήθελα να ευχαριστήσω την θεία μου Ζωή, η οποία πάντα ήταν διαθέσιμη για να με ακούσει και να συζητήσουμε για οποιοδήποτε θέμα.

Θα ήθελα να ευχαριστήσω τον σύντροφο μου Νίκο, ο οποίος ήρθε στη ζωή μου την μέρα που βγήκαν τα αποτελέσματα της υποτροφίας και είναι δίπλα μου όλα αυτά τα χρόνια όχι μόνο στις καλές αλλά και στις πιο δύσκολες στιγμές μου. Οι ατελείωτες συζητήσεις μας μου έδιναν το κουράγιο και την υποστήριξη που χρειαζόμουν για να νιώσω καλύτερα και να μπορέσω να προχωρήσω μπροστά. Η έμπρακτη αγάπη, συμπαράσταση και υποστήριξη του με βοήθησαν στο να ολοκληρώσω αυτό το εγχείρημα και να βλέπω κάποια πράγματα διαφορετικά στη ζωή.

Κλείνοντας, θα ήθελα να παραθέσω κάποιους αγαπημένους μου στίχους: “Και αν είσαι στο σκαλί το πρώτο, πρέπει νάσαι υπερήφανος κ’ ευτυχισμένος. Εδώ που έφθασες, λίγο δεν είναι τόσο που έκαμες, μεγάλη δόξα - Κωνσταντίνος Π. Καβάφης.”

Abstract

This dissertation studies, analyses, discusses and proposes the assessment of entrepreneurial or entrepreneurship ecosystems. Entrepreneurship and innovation are two elements that can promote economic growth globally and can impact people's life, for example through innovative products or services. Although the term "ecosystem" was first used in the fields of ecology and biology, this term has appeared in the field of management with the entrepreneurial ecosystems. Thus, entrepreneurial ecosystems are a new and emerging research field.

Entrepreneurial ecosystems can be seen as networks of various actors, factors and relations that interact with each other, as well as with the environment and can contribute not only to economic growth worldwide, but they can affect the chances of a company surviving in a specific region or country. An example of the most widely known entrepreneurial ecosystem is the Silicon Valley in the US.

Entrepreneurial ecosystems can promote and facilitate not only entrepreneurship but also innovation where elements, such as access to human capital, finance and other resources, are all vital in order for the ecosystem to prosper combined with the appropriate environment where policies will enable and facilitate entrepreneurship.

The question that rises is how can the assessment of entrepreneurial ecosystems be conducted? In this thesis the current assessment frameworks of entrepreneurial ecosystems are studied in depth. In addition, it is also studied how the evaluation of innovation ecosystems is conducted, since both innovation and entrepreneurial ecosystems have common points. This is proven through the existing frameworks and indexes that are being used for these assessments such as for example the European Innovation Scoreboard, the Global Entrepreneurship Index, etc.

Until now, in the existing literature the assessment of ecosystems is conducted based on the category of ecosystems, if they are innovation or entrepreneurial ecosystems and only at one level each time for example at the macro level which concerns countries, at the meso level which concerns regions and at the micro level which concerns companies. Therefore, there is a gap in the literature and a need for the creation of a new framework that can address this gap through a multilevel approach.

The aim of this thesis is the multilevel assessment of the innovative entrepreneurial ecosystems through the development of a new proposed framework. This new proposed framework can assess these ecosystems at the macro, meso and micro level.

At the national level 28 EU countries, at the regional level 212 EU regions and at the firm level 120 companies in the Cretan Agrofood industry have been assessed. The new proposed framework was implemented with Multi-Criteria Decision Making (MCDM) methods and more specifically with the Non-Weighted model (NWM) and the TOPSIS method.

This new proposed framework is based on existing theories and studies. More specifically, the 3P framework of Carayannis and Provan (2008) is used, which measures firm innovativeness. The 3P framework is incorporated in this thesis, in order to create the domains of the new proposed framework and evaluate the immediate, mid-range and long-range results of different innovative entrepreneurial ecosystems. In addition, existing studies such as for example the studies of Isenberg (2011a) and Stam (2017) on the elements of the entrepreneurial ecosystems were also incorporated, in order to create the pillars of the framework. Moreover, the existing frameworks such as the European Innovation Scoreboard, the Global Entrepreneurship Index, etc were studied, in order to select the most appropriate variables.

This new proposed framework can also be connected to the Quadruple Innovation Helix (QIH) model through the evaluation of different stakeholders which can be found within the

innovative entrepreneurial ecosystems and these are industry, academia, university and civil society.

The results of this thesis led to the development of a unique typology. This new proposed typology goes beyond the existing classification schemes, such as the European Innovation Scoreboard classification scheme for countries based on their innovation performance. The typology uses the K-means algorithm for the creation of clusters based on the four helices of the QIH model. It shows not only the performance of the nations, regions and firms but also it gives insights about the characteristics of success for each cluster. For example, the typology revealed that at the national level the most innovative countries such as Sweden have higher performance on the dimension human capital.

Consequently, the originality of this thesis is that the new proposed framework compared to other models and frameworks provides a complete multilevel assessment of the innovative entrepreneurial ecosystems at the macro, meso and micro level with the use of the MCDM methods.

As far as it is known, there are limited MCDM studies that have used the NWM and the TOPSIS method for the assessment of innovative entrepreneurial ecosystems. Also, there are limited studies that have linked their frameworks for the assessment of innovative entrepreneurial ecosystems with the QIH model. Furthermore, there is a need for adoption of the 3P framework of Carayannis and Provan (2008) since it can be used for various assessments, besides the measurement of firm innovativeness.

Another fact of this thesis's originality is that a typology has not been proposed in the literature until now, that presents clusters at the national, regional and firm level as well as the characteristics that can be found in each cluster.

This thesis contributes to the existing academic literature since it covers different themes such as the assessment of innovative entrepreneurial ecosystems, the Triple and the Quadruple/Quintuple Innovation Helix models, the 3P framework and the MCDM methods. Moreover, it provides a wide understanding of how a complete multilevel assessment of innovative entrepreneurial ecosystems can be conducted, through the new proposed framework which can also be implemented with advanced quantitative methods such as MCDM methods. It also extends the use of the 3P framework of Carayannis and Provan (2008) which is used for measuring firm innovativeness.

Moreover, this thesis contributes to the evaluation of different stakeholders within the innovative entrepreneurial ecosystems and it can be connected to the different stakeholders of the QIH model. It is also important that the results from the assessment of different innovative entrepreneurial ecosystems led to the development of a unique typology. This thesis contributes to the better understanding of a specific country, region or company. Until now, most of the existing studies focused on the assessment of large firms rather than SMEs whereas this thesis focuses on the assessment of SMEs at the micro level. This assessment at all levels can show strong and weak points and it can contribute also to future improvement efforts. Last but not least, the combination of the quantitative research through the development of the new proposed multilevel framework and the qualitative research through the conduction of case studies at the micro level can be an additional contribution and originality of this dissertation.

The results of the framework at the macro, meso and micro level revealed significant findings. First, at the macro level, the framework revealed an overall low performance of Greece and a high performance of Sweden out of 28 countries. These results are in line with the results of the existing frameworks. Then, at the meso level, the framework revealed a moderate performance of the region Crete and a high performance of the region Stockholm out of 212 regions. At the micro level, the framework revealed that the Agrofood industry as well as all sectors perform better on the pillars Culture, Policy and Impacts and present a rather low performance on the pillars Human Capital, Finance, Outputs and Outcomes. This is

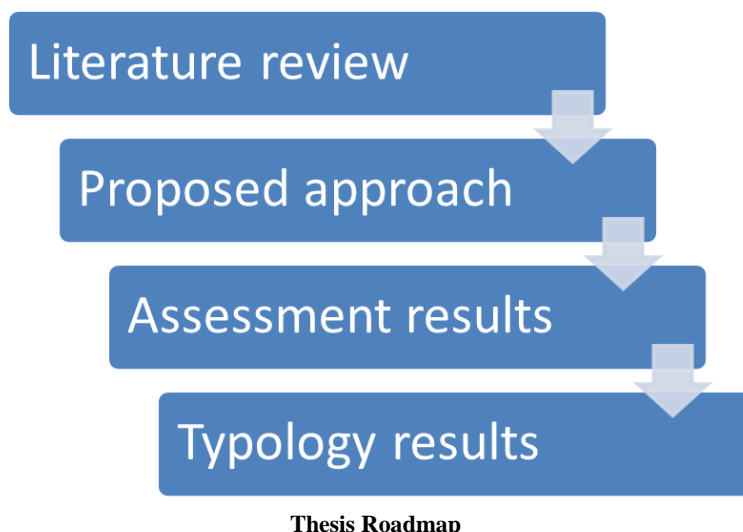
in line with most of the findings from the three case studies, Avoel, Mills of Crete and Stathakis Family that were conducted.

As regards to the 3P framework, the performance of the pillars directly affect the three firm factors which are Enablers (Posture), Capabilities (Propensity) and Results (Performance) at all levels, macro meso and micro. This means for example that when a pillar has a better performance than the other, this affects the overall rank and score of these domains. Regarding the results of the QIH model at all levels, the same applies here, where the variables that constitute each helix directly affect how each helix will perform.

It is important to present the thesis roadmap. The steps that are followed in this thesis include the Literature review, the Proposed approach, the Assessment and the Typology results. As regards to the Literature review, the aim is to describe entrepreneurial ecosystems in depth through their definitions, their characteristics, their classification and their types as well as to describe innovative ecosystems and ecosystems in general.

Equally important is to understand how the entrepreneurial ecosystems can be connected to the QIH model through different studies, how the assessment of these ecosystems takes place at all levels, macro, meso and micro through the existing frameworks such as EIS, RIS, etc, as well as how the MCDM methods can be used for this kind of assessment.

As regards to the Proposed approach, the goal is to define the domains and the pillars of the new proposed framework which are based on existing theories such as Carayannis and Provan (2008), Isenberg (2011a) and Stam (2015) as well as the variables which are based on existing frameworks. Other objectives are to present the two methods, the NWM and the TOPSIS method that are implemented, to describe how the new proposed framework can be connected to the QIH as well as to analyze the typology's approach at all levels, using the K-Means algorithm.



The Assessment results present the data processing that were applied to all levels, macro, meso and micro, as well as the results. At the macro level, the results for Greece and Sweden are presented across the entrepreneurship pillars of the new proposed framework, the 3P framework and the QIH model. In the same way, at the meso level the results for Crete and Stockholm are presented and the results at the micro level for the Cretan Agrofood industry are also presented. Last but not least, the Typology results present the clusters for the countries, regions and companies as well as the characteristics that can be found in each cluster.

Περίληψη

Η παρούσα διατριβή συζητά, μελετά, αναλύει και προτείνει την νέα αξιολόγηση των επιχειρηματικών οικοσυστημάτων. Η επιχειρηματικότητα και η καινοτομία είναι δύο στοιχεία τα οποία μπορούν να προωθήσουν την οικονομική ανάπτυξη παγκοσμίως και μπορούν να έχουν κάποιο αντίκτυπο στις ζωές των ανθρώπων, για παράδειγμα μέσω των καινοτόμων προϊόντων ή υπηρεσιών. Αν και ο όρος “οικοσύστημα” χρησιμοποιήθηκε για πρώτη φορά στους τομείς της οικολογίας και της βιολογίας, αυτός ο όρος εμφανίστηκε και στο τομέα του management με τα επιχειρηματικά οικοσυστήματα. Κατά αυτήν την έννοια, τα επιχειρηματικά οικοσυστήματα είναι ένα νέο και αναδυόμενο ερευνητικό πεδίο.

Τα επιχειρηματικά οικοσυστήματα μπορούν να θεωρηθούν ως δίκτυα διαφόρων συμμετεχόντων και παραγόντων οι οποίοι αλληλεπιδρούν μεταξύ τους αλλά και με το περιβάλλον και μπορούν να συνεισφέρουν όχι μόνο στη παγκόσμια οικονομική ανάπτυξη αλλά μπορούν να επηρεάσουν τις πιθανότητες που έχει μια εταιρεία να επιβιώσει σε μια συγκεκριμένη περιοχή ή χώρα. Ένα παράδειγμα του πιο γνωστού επιχειρηματικού οικοσυστήματος είναι η Silicon Valley στις ΗΠΑ.

Τα επιχειρηματικά οικοσυστήματα μπορούν να προωθήσουν και να διευκολύνουν όχι μόνο την επιχειρηματικότητα αλλά και την καινοτομία ενώ στοιχεία όπως η πρόσβαση στο ανθρώπινο κεφάλαιο, η χρηματοδότηση και άλλοι πόροι, είναι όλα ζωτικής σημασίας για να ευημερήσει το οικοσύστημα σε συνδυασμό με το κατάλληλο περιβάλλον όπου οι πολιτικές θα επιτρέψουν και θα διευκολύνουν την επιχειρηματικότητα.

Η ερώτηση που τίθεται είναι πως μπορεί η αξιολόγηση των επιχειρηματικών οικοσυστημάτων να πραγματοποιηθεί? Στη παρούσα διατριβή η υπάρχουσα αξιολόγηση αυτών των οικοσυστημάτων μελετάται σε βάθος. Ο τρόπος με τον οποίο γίνεται η αξιολόγηση των οικοσυστημάτων καινοτομίας, καθώς και των επιχειρηματικών οικοσυστημάτων έχουν κοινά σημεία. Αυτό αποδεικνύεται μέσω των υφιστάμενων πλαισίων και δεικτών που χρησιμοποιούνται για αυτές τις αξιολογήσεις όπως είναι για παράδειγμα τα European Innovation Scoreboard, Global Entrepreneurship Index, κτλ.

Μέχρι τώρα, στην υπάρχουσα βιβλιογραφία η αξιολόγηση των οικοσυστημάτων διενεργείται με βάση την κατηγορία των οικοσυστημάτων, αν είναι οικοσυστήματα καινοτομίας ή επιχειρηματικότητας και μόνο σε ένα επίπεδο κάθε φορά, για παράδειγμα στο εθνικό επίπεδο που αφορά χώρες, στο περιφερειακό επίπεδο που αφορά περιφέρειες και στο επίπεδο επιχείρησης. Επομένως, υπάρχει ένα κενό στη βιβλιογραφία και η ανάγκη για την ανάπτυξη ενός νέου πλαισίου που μπορεί να αντιμετωπίσει αυτό το κενό μέσω μιας πολυεπίπεδης προσέγγισης.

Σκοπός αυτής της διατριβής είναι η πολυεπίπεδη αξιολόγηση των καινοτόμων επιχειρηματικών οικοσυστημάτων μέσω της ανάπτυξης ενός νέου προτεινόμενου πλαισίου. Αυτό το νέο προτεινόμενο πλαίσιο μπορεί να αξιολογήσει αυτά τα οικοσυστήματα σε επίπεδο εθνικό, περιφερειακό αλλά και σε επίπεδο επιχείρησης.

Στο εθνικό επίπεδο 28 Ευρωπαϊκές χώρες αξιολογήθηκαν, στο περιφερειακό 212 Ευρωπαϊκές περιφέρειες και στο εταιρικό επίπεδο 120 επιχειρήσεις στον αγροδιατροφικό τομέα της Κρήτης. Το νέο προτεινόμενο πλαίσιο μπορεί να εφαρμοστεί με τις μεθόδους της Πολυκριτήριας Ανάλυσης και πιο συγκεκριμένα με το Non-Weighted μοντέλο και με την μέθοδο TOPSIS που ανήκουν σε αυτές τις μεθόδους.

Αυτό το νέο προτεινόμενο πλαίσιο βασίζεται σε υπάρχουσες θεωρίες και μελέτες. Πιο συγκεκριμένα, χρησιμοποιείται το πλαίσιο 3P των Carayannis και Provan (2008) το οποίο μπορεί να μετρήσει την εταιρική καινοτομία. Το πλαίσιο 3P ενσωματώνεται σε αυτή τη διατριβή για να δημιουργήσει τους τομείς του νέου προτεινόμενου πλαισίου και να αξιολογήσει τα άμεσα, μεσοπρόθεσμα και μακροπρόθεσμα αποτελέσματα των διαφορετικών καινοτόμων επιχειρηματικών οικοσυστημάτων. Επιπλέον, οι υπάρχουσες μελέτες όπως για παράδειγμα οι μελέτες των Isenberg (2011a) και Stam (2017) σχετικά με τα στοιχεία των

επιχειρηματικών οικοσυστημάτων ενσωματώθηκαν, προκειμένου να δημιουργηθούν οι πυλώνες του πλαισίου. Επιπλέον, μελετήθηκαν τα υπάρχοντα πλαίσια, όπως τα European Innovation Scoreboard, Global Entrepreneurship Index κ.λπ., προκειμένου να επιλεγούν οι κατάλληλες μεταβλητές.

Αυτό το νέο προτεινόμενο πλαίσιο μπορεί επίσης να συνδεθεί με το μοντέλο της Τετραπλής Έλικας μέσω της αξιολόγησης των διαφορετικών ενδιαφερομένων που μπορούν να βρεθούν στα καινοτόμα επιχειρηματικά οικοσυστήματα και αυτά είναι η βιομηχανία, η ακαδημαϊκή κοινότητα, το πανεπιστήμιο και η κοινωνία των πολιτών.

Τα αποτελέσματα αυτής της διατριβής οδήγησαν στην ανάπτυξη μιας μοναδικής τυπολογίας. Αυτή η νέα προτεινόμενη τυπολογία υπερβαίνει τα υφιστάμενα συστήματα ταξινόμησης, όπως το σύστημα ταξινόμησης του European Innovation Scoreboard για χώρες με βάση την απόδοση της καινοτομίας τους. Η τυπολογία χρησιμοποιεί τον αλγόριθμο K-means για τη δημιουργία συστάδων βάσει των τεσσάρων ελικών του μοντέλου της Τετραπλής Έλικας. Δείχνει όχι μόνο την απόδοση των εθνών, των περιφερειών και των εταιρειών, αλλά επίσης δίνει πληροφορίες για τα χαρακτηριστικά επιτυχίας της κάθε συστάδας. Για παράδειγμα, η τυπολογία αποκάλυψε ότι σε εθνικό επίπεδο οι πιο καινοτόμες χώρες όπως η Σουηδία έχουν υψηλότερες επιδόσεις στη διάσταση ανθρώπινο κεφάλαιο.

Κατά συνέπεια, η πρωτοτυπία αυτής της διατριβής βρίσκεται στο ότι το νέο προτεινόμενο πλαίσιο σε σύγκριση με άλλα μοντέλα και πλαίσια παρέχει μια πλήρη πολυεπίπεδη αξιολόγηση των καινοτόμων επιχειρηματικών οικοσυστημάτων με τη χρήση των μεθόδων της Πολυκριτήριας Ανάλυσης.

Από ό,τι είναι γνωστό, υπάρχουν περιορισμένες μελέτες Πολυκριτήριας Ανάλυσης που έχουν χρησιμοποιήσει το Non-Weighted μοντέλο και την μέθοδο TOPSIS για την αξιολόγηση των καινοτόμων επιχειρηματικών οικοσυστημάτων. Επίσης, υπάρχουν περιορισμένες μελέτες που έχουν συνδέσει τα πλαίσια τους για την αξιολόγηση των καινοτόμων επιχειρηματικών οικοσυστημάτων με το μοντέλο της Τετραπλής Έλικας. Επιπλέον, υπάρχει η ανάγκη για την υιοθέτηση του πλαισίου 3P των Carayannis και Provan (2008), καθώς μπορεί να χρησιμοποιηθεί για διάφορες αξιολογήσεις, πέρα από τη μέτρηση της εταιρικής καινοτομίας.

Ένα άλλο γεγονός της πρωτοτυπίας αυτής της διατριβής, είναι ότι δεν έχει προταθεί τυπολογία στη βιβλιογραφία μέχρι τώρα που να παρουσιάζει συστάδες σε εθνικό, περιφερειακό και εταιρικό επίπεδο καθώς και τα χαρακτηριστικά που μπορούν να βρεθούν σε κάθε συστάδα.

Αυτή η διατριβή συμβάλλει στην υπάρχουσα ακαδημαϊκή βιβλιογραφία αφού καλύπτει διαφορετικά θέματα όπως είναι η αξιολόγηση των καινοτόμων επιχειρηματικών οικοσυστημάτων, τα μοντέλα της Τριπλής Έλικας και της Τετραπλής/Πενταπλής Έλικας, το πλαίσιο 3P και τις μεθόδους της Πολυκριτήριας Ανάλυσης. Επιπλέον, παρέχει μια ευρεία κατανόηση του τρόπου με τον οποίο μπορεί να διεξαχθεί μια πλήρης πολυεπίπεδη αξιολόγηση των καινοτόμων επιχειρηματικών οικοσυστημάτων μέσω του νέου προτεινόμενου πλαισίου, το οποίο μπορεί επίσης να εφαρμοστεί με προηγμένες ποσοτικές μεθόδους όπως είναι οι μέθοδοι της Πολυκριτήριας Ανάλυσης. Επεκτείνει επίσης τη χρήση του πλαισίου 3P των Carayannis και Provan (2008) που χρησιμοποιείται για τη μέτρηση της εταιρικής καινοτομίας.

Επιπλέον, αυτή η διατριβή συμβάλλει στην αξιολόγηση των διαφορετικών ενδιαφερομένων στα καινοτόμα επιχειρηματικά οικοσυστήματα και μπορεί να συνδεθεί με τους διαφορετικούς ενδιαφερόμενους του μοντέλου της Τετραπλής Έλικας. Είναι επίσης σημαντικό ότι τα αποτελέσματα από την αξιολόγηση των διαφορετικών καινοτόμων επιχειρηματικών οικοσυστημάτων οδήγησαν στην ανάπτυξη μιας μοναδικής τυπολογίας. Αυτή η διατριβή συμβάλλει στην καλύτερη κατανόηση μιας συγκεκριμένης χώρας, περιοχής ή εταιρείας. Μέχρι τώρα, οι περισσότερες από τις υπάρχουσες μελέτες επικεντρώνονται στην αξιολόγηση μεγάλων επιχειρήσεων και όχι μικρομεσαίων επιχειρήσεων, ενώ η παρούσα διατριβή επικεντρώνεται στην αξιολόγηση των μικρομεσαίων επιχειρήσεων στο εταιρικό επίπεδο.

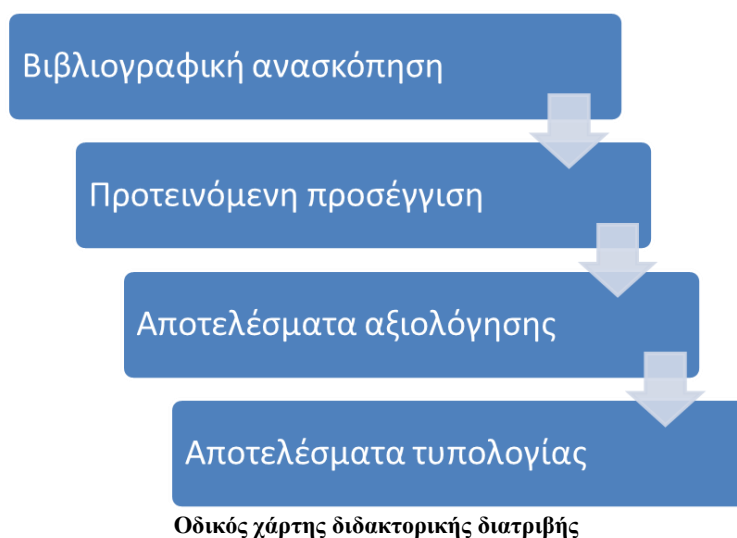
Δεδομένου ότι η αξιολόγηση μπορεί να δείξει ισχυρά και αδύναμα σημεία, μπορεί επίσης να συμβάλλει και σε προσπάθειες βελτίωσης. Τελευταίο αλλά όχι λιγότερο σημαντικό, είναι το γεγονός ότι ο συνδυασμός της ποσοτικής έρευνας μέσω της ανάπτυξης του νέου προτεινόμενου πολυεπίπεδου πλαισίου και της ποιοτικής έρευνας μέσω της διεξαγωγής μελετών περιπτώσεων στο επίπεδο εταιρειών μπορεί να αποτελέσει πρόσθετη συμβολή και πρωτοτυπία αυτής της διατριβής.

Τα αποτελέσματα του πλαισίου σε επίπεδο χωρών, περιφερειών και εταιρειών αποκάλυψαν σημαντικά ευρήματα. Πρώτον, σε επίπεδο χωρών, το πλαίσιο αποκάλυψε μια συνολική χαμηλή απόδοση της Ελλάδας και μια υψηλή απόδοση της Σουηδίας από 28 χώρες. Αυτά τα αποτελέσματα είναι σύμφωνα με τα αποτελέσματα των υφιστάμενων πλαισίων. Στη συνέχεια, σε επίπεδο περιφερειών, το πλαίσιο αποκάλυψε μια μέτρια απόδοση της Κρήτης και μια υψηλή απόδοση της Στοκχόλμης από 212 περιφέρειες.

Σε εταιρικό επίπεδο, το πλαίσιο αποκάλυψε μια σχετικά υψηλή απόδοση του Αγροδιατροφικού κλάδου και όλων των τομέων στους πυλώνες Κουλτούρα, Πολιτική και Μακροπρόθεσμα Αποτελέσματα και μάλλον μια χαμηλή απόδοση στους πυλώνες Ανθρώπινο Κεφάλαιο, Χρηματοοικονομικά, Βραχυπρόθεσμα Αποτελέσματα και Μεσοπρόθεσμα Αποτελέσματα. Αυτό ευθυγραμμίζεται με τα περισσότερα από τα ευρήματα των τριών περιπτώσιολογικών μελετών, των εταιρειών Avoe!, Mills of Crete και Stathakis Family που πραγματοποιήθηκαν.

Όσον αφορά το πλαίσιο 3P σε όλα τα επίπεδα, η απόδοση των πυλώνων επηρεάζει άμεσα τους τρεις σταθερούς τομείς που είναι οι Enablers (Posture), Capabilities (Propensity) και Results (Performance) τόσο σε επίπεδο χωρών, σε επίπεδο περιφερειών όσο και σε επίπεδο εταιρειών. Αυτό σημαίνει για παράδειγμα, ότι όταν ένας πυλώνας έχει καλύτερη απόδοση από τον άλλο, αυτό επηρεάζει τη συνολική κατάταξη και βαθμολογία αυτών των τομέων. Τέλος, όσον αφορά το μοντέλο της Τετραπλής Έλικας, το ίδιο ισχύει και εδώ, δηλαδή οι μεταβλητές που αποτελούν την κάθε έλικα άμεσα επηρεάζουν το πώς θα αποδώσει η κάθε έλικα.

Είναι σημαντικό να παρουσιαστεί ο οδικός χάρτης της διατριβής. Τα βήματα που ακολουθούνται σε αυτή τη διατριβή περιλαμβάνουν την Ανασκόπηση της βιβλιογραφίας, την Προτεινόμενη προσέγγιση, τα Αποτελέσματα αξιολόγησης και της τυπολογίας. Όσον αφορά την Ανασκόπηση της βιβλιογραφίας, στόχος είναι να περιγραφούν σε βάθος τα επιχειρηματικά οικοσυστήματα μέσα από τους ορισμούς τους, τα χαρακτηριστικά τους, την ταξινόμηση τους και τους τύπους τους καθώς και να περιγραφούν τα καινοτόμα οικοσυστήματα αλλά και τα οικοσυστήματα γενικότερα.



Εξίσου σημαντικό είναι να κατανοήσουμε πώς τα επιχειρηματικά οικοσυστήματα μπορούν να συνδεθούν με το μοντέλο της Τετραπλής Έλικας μέσω διαφορετικών μελετών, πώς η αξιολόγηση αυτών των οικοσυστημάτων πραγματοποιείται σε όλα τα επίπεδα, χωρών, περιφερειών και εταιρειών, μέσω των υφιστάμενων πλαισίων όπως EIS, RIS κ.λπ. καθώς και πώς μπορούν να χρησιμοποιηθούν οι μέθοδοι της Πολυκριτήριας Ανάλυσης για αυτή την αξιολόγηση.

Όσον αφορά την Προτεινόμενη προσέγγιση, στόχος είναι να οριστούν οι τομείς και οι πυλώνες του νέου προτεινόμενου πλαισίου που βασίζονται σε υπάρχουσες θεωρίες όπως οι θεωρίες των Carayannis και Provance (2008), Isenberg (2011a) και Stam (2015) καθώς και οι μεταβλητές που βασίζονται σε ήδη υπάρχοντα πλαίσια. Άλλοι στόχοι είναι να παρουσιαστούν οι δύο μέθοδοι, το Non-Weighted μοντέλο και η μέθοδος TOPSIS που εφαρμόστηκαν, να περιγραφεί το πώς μπορεί να συνδεθεί το νέο προτεινόμενο πλαίσιο με την Τετραπλή Έλικα καθώς και να αναλυθεί η προσέγγιση της τυπολογίας σε όλα τα επίπεδα, χρησιμοποιώντας τον αλγόριθμο K-Means.

Τα Αποτελέσματα της αξιολόγησης παρουσιάζουν την επεξεργασία των δεδομένων που εφαρμόστηκαν σε όλα τα επίπεδα, χωρών, περιφερειών και εταιρειών, καθώς και τα αποτελέσματα. Σε επίπεδο χωρών, τα αποτελέσματα για την Ελλάδα και τη Σουηδία παρουσιάζονται με βάση τους πυλώνες του νέου προτεινόμενου πλαισίου, με βάση το μοντέλο 3P και με βάση το μοντέλο της Τετραπλής Έλικας. Με τον ίδιο τρόπο, παρουσιάζονται τα αποτελέσματα σε επίπεδο περιφερειών για την Κρήτη και τη Στοκχόλμη και σε επίπεδο εταιρειών παρουσιάζονται επίσης τα αποτελέσματα για τον Αγροδιατροφικό κλάδο στην Κρήτη. Τελευταίο αλλά εξίσου σημαντικό, τα Αποτελέσματα της τυπολογίας παρουσιάζουν τις συστάδες των χωρών, των περιφερειών και των εταιρειών καθώς και τα χαρακτηριστικά που μπορούν να βρεθούν σε κάθε συστάδα.

Table of Contents

Abstract	6
Περίληψη.....	9
Chapter 1. Introduction	21
1.1 Importance of entrepreneurial ecosystems	21
1.2 Research problem and hypotheses.....	23
1.3 Research objectives and contribution	28
1.4 Thesis Structure	29
Chapter 2. Entrepreneurial Ecosystems.....	31
2.1 Defining entrepreneurial ecosystems	31
2.2 Characteristics of ecosystems.....	37
2.3 Classification of ecosystems.....	42
2.4 Types of ecosystems.....	44
2.5 Entrepreneurship vs Innovation ecosystems.....	56
2.6 Entrepreneurial ecosystems and the QIH model	75
Chapter 3. Assessing Entrepreneurial Ecosystems	80
3.1 Assessment frameworks at macro level.....	80
3.2 Assessment frameworks at meso level	90
3.3 Assessment frameworks at micro level	95
3.4 MCDM and entrepreneurship assessment	97
3.5 Other approaches	102
3.6 Comparison and discussion	105
Chapter 4. Proposed Approach.....	117
4.1 Overview	117
4.1.1 Innovative posture, propensity and performance	118
4.1.2 Quadruple Innovation Helix model	126
4.2 Macro-level framework	128
4.2.1 Dimensions and indicators	129
4.2.2 Combining 3P and QIH models	150
4.3 Meso-level framework.....	151
4.3.1 Dimensions and indicators	156
4.3.2 Combining 3P and QIH models.....	172
4.4 Micro level framework	173
4.4.1 Dimensions and indicators	173
4.4.2 Combining 3P and QIH models	179

4.5 Typology approach.....	181
Chapter 5. Assessment Results	182
5.1 National entrepreneurship ecosystems	183
5.1.1 Data processing	183
5.1.2 Results based on the entrepreneurship pillars.....	185
5.1.3 Results based on the 3P model	197
5.1.4 Results based on the QIH model	201
5.2 Regional entrepreneurship ecosystems.....	203
5.2.1 Data processing	203
5.2.2 Results based on the entrepreneurship pillars.....	206
5.2.3 Results based on the 3P model	214
5.2.4 Results based on the QIH model	218
5.3 Firm level entrepreneurship ecosystems.....	219
5.3.1 Survey details and respondents' profile.....	219
5.3.2 Results based on the entrepreneurship pillars.....	222
5.3.3 Results based on the 3P model	225
5.3.4 Results based on the QIH model	227
5.4 Case studies	228
5.4.1 Objectives and interviews.....	228
5.4.2 Avoel	229
5.4.3 Mills of Crete.....	231
5.4.4 Stathakis Family	233
5.5 Comparison and Discussion	234
Chapter 6. Entrepreneurship Ecosystems Typology.....	238
6.1 Results for national ecosystems.....	238
6.2 Results for regional ecosystems	244
6.3 Results for firm level ecosystems.....	261
Chapter 7. Conclusions	271
7.1 Overview of results and findings.....	271
7.2 Limitations and Future Research.....	273
References	275
Appendices	299
Appendix 1. NWM and TOPSIS method	299
Appendix 2. Imputation at macro and meso level	302
Macro level Imputation	302
Meso level Imputation	305

Appendix 3. Results NWM-TOPSIS.....	327
Macro Level Results NWM-TOPSIS	327
Meso Level Results NWM-TOPSIS	328
Micro Level Results NWM-TOPSIS.....	343
Appendix 4. Quadruple Innovation Helix model results	350
Macro level Quadruple Innovation Helix model results	350
Meso level Quadruple Innovation Helix model results	352
Micro level Quadruple Innovation Helix model results	373
Appendix 5. Macro, meso and micro level clusters' characteristics	376
Macro level clusters' characteristics	376
Meso level clusters' characteristics	397
Micro level clusters' characteristics	428

List of Tables

Table 2.1. Selected definitions of entrepreneurial ecosystems.....	35
Table 2.1. The analogy between a natural and an entrepreneurial ecosystem.....	35
Table 2.2. The analogy between business, innovation, knowledge and natural ecosystems- adapted from: Valkokari (2015).....	39
Table 2.3. Differences between entrepreneurial ecosystems and other approaches. Source: O'Connor et al. (2018).....	41
Table 2.4. Similarities and differences of business and knowledge ecosystems.....	47
Table 2.5. Definitions of ecosystems across sectors.....	48
Table 2.6. Comparison of innovation and entrepreneurship ecosystem analogies - adapted from: Pilinkienė and Mačiulis (2014).....	57
Table 2.7. Thematic analytical categorization of entrepreneurial ecosystem. Source: Kansheba and Wald (2020).....	58
Table 2.8. Typology of innovation ecosystems. Source: Klimas and Czakon (2021).....	71
Table 2.9. Similarities and differences of innovation and entrepreneurship ecosystems....	72
Table 2.10. Productive triadic entrepreneurial activities in the digital economy. Source: Chinta and Sussan (2018).....	75
Table 3.1. The EIS measurement framework. Source: European Commission (2018a).....	80
Table 3.2. The 14 pillars of the Global Entrepreneurship Index. Source: Acs et al. (2017a)....	84
Table 3.3. The OECD/Eurostat Framework for Entrepreneurship indicators – adding policy areas for entrepreneurial determinants. Source: Ahmad and Hoffman (2007).....	87
Table 3.4. The Global Competitiveness Index framework. Source: Schwab (2019).....	89
Table 3.5. Comparison of the indicators of the EIS 2017 and the RIS 2017. Source: European Commission (2018b).....	90
Table 3.6. The structure of the Regional REDI. Source: European Commission (2013b).....	94
Table 3.7. Indicators for the measurement of the entrepreneurial ecosystem vibrancy. Source: Stangler & Bell-Masterson (2015).....	103
Table 3.8. Data availability throughout the years.....	108
Table 3.9. Contributions and Limitations of MCDM studies.....	109
Table 4.1. Empirical measures of the entrepreneurial ecosystem elements. Source: Stam (2017)...	121
Table 4.2. The proposed framework at macro and meso level.....	123
Table 4.3. Macro level Variables.....	129
Table 4.4. The QIH model at the macro level.....	150
Table 4.5. NUTS 1 and NUTS 2 Regions.....	152
Table 4.6. Meso level variables.....	156
Table 4.7. The QIH model at the meso level.....	173
Table 4.8. Micro level variables.....	175
Table 4.9. The QIH model at the micro level.....	181
Table 5.1. Macro level Descriptive Statistics.....	185
Table 5.2. Results at the macro level for all 28-EU countries.....	186
Table 5.3. Meso level Descriptive Statistics.....	206
Table 5.4. Results at the macro level for all 28-EU countries.....	207
Table 5.5. Micro Level Descriptive Statistics.....	221
Table 6.1. K-means per helices 3 clusters results at the macro level (Average of 2013-2018).....	239
Table 6.2. Distances between Final Cluster Centers.....	240
Table 6.3. Post Hoc Tests, Multiple Comparisons, Tukey HSD.....	240
Table 6.4. Means of clusters for variable Tertiary Education.....	241
Table 6.5. Post Hoc Tests, Multiple Comparisons, Tukey HSD.....	241
Table 6.6. Macro typology results compared to EIS and GEI.....	242
Table 6.7. K-means per helices 5 clusters results at the meso level (Average of 2013-2018).....	246
Table 6.8. Distances between Final Cluster Centers.....	249
Table 6.9. Post Hoc Tests, Multiple Comparisons, Tukey HSD.....	250
Table 6.10. Means of clusters for variable Researchers.....	252
Table 6.11. Post Hoc Tests, Multiple Comparisons, Tukey HSD.....	253
Table 6.12. Meso typology results compared to RIS.....	255
Table 6.13. K-means per helices 3 clusters results at the micro level.....	262
Table 6.14. Distances between Final Cluster Centers.....	263
Table 6.15. Post Hoc Tests, Multiple Comparisons, Tukey HSD.....	263
Table 6.16. Means of clusters for variable Lifelong Learning.....	264

Table 6.17. Post Hoc Tests, Multiple Comparisons, Tukey HSD.....	265
Table 6.18. Elements that contributed to clusters' formation.....	266

List of Figures

Figure 2.1. Levels of organization of Ecology, highlighting ecosystems. Source: Ellis (2008).....	32
Figure 1.2. Illustration of the flow of matter and energy in ecosystems. Source: Ellis (2008).....	33
Figure 2.2. Energy flows and material cycles. Source: Whitman (2017).....	38
Figure 2.3. The Business Ecosystem. Source: Moore (1996).....	45
Figure 2.4. The Knowledge Ecosystem. Source: Osborne (2017).....	47
Figure 2.5. The principles of an innovation ecosystem. Source: UK Department for Business Innovation and Skills (2011).....	67
Figure 2.6. Theoretical framework of innovation ecosystem. Source: Meng and Ma (2018).....	70
Figure 2.7. The helices of the QIH model matched with the ecosystems.....	76
Figure 3.1. The Global Innovation Index Framework. Source: Cornell University et al. (2018).....	82
Figure 3.2. The Bloomberg Innovation Index. Source: bloomberg (2015).....	83
Figure 3.3. The GEM Conceptual Framework. Source: Schwab (2017).....	86
Figure 3.4. Innovation Index by the Indiana Business Research Center. Source: statsamerica.org (n.d.).....	93
Figure 3.5. The Asset Mapping Roadmap by the Council on Competitiveness. Source: Council on Competitiveness (2007).....	95
Figure 3.6. The BEEP project. Source: Babson College (n.d.).....	104
Figure 3.7. The Six + Six model of the Koltai and Company LLC. Source: koltai.co (n.d.).....	104
Figure 4.1. The 3P framework. Source: Carayannis and Provance (2008).....	119
Figure 4.2. Domains of the entrepreneurship ecosystem. Source: Isenberg (2011a)....	120
Figure 4.3. Key elements, outputs and outcomes of the entrepreneurial ecosystem. Source: Stam (2015).....	120
Figure 4.4. Quadruple Innovation Helix model. Source: Carayannis and Campbell (2009).....	126
Figure 5.1. Greece performance per pillar NWM rank 2018.....	188
Figure 5.2. Greece performance per pillar TOPSIS score 2018.....	189
Figure 5.3. Greece performance per pillar NWM rank 2013-2018.....	192
Figure 5.4. Greece performance per pillar TOPSIS score 2013-2018.....	193
Figure 5.5. Sweden performance per pillar NWM rank 2018.....	193
Figure 5.6. Sweden performance per pillar TOPSIS score 2018.....	194
Figure 5.7. Sweden performance per pillar NWM rank 2013-2018.....	197
Figure 5.8. Sweden performance per pillar TOPSIS score 2013-2018.....	198
Figure 5.9. Greece 3P framework NWM rank 2018.....	198
Figure 5.10. Greece 3P framework TOPSIS score 2018.....	199
Figure 5.11. Greece 3P framework NWM rank 2013-2018.....	199
Figure 5.12. Greece 3P framework TOPSIS score 2013-2018.....	200
Figure 5.13. Sweden 3P framework NWM rank 2018.....	200
Figure 5.14. Sweden 3P framework TOPSIS score 2018.....	201
Figure 5.15. Sweden 3P framework NWM rank 2013-2018.....	201
Figure 5.16. Sweden 3P framework TOPSIS score 2013-2018.....	201
Figure 5.17. Greece QIH model Average of 2013-2018 TOPSIS score.....	202
Figure 5.18. Sweden QIH model Average of 2013-2018 TOPSIS score.....	203
Figure 5.19. Crete performance per pillar NWM rank 2018.....	208
Figure 5.20. Crete performance per pillar TOPSIS score 2018.....	209
Figure 5.21. Crete performance per pillar NWM rank 2013-2018.....	211
Figure 5.22. Crete performance per pillar TOPSIS score 2013-2018.....	211
Figure 5.23. Stockholm performance per pillar NWM rank 2018.....	212
Figure 5.24. Stockholm performance per pillar TOPSIS score 2018.....	212
Figure 5.25. Stockholm performance per pillar NWM rank 2013-2018.....	215
Figure 5.26. Stockholm performance per pillar TOPSIS score 2013-2018.....	215
Figure 5.27. Crete 3P framework NWM rank 2018.....	216
Figure 5.28. Crete 3P framework TOPSIS score 2018.....	216
Figure 5.29. Crete 3P framework NWM rank 2013-2018.....	217
Figure 5.30. Crete 3P framework TOPSIS score 2013-2018.....	217
Figure 5.31. Stockholm 3P framework NWM rank 2018.....	217
Figure 5.32. Stockholm 3P framework TOPSIS score 2018.....	218
Figure 5.33. Stockholm 3P framework NWM rank 2013-2018.....	218
Figure 5.34. Stockholm 3P framework TOPSIS score 2013-2018.....	219
Figure 5.35. Crete QIH model Average of 2013-2018 TOPSIS Score.....	219

Figure 5.36. Stockholm QIH model Average of 2013-2018 TOPSIS Score.....	220
Figure 5.37. Distribution of companies to sectors.....	222
Figure 5.38. Years of operation.....	222
Figure 5.39. Number of employees.....	223
Figure 5.40. Turnover of companies.....	223
Figure 5.41. Cretan Agrofood industry performance per pillar TOPSIS score.....	223
Figure 5.42. Sectors performance per pillar NWM rank.....	224
Figure 5.43. Sectors performance per pillar TOPSIS score.....	224
Figure 5.44. Cretan Agrofood industry 3P framework TOPSIS score.....	227
Figure 5.45. Sectors performance 3P framework NWM rank.....	227
Figure 5.46. Sectors performance 3P framework TOPSIS score.....	227
Figure 5.47. Cretan Agrofood industry per QIH TOPSIS score.....	228
Figure 5.48. Sectors performance per QIH TOPSIS score.....	229
Figure 6.1. Final Cluster Centers for countries.....	239
Figure 6.2. Final Cluster Centers for regions.....	250
Figure 6.3. Final Cluster Centers for companies.....	263

List of Abbreviations

Abbreviation	Explanation
QIH	Quadruple Innovation Helix
MCDM	Multi-Criteria Decision Making
EIS	European Innovation Scoreboard
RIS	Regional Innovation Scoreboard
GII	Global Innovation Index
GEI	Global Entrepreneurship Index
GEM	Global Entrepreneurship Monitor
WEF	World Economic Forum
GEDI	Global Entrepreneurship and Development Institute
GCI	Global Competitiveness Index
REDI	Regional Entrepreneurship and Development Index
WBGES	World Bank Group Entrepreneurship Survey
CIS	Community Innovation Survey
RIS3	Research and Innovation Strategies for Smart Specialization
EU	European Union
ESS	European Social Survey
SBA	Small Business Act
BEEPS	Business Environment and Enterprise Performance Survey
COMPENDIA	Comparable Entrepreneurship Data for International Analysis
NWM	Non-Weighted model
SMAA	Stochastic Multicriteria Acceptability Analysis
TOPSIS	Technique for Order of Preference by Similarity to Ideal Solution
WIPO	World Intellectual Property Organization
KAM	Knowledge Assessment Methodology
SAW	Simple Additive Weighting
AHP	Analytic Hierarchy Process
RSCI	European Regional Sustainability Competitiveness Index
RCI	Regional Competitiveness Index
MRP-WSCI	Multi-Reference Point based Weak and Strong Composite Indicator
DEA	Data Envelopment Analysis
SMEs	Small and Medium Enterprises
FAHP	Fuzzy Analytic Hierarchy Process
MSMEs	Micro and Small Medium enterprises
COPRAS	Complex Proportional Assessment
ANDE	Aspen Network of Development Entrepreneurs
DFID	UK Department for International Development
BEEP	Babson Entrepreneurship Ecosystem Project

Chapter 1. Introduction

1.1 Importance of entrepreneurial ecosystems

The key drivers for economic growth globally, are innovation and entrepreneurship. However, the question that rises according to Baine (2013) is if entrepreneurship is an attribute that can be trained. Chaharbaghi and Willis (1998) claim that “*entrepreneurs cannot be manufactured, only recognized.*”

Kang et al. (2019) argue that entrepreneurial ecosystem is an emerging field and essentially a new research field. In their study, where the authors performed a quantitative examination of the research related to the entrepreneurial ecosystems, they discovered that there were until March 2019 only 286 articles as regards to this term on the Web of Science Core Collection.

It is interesting to see how the term ‘ecosystem’ was first used and how it can be explained. Ecosystems were first found in the field of ecology. Tansley in 1935 was the first who used this term and claims that there is a variation of ecosystems’ kinds and sizes, as well as an ecosystem can range from universe to a single atom.

Furthermore, Cavallo et al. (2018) explain the term ecosystem from an etymological perspective and claim that the term ecosystem is constituted of two Greek words as follows: “*οἶκος which is eco and means home and σύστημα which is system and means complex.*” For the authors the term ecosystem is “*a complex system hosting a number of entities.*” In addition, Malecki (2018) supports that the key ingredient in an entrepreneurial ecosystem is that it is a system.

In the field of strategic management, Moore (1993) was the first author to suggest the concept of ecosystem and more specifically the concept of business ecosystem. The author parallelized the business ecosystem with a biological counterpart. Following, Isenberg (2010) brought the term ecosystem in the field of entrepreneurship.

There are many scholars who claim that the metaphor of the natural or biological ecosystems can be used in the field of management studies. Valkokari (2015) supports that this metaphor of the natural ecosystem can be applied to business, innovation and knowledge ecosystems. This metaphor can be also applied to the entrepreneurship ecosystem where, according to Isenberg (2011a), there are elements that combine in complex ways. All these four ecosystems, entrepreneurial, business, innovation and knowledge, present similarities with the natural ecosystem where various actors exist, they have their own role, they interact in complex ways and they evolve in their own manner.

Davey and Galan-Muros (2016) present the analogy between an Amazon rainforest and the most widely known entrepreneurship ecosystem, which is the Silicon Valley in the US. In the Amazon rainforest there is the Brazil Nut tree and in the Silicon Valley there is an entrepreneur. In both ecosystems there are various and complex factors that exist in balance which can easily be disturbed and in one case they help the rainforest to prosper and in the other case they help the entrepreneurship behaviour to be strengthened. The authors explain this analogy through different stages of development as follows:

1. At the initial conception, the Brazil Nut needs an opportunity to have access to soil, water, light, seedling and luck from predators. In the same way, the entrepreneur needs a market opportunity and access to human capital, technology, finance and luck against the competitors.
2. During the development stage, the Brazil Nut needs more light as now interacts more with its environment and tries to find the necessary resources for its growth and become an established entity. In the same way, the entrepreneur continues to grow its business by enhancing it and interacting with the market in order to try to fill the market gap, find the necessary resources and become an established entity.

3. During the maturity phase, the Brazil Nut has become an established entity in the environment, it has found its own sources of nutrients and tries to become more resilient to threats or predators. In the same way the entrepreneur has become an established entity in the environment, it has found its own sources of resources and tries to become more resilient to competitors by creating new contacts and networks.

The most widely known entrepreneurial ecosystem is the Silicon Valley, according to Davey and Galan-Muros (2016) and this is based mostly on three factors. First, some of the world's leading universities are in this region, constituting its cultural and intellectual capital. Also, in the region there is a strong venture capital market which constitute the economic capital. Moreover, the strategic and network capital is related to the fact that several high profile and successful companies in the region, such as HP, decided to stay there and attracted others to develop a network of not only individuals but also businesses.

Dynamics and co-evolution are some of the ecosystems' characteristics. Phillips and Ritala (2019) claim that as regards to dynamics there is a consistent change in the system. This change can vary based: 1) on the goal of the ecosystem whether it is stability or change, 2) where this change takes places either on relationships or structures and 3) depending on the lifecycle phase of the ecosystem. The dynamics will result in the co-evolution where *"ecosystems co-evolve in alignment with their socio-technical environment"* (Walrave et al. 2018).

Moreover, Thomas and Autio (2020) support that two other important aspects of the ecosystems' dynamics is competition and co-evolution. Regarding to competition, the authors mention that in general little is known about how ecosystems compete. Also, they mention that, although the properties of entrepreneurial and knowledge ecosystems are methodologically measured, limited previous studies examine how these ecosystems compete.

Many studies have been conducted in order to understand in depth entrepreneurial ecosystems. However, according to Isenberg (2011a), six are the general domains that can be used in order to group the entrepreneurial ecosystem's elements since it consists of hundreds of specific elements. Moreover, according to Auerswald (2015), an entrepreneurial ecosystem can be enabled by applying specific strategies.

Mason and Brown (2014) support that an entrepreneurial ecosystem cannot emerge anywhere but in places that are judged to be attractive. In such areas, there are one or more technology-rich organizations that act as talent magnets, attracting skilled workers. The authors also suggest general policies that should be implemented in the entrepreneurial ecosystems and they claim that: *"the objective of an ecosystem policy is to achieve its goal by improving the environment that surrounds such firms."*

Isenberg (2014) supports that entrepreneurship, in cities and countries, is a vital element for economic development worldwide. An entrepreneurial ecosystem can be seen as a metaphor of an economic development strategy, where entrepreneurship is being fostered.

Although, according to Kang et al. (2019), the 'entrepreneurial ecosystem' is an emerging new field, there is an increase on the number of publications from 2017, since it has gained more importance. Entrepreneurial ecosystems are very important for economic growth worldwide and they can promote and facilitate not only entrepreneurship but also innovation. They can be seen as networks where interactive actors can have an impact to each other but they also can affect the chances for a business to survive in a specific region or country. Access to human capital, finance and other resources are all vital for an entrepreneurial ecosystem in order to prosper combined with the appropriate environment, where policies will enable and facilitate entrepreneurship.

1.2 Research problem and hypotheses

As reported by Mason and Brown (2014) the model of entrepreneurial ecosystems has dynamic nature. Moreover, Cavallo et al. (2018) support that “*entrepreneurial ecosystems have been widely recognized as complex and “evolving” and dynamic systems (Acs et al. 2014; Feld 2012; Isenberg 2010; Spiegel 2017; Dubina et al. 2017).*” In addition, Thomas and Autio (2020) claim that also innovation ecosystems have a dynamic nature since they can be characterized as coevolving organizational communities.

The assessment of innovation ecosystems differs from the assessment of entrepreneurial ecosystems. On the one hand, for the assessment of innovation ecosystems, various innovation metrics are used such as Non-R&D innovation expenditures, patent applications, high-tech exports, etc. On the other hand, for the assessment of entrepreneurial ecosystems, entrepreneurial metrics related to skills or self-employment are used such as startup skills, established business ownership, total early-stage entrepreneurial activity, etc. Despite, both innovation and entrepreneurial ecosystems have common points and this is proven through the existing frameworks and indexes that are being used for these assessments.

The main research question that emerges here is how can the assessment of an innovative entrepreneurial ecosystem be conducted at the macro, meso and micro level? It is important to understand what methods and data are appropriate to be used for the whole process of this kind of assessment. There are various frameworks and indexes, as well as surveys that are being used for this assessment at each level.

As regards to the measurement of innovation, at the national level there is the European Innovation Scoreboard (EIS) where according to the European Commission (2018a) it is used for the assessment of innovation performance of 28 EU and 8 non EU countries. The measurement framework of the European Innovation Scoreboard is constituted by different domains, which include different indicators that change each year. However, four are the main domains as follows: 1) Framework Conditions, 2) Investments, 3) Innovation Activities and 4) Impacts.

The Global Innovation Index (GII) aims to capture the multi-dimensional facets of innovation and provide the tools that can assist in tailoring policies to promote long-term output growth, improved productivity and job growth. It is co-published by the Cornell University, INSEAD and the World Intellectual Property Organization. The core of the GII Report provides a ranking of world economies’ innovation capabilities and results (as cited in Cornell University et al., 2018).

Also, the GII relies on two sub-indices, the Innovation Input Sub-Index and the Innovation Output Sub-Index, each built around key pillars. Five input pillars capture elements of the national economy that enable innovative activities: 1) Institutions, 2) Human capital and research, 3) Infrastructure, 4) Market sophistication and 5) Business sophistication. Two output pillars capture actual evidence of innovation outputs: 6) Knowledge and technology outputs and 7) Creative outputs (as cited in Cornell University et al., 2018).

Moreover, the Bloomberg Innovation Index has been developed by the Bloomberg Company and it is an index used to measure how innovative a country is. Bloomberg ranks countries and sovereigns based on their overall ability to innovate and identifies the top 50. Six equally weighted metrics were taken into consideration and their scores were combined to provide an overall score for each country from 0 to 100, which are the following: 1) Research and Development, 2) Manufacturing, 3) High-tech companies, 4) Postsecondary education, 5) Research personnel and 6) Patents.

Regarding the measurement of entrepreneurship, at the national level, there is the Global Entrepreneurship Index (GEI) which was developed by the Global Entrepreneurship and Development Institute and according to thegedi.org (n.d.) it measures how healthy an entrepreneurship ecosystem is. Overall it assesses and ranks 137 countries. It is constituted of the following pillars: 1) Opportunity Perception, 2) Startup Skills, 3) Risk Acceptance, 4)

Networking, 5) Cultural Support, 6) Opportunity Perception, 7) Technology Absorption, 8) Human Capital, 9) Competition, 10) Product Innovation, 11) Process Innovation, 12) High Growth, 13) Internationalization and 14) Risk Capital.

Furthermore, a new and important tool for examining entrepreneurial activity across countries, according to Justo et al. (2008), is the Global Entrepreneurship Monitor (GEM) project, which aims at assessing the proportion of the adult population in various countries that are involved in business startups at a given point in time.

GEM represents a unique attempt to both provide homogeneous cross-country measures of entrepreneurial activity and ascertain the relationship between entrepreneurship and economic development. One of the better known outcomes of the GEM project is an estimate of a nation's entrepreneurial activity, the Total Entrepreneurship Activity (TEA) index, which is designed to overcome a number of concerns raised in prior research about the measurement of entrepreneurship (as cited in Justo et al., 2008).

The World Economic Forum (WEF) measures the competitiveness of a country with an overall index called the Global Competitiveness Index (GCI) in the Global Competitiveness Report and covers 141 countries. Schwab (2019) claims that 103 individual indicators constitute this index that are collected from international organizations and the Executive Opinion Survey of the World Economic Forum. The framework of the GCI 4.0 includes four main components which are the following: 1) Enabling Environment, 2) Human Capital, 3) Markets and 4) Innovation Ecosystem.

In addition, Ahmad and Hoffmann (2007) propose a framework for addressing and measuring entrepreneurship. The framework is named OECD/Eurostat framework for Entrepreneurship Indicators and it identifies three separate but inter-connected flows, all of which are important in the formulation, assessment and appraisal of policy measures: '*determinants*', '*entrepreneurial performance*' and '*impact*', where: '*determinants*' reflects the key factors that affect '*entrepreneurial performance*'; '*entrepreneurial performance*' reflects the target indicators that policy makers believe have an impact on some or many ultimate objectives (*impacts*).

According to Acs et al. (2008), the World Bank Group Entrepreneurship Survey (WBGES) measures entrepreneurial activity based on official business registers and thus provides cross-national data on the number of newly registered businesses. The Entrepreneurship Database and the Doing Business have together created this methodology to help in the measurement of entrepreneurship activity with cross-country data (as cited in Stenholm et al., 2013).

At the regional level, the measurement of innovation can be conducted with the Regional Innovation Scoreboard (RIS) and the Innovation Index of the Indiana Business Research Center whereas the measurement of entrepreneurship can be conducted with the Regional REDI.

According to the European Commission (2018b) the Regional Innovation Scoreboard (RIS) is the extension of the European Innovation Scoreboard at the regional level. It assesses the regions' innovation performance and it covers 220 European regions whereas its framework is similar to the European Innovation Scoreboard.

The Innovation Index of the Indiana Business Research Center reflects a region's innovation activity and capacity. The Innovation Index shows the regional performance of America's regions and is calculated based on four component indexes as follows: 1) Human Capital, 2) Economic Dynamics, 3) Productivity and Employment and 4) Economic Well-Being. These four component indexes include many and different variables (as cited in innovation in statsamerica.org n.d.).

According to theredi.org (n.d.), the Regional REDI is part of the Europe 2020 agenda for strategy in order to enhance the capacity for smart, sustainable and inclusive growth. The Regional REDI covers 27 EU member states and Croatia at the NUTS-2 level. Three are its

main sub-indices as follows: 1) Entrepreneurial Attitudes, 2) Entrepreneurial Abilities and 3) Entrepreneurial Aspirations.

At the micro level, there are the following surveys, the Innobarometer which measures the innovation activities and attitudes of businesses, the Eurobarometer which provides annual figures on entrepreneurial activity among 25 European Union (EU) member states and the Community Innovation Survey. According to eurostat (n.d.) the Community Innovation Survey can give information as regards to the innovativeness of sectors by type of enterprises, on different types of innovations as well as different aspects on the creation of innovations such as funding, expenditures etc.

A different way of measuring an entrepreneurial ecosystem, according to Stangler and Bell-Masterson (2015), is by measuring the vibrancy of the entrepreneurial ecosystem through the following four indicators: 1) Density, 2) Fluidity, 3) Connectivity and 4) Diversity.

What is more interesting, though, is a toolkit designed by the ANDE and DFID (2013) which are the Aspen Network of Development Entrepreneurs and the UK Department for International Development. Nine approaches were identified that can be used for the assessment of an entrepreneurial ecosystem as follows:

1. Babson College - Babson Entrepreneurship Ecosystem Project
2. Council on Competitiveness - Asset Mapping Roadmap
3. George Mason University - Global Entrepreneurship and Development Index
4. Hwang, V.H. - Innovation Rainforest Blueprint
5. Koltai and Company - Six + Six
6. GSM Association – Information and Communication Technology Entrepreneurship
7. Organisation Economic Co-operation and Development - Entrepreneurship Measurement Framework
8. World Bank - Doing Business
9. World Economic Forum - Entrepreneurship Ecosystem

At the national level the following approaches can allow cross-country comparisons: the OECD's Entrepreneurship Measurement Framework, the World Bank's Doing Business ranking and George Mason University's Global Entrepreneurship and Development Index. At the regional or local ecosystems the following approaches can be used: the Council on Competitiveness' Asset Mapping Roadmap and the Innovation Rainforest Blueprint whereas frameworks such as the Babson Entrepreneurship Ecosystem Project and the Koltai Six+Six can be used either at the national or sub-national level (as cited in ANDE 2013).

Other studies have used MCDM methods for the evaluation of the performance of innovation and entrepreneurial ecosystems at the macro, meso and micro level.

As regards to the assessment of entrepreneurship at the macro level, Kitsios and Sitaridis (2017) have used the GEM data and the NWM model to rank and compare the Greek entrepreneurial ecosystem to 9 other countries. In addition, Sitaridis and Kitsios (2019) have also used the GEM data and the NWM in comparison with the methods TOPSIS and PROMETHEE II to rank and compare the Greek entrepreneurial ecosystem to 9 other countries.

As regards to the assessment of innovation at the macro level, Silva et al. (2017) used TOPSIS in order to analyze the ranking of the Latin America and Caribbean countries between the World Intellectual Property Organization and the Global Innovation Index in order to select the innovation indicators. In addition, Silva et al. (2019) used TOPSIS in order to rank the innovation indicators of the World Intellectual Property Organization (WIPO) for African, Asian and Oceanic countries.

At the meso level for the assessment of regional ecosystems, the studies of Poledníková (2014) and Bilbao-Terol et al. (2017) use the TOPSIS method, in addition Poledníková (2014) also use AHP and SAW methods whereas Garcia-Bernabeu et al. (2020) use for the first time the Multi-Reference Point based Weak and Strong Composite Indicator approach.

As regards to the assessment of entrepreneurship at the micro level, Adebisi et al. (2019) used AHP to analyze the entrepreneurial orientation and business performance on a sample of 327 Nigerian entrepreneurs. Moreover, Rezaei et al. (2013) used the Fuzzy AHP to measure the entrepreneurial orientation of 59 Dutch SMEs, whereas Rostamzadeh et al. (2014) evaluated the entrepreneurial intensity of 30 Malaysian SMEs in the manufacturing sector with the use of Fuzzy AHP, VIKOR and TOPSIS. Regarding the assessment of innovation at the micro level, Sepulveda and Vasquez (2014) used the FlowSort method to determine the innovation capability of 9 SMEs in Chile.

It is evident from the existing frameworks and indexes that were briefly described here since they will be described in depth in Chapter 3 of this thesis, that they assess either the innovation or the entrepreneurial ecosystem and only at one level either macro level which concerns countries, meso level which concerns regions or micro level which concerns companies. In addition, there are not many studies as regards to the assessment of ecosystems with the use of the MCDM methods. Therefore there is a need for a multilevel approach to fill this gap that exists in the literature. Consequently, the following research questions emerge in this thesis:

1. Which framework is appropriate for a complete multilevel assessment of an innovative entrepreneurial ecosystem at the macro, meso and micro level?
2. How can this framework evaluate the immediate, mid-range and long-range results of an innovative entrepreneurial ecosystem through the 3P framework?
3. How can this framework evaluate the different stakeholders of the QIH model which are industry, academia, university and civil society?
4. Which are the characteristics of success for an innovative entrepreneurial ecosystem that can be found through a typology at the macro, meso and micro level?
5. How can this framework be implemented with advanced quantitative methods such as MCDM methods and more specifically the NWM and the TOPSIS method?

Regarding the relevance of this thesis to policy, practice and theory, this thesis can provide useful insights to government policymaking, managers of organizations as well as academics as regards to the assessment of the innovative entrepreneurial ecosystems. The new proposed framework can address the gap that there is in the existing literature and the need for a multilevel approach. The new proposed framework is a multilevel approach that concerns the following three levels, the national level where 28 EU countries are studied, the regional level where 212 EU regions are studied and the firm level where a sample of 120 companies are studied.

The domains of the new proposed framework follow the 3P framework of Carayannis and Provan (2008) which is used for the measurement of firm innovativeness. The same framework is used for the assessment of the innovative entrepreneurial ecosystems whereas now the firm factors Posture, Propensity and Performance have been replaced by Enablers, Capabilities and Results. This approach can help academics, firms and managers gain a better understanding on how the 3P framework could be applied on different assessments besides the measurement of firm innovativeness.

Moreover, the new proposed framework is constituted of the following seven pillars: human capital, culture, finance, policy, outputs, outcomes and impacts where each of these pillars is constituted of various variables. These pillars were based on the studies of Isenberg (2011a), Stam (2017) and Carayannis and Provan (2008). The variables were chosen after the study

of existing frameworks and indexes in order to be appropriate for each pillar as well as to have consistency in all levels.

Again, these approaches can be useful for academics since they can gain a better understanding on how the combination of existing studies can create a new framework as well as on how the data from existing frameworks and indexes can be used in different ways.

Each level of the new proposed framework offers new knowledge not only for the performance of a nation, a region or a company but also it allows the comparison of different innovative entrepreneurial ecosystems at each level which can be useful for academics, policymakers and managers.

First, academics can use these insights of the new proposed framework as regards to the development of new frameworks and exploration of different ways for the assessment of the innovative entrepreneurial ecosystems as well as to enhance their understanding on this specific area.

Then, policymakers can use these insights in order to set different priorities on dimensions that are weak and enhance the already strong dimensions, as well as they can develop and implement better policies for nations, regions and companies. These policies will affect not only a nation, region or company but the society as a whole where participation and engagement are vital. In the same way also managers and firms can use the insights of the new proposed framework in their internal processes.

In addition, the connection of the new proposed framework of all levels to the QIH model shows that it is a tool that can help policymakers understand better the strategies they need to implement. These strategies can be for example the Research and Innovation Strategies for Smart Specialization (RIS3) that can enhance the national and the regional performance as regards to innovation and entrepreneurship.

It can also help academics to gain new knowledge since to date there is limited knowledge on how an existing framework or index that is used for this kind of assessment can be connected to the QIH model.

Managers can extract valuable information for their companies from this connection on different perspectives that are represented by the four helices of this model, industry, academia, government and civil society and can have an impact on the way a company operates.

Overall, the strengths and the weaknesses that the new proposed framework reveal can be used by policymakers for the development of new regulations.

For example, according to Schwab et al. (2016) the most problematic factors for doing business in Greece is policy instability, tax rates, inefficient government bureaucracy as well as access to finance and tax regulations. Nikolaidis and Bakouros (2009) also report that in Crete there are not adequate funds and investment whereas there was a low impact on the Cretan economy from the application of national funding programs.

Therefore, policymakers can develop new regulations regarding taxes as well as new frameworks and programs for the increase of funds and investments which can have an impact not only to a nation's or a region's performance but also to SMEs.

These strengths and weaknesses can also be used by managers, who can apply National European programs to invest and improve their existing infrastructure. For example companies in the region of Crete can utilize programs such as the Horizon 2020 in order to strengthen their innovative and entrepreneurial activities or they can invest in new technologies that will help them enhance their products or services.

Last but not least, these strengths and weaknesses can be used by academics. Academics can cooperate with companies in order to apply their know-how. Through this cooperation, the creation of new innovations or new intellectual property rights can occur such as product or

process innovations as well as patents. This transfer of new knowledge can benefit not only the industry but a whole nation or a region as regards to their total performance towards innovation and entrepreneurship.

1.3 Research objectives and contribution

The aim of this thesis is the multilevel assessment of innovative entrepreneurial ecosystems. More specifically, the research objectives of this thesis are to develop a framework that can assess the innovative entrepreneurial ecosystems at the macro level (nations), at the regional level (regions) and at the firm level (companies).

In addition, another research objective is the connection of the new framework with the QIH model to all levels. Moreover, another research objective is the development of a typology at all levels using the K-means clustering algorithm based on the four helices of the QIH model in order to find the profile of each cluster as well as its characteristics.

As regards to the contributions of this thesis, they can be presented as follows:

1. This thesis contributes to the existing academic literature since it covers different themes, such as the assessment of innovative entrepreneurial ecosystems, the Triple and the Quadruple/Quintuple Innovation Helix models, the 3P framework and the MCDM methods.
2. This thesis contributes to the wide understanding of how a complete multilevel assessment can be conducted for different innovative entrepreneurial ecosystems at the macro, meso and micro level.
3. This thesis contributes to the further use of the 3P framework of Carayannis and Provan (2008) that measures firm innovativeness. The 3P framework is incorporated in this thesis in order to create the domains of the new proposed framework and evaluate the immediate, mid-range and long-range results of different innovative entrepreneurial ecosystems.
4. This thesis contributes to the evaluation of different stakeholders within the innovative entrepreneurial ecosystems. The framework developed in this thesis is connected to the different stakeholders of the QIH model, industry, academia, university and civil society.
5. The results from the assessment of different innovative entrepreneurial ecosystems led to the development of a unique typology that could further be used in future studies. This typology finds the characteristics of success for innovative entrepreneurial ecosystems at the macro, meso and micro level.
6. This thesis contributes to the wide understanding of how the new proposed framework for the multilevel assessment of the innovative entrepreneurial ecosystems can be implemented with advanced quantitative methods such as MCDM methods and more specifically the NWM and the TOPSIS method.
7. The assessment of specific innovative entrepreneurial ecosystems in this thesis through the new proposed framework can contribute to the better understanding of a specific country, region or company. Until now, most of the existing studies focused on the assessment of large firms rather than SMEs whereas this thesis focuses on the assessment of SMEs at the micro level. This assessment at all levels can reveal strong and weak points and it can contribute also to future improvement efforts.
8. The combination of the quantitative research through the development of the new proposed multilevel framework and the qualitative research through the conduction of the case studies at the micro level can be an additional contribution and originality of this dissertation.

Consequently the originality of this thesis is that the new proposed framework compared to other models and frameworks provides a complete multilevel assessment of the innovative entrepreneurial ecosystems with the use of the MCDM methods.

As far as it is known, there are limited MCDM studies that have used the NWM and the TOPSIS method for the assessment of innovative entrepreneurial ecosystems such as the studies of Kitsios and Sitaridis (2017) and Sitaridis and Kitsios (2019).

Also, there are limited studies that have linked their frameworks for the assessment of innovative entrepreneurial ecosystems with the QIH model. Furthermore, there is a need for adoption of the 3P framework of Carayannis and Provan (2008) since it can be used for various assessments, besides the measurement of firm innovativeness.

Another fact of this thesis's originality is that a typology has not been proposed in the literature until now that presents clusters at the national, regional and firm level as well as the characteristics that can be found in each cluster.

In the literature until now there are available only the classification schemes of the European Innovation Scoreboard for countries and the Regional Innovation Scoreboard for regions based on their innovation performance. Also, the Global Entrepreneurship Index presents the strongest and the weakest area for each country although until 2016 it used to present three stages of development for each country, factor-driven, efficiency-driven and innovation-driven. In the same way the Global Competitiveness Index of the World Economic Forum used to present in older versions of its reports, the same stages of development and the most problematic factors for doing business.

This new proposed typology goes beyond the existing classification schemes and shows not only the performance of the nations, regions and firms but also it gives insights about the characteristics of each cluster. For example, the typology revealed that at the national level the most innovative countries such as Sweden have higher performance on the dimension human capital.

Moreover, another fact that contributes to the originality of this thesis is that quantitative data from different frameworks and indexes have been studied and chosen carefully in order to apply this framework for the assessment of specific innovative entrepreneurial ecosystems. The selection of these data was conducted through an approach where the common points of each framework and index were found and documented in order to ensure as much as possible consistency in all levels, macro, meso and micro. This approach can also be considered as a value added point of this thesis.

1.4 Thesis Structure

The structure of this thesis is as follows: in Chapters 2 and 3 the literature review as regards to entrepreneurial ecosystems and the assessment of these ecosystems are presented. More specifically Chapter 2 outlines the following themes: the definition of the entrepreneurial ecosystems, the characteristics, the classification and the types of ecosystems, the entrepreneurship in comparison to innovation ecosystems, the entrepreneurial ecosystems and the QIH model as well as studies on ecosystems.

In Chapter 3 the existing frameworks, indexes and surveys that are being used for the assessment of the entrepreneurial ecosystems are presented at the macro, meso and micro level. In addition, MCDM studies and other approaches that are being used for this kind of assessment, as well as a comparison and a discussion are presented.

Chapter 4 presents the proposed framework at the macro, meso and micro level as regards to their pillars, dimensions and indicators. Also, a discussion about how the QIH model can be incorporated in the assessment framework is given. Moreover, the typology approach for the macro, meso and micro level is presented.

Chapter 5 analyzes the data processing, as well as the results for the national, regional and firm level entrepreneurial ecosystems based on the entrepreneurship pillars, the 3P framework

and the QIH model. In addition, the case studies conducted at the micro level are presented whereas a discussion and a comparison of all these results are also given.

In Chapter 6 the results of the typology at the macro, meso and micro level are presented, while Chapter 7 highlights the overview of the results and findings in addition to, the limitations of the study and the outline of future research.

Chapter 2. Entrepreneurial Ecosystems

2.1 Defining entrepreneurial ecosystems

The term 'ecosystem' has been studied by many scholars and researchers throughout the years however, it is very interesting to see how this term has evolved and how it can be defined. The term 'ecosystem' was first used in 1935 and more specifically by Tansley (1935, p.229) who claims the following:

"... These ecosystems, as we may call them, are of the most various kinds and sizes. They form one category of the multitudinous physical systems of the universe, which range from the universe as a whole down to the atom."

Although the term 'ecosystem' is first connected to Tansley, Willis (1997) mentions that Tansley asked A. R. Clapham to think of a term that could describe the elements both physical and biological in a specific environment and recognize them as an entity and in the early 1930s the term 'ecosystem' was born.

Lindeman (1942, p. 400) defines the ecosystem as: *"The ecosystem may be formally defined as the system composed of physical-chemical-biological processes active within a space-time unit of any magnitude, i.e., the biotic community plus its abiotic environment."*

Odum with his book Fundamentals of Ecology (1953) played a huge role in using and explaining the term 'ecosystem' in the field of ecology. Odum (1953) defines the ecosystem as follows: *"Any unit that includes all of the organisms (i.e. the "community") in a given area interacting with the physical environment so that a flow of energy leads to clearly defined trophic structure, biotic diversity, and material cycles (i.e. exchange of materials between living and nonliving parts) within the system is an ecological system or ecosystem."*

Ellis (2008) reports that ecosystems are fundamental ideas of sciences such as biology and ecology (see Fig. 2.1) because they can explain how the different elements can interact with each other as well as with their environment.

The author defines ecosystems as follows: *"Ecosystems include living organisms, the dead organic matter produced by them, the abiotic environment within which the organisms live and exchange elements (soils, water, and atmosphere), and the interactions between these components. Ecosystems embody the concept that living organisms continually interact with each other and with the environment to produce complex systems with emergent properties, such that "the whole is greater than the sum of its parts" and "everything is connected."*

Whitman (2017) claims that the biological communities that exist in a specific area along with the physical and chemical factors that constitute the abiotic environment are the elements that create an ecosystem. Examples of ecosystems are a pond, a forest, a grassland. However, the boundaries of an ecosystem are subjective and can be obvious such as the shoreline of a pond, the boundaries can be fixed according to practical reasons and the aim of the specific study. When studying ecosystems the biotic and abiotic components must be both taken into consideration, whereas two of the most important processes are energy transformation and biogeochemical cycling.

The common elements that can be found in the above definitions are the living and the non-living organisms as well as the environment. In this environment all these organisms exist together and interact both with one another as well as with the environment itself.

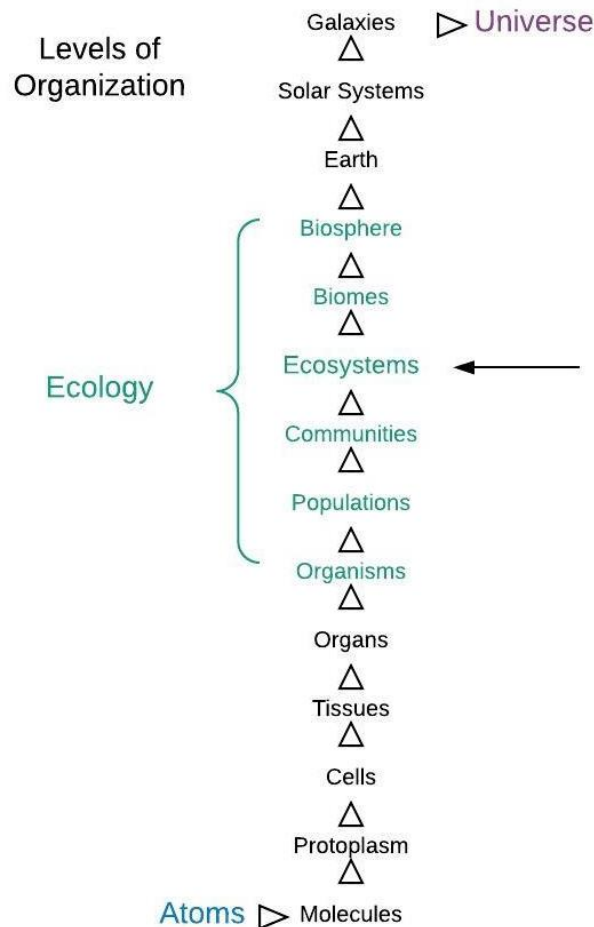


Figure 2.1. Levels of organization of Ecology, highlighting ecosystems. Source: Ellis (2008).

But which are the components of the ecosystems and how these are structured? In addition, what are their main processes? Regarding the components of the ecosystems, these can be categorized as follows: 1) to biotic or living components and these include for example animals, etc and 2) to abiotic or non-living components and these include for example soil, water, sunlight, etc. As regards to the main processes of the ecosystems, Whitman (2017) reports that two are the main processes as follows: 1) energy flows and 2) cycle materials.

Ellis (2008) supports that at the ecosystems there are the producers, consumers, decomposers as well as there are energy and matter (see Fig. 2.2). First of all, the producers are the ones that can take energy from the sun for example through photosynthesis and transform this energy into carbon dioxide or any other inorganic chemicals into organic components.

Then, the consumers are the ones that will take this energy together with the decomposers, who decompose the organic matter into inorganic components, which the producers can use. The ways through all these organisms communicate can be named as trophic interactions. What shapes the structure and the function of the ecosystems as well as they play a huge role on the types of interactions between all organisms and the environment are the energy transfer and the matter cycling however, it should be taken into consideration the variety of different species that coexist into an ecosystem and also play a role in the ecosystem's structure.

By having presented the different definitions of ecosystems, the way they are structured and function, as well as the main processes of these, it is interesting to examine the terms 'ecosystem' and 'system'.

Ritala and Almpnanopoulou (2017) claim that the concept of a system, when seen from the systems science perspective, is a particular group of parts such as actors, organizations and

entities that are associated to each other but are autonomous to other systems (e.g., von Bertalanffy, 1956).

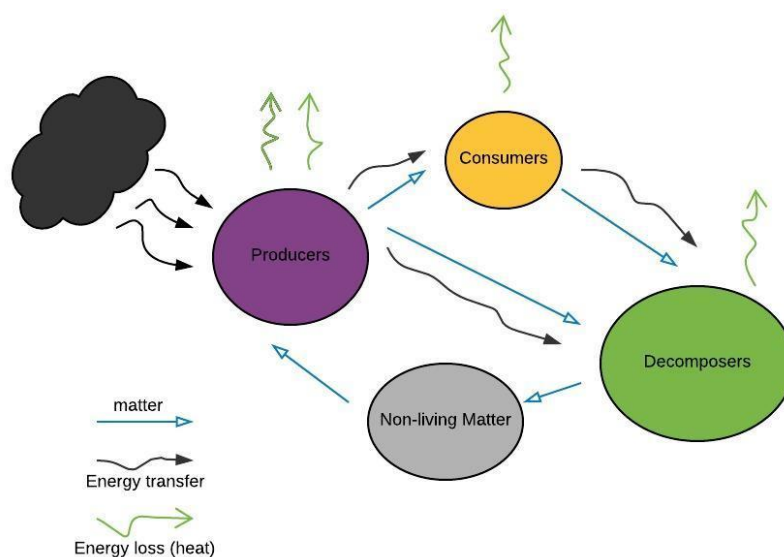


Figure 2.2. Illustration of the flow of matter and energy in ecosystems. Source: Ellis (2008).

Moreover, Phillips and Ritala (2019) explain that systems are groups with more than one associated or linked elements (von Bertalanffy, 1956). As the number of elements and the relationships between them increases, the systems turn into a more complex system, not enabling the prediction of cause and effect (Anderson, 1999), as these elements are also “*in interaction*” (von Bertalanffy, 1956, p. 19).

Cavallo et al. (2018) explain the term ecosystem from an etymological perspective and claim that the term ecosystem is constituted of two Greek words as follows: “*οἶκος, which is eco and means home and σύστημα, which is system and means complex.*” For the authors the term ecosystem is “*a complex system hosting a number of entities.*” In addition, Malecki (2018) supports that the key ingredient in an entrepreneurial ecosystem is that it is a system.

Moreover, Granstrand and Holgersson (2020) claim that in the system concept there are “*a set C of components and a set R of relations among these components*” whereas in the ecosystem concept there is the flow of material and energy.

In the field of strategic management, Moore (1993) was the first author to suggest the concept of ecosystem and more specifically the concept of the business ecosystem. The author parallelized the business ecosystem with a biological counterpart. Following, Isenberg (2010) brought the term ecosystem in the field of entrepreneurship.

However, Malecki (2018) claims that the notion of entrepreneurship ecosystems is quite new, whereas Stam (2015) supports that there is not a shared definition that can be widely used since this concept has only emerged in the last five years.

Moreover, Stam (2015) explains the two components of the entrepreneurial ecosystem approach as follows: the first component is the word entrepreneurial which refers to entrepreneurship where Schumpeter (1934) supports that entrepreneurship is the process of exploiting opportunities for innovation. The second component is the word ecosystem which has a biological interpretation as explained above. However, in the context of entrepreneurial ecosystems this should not be taken literally since the entrepreneurial ecosystems focus more on the entrepreneurship that can occur within a community of associated actors.

This approach, according to Stam (2015), also focuses on the external business environment, on the entrepreneurial individual, on the role of entrepreneurship, as well as on the fact that

entrepreneurship is not only the result of the system. Rather the entrepreneurs are the ones with a leading role in the creation of a system and how well it performs. However, the government can have the role of the feeder of the ecosystem according to Feld (2012) when concerning laws and regulations.

In addition, the entrepreneurship ecosystem approach according to Cavallo et al. (2018) is highlighted by scholars who take into consideration both the biotic and abiotic elements of the ecosystem in biology and suggest that in the entrepreneurial ecosystems the systemic and framework conditions respectively should be also taken into consideration (Stam and Spigel, 2016).

At the heart of the ecosystem there are the living organisms in the same manner at the heart of the entrepreneurship ecosystems the authors suggest that there are the systemic conditions which include networks of entrepreneurs, leadership, finance, talent, knowledge and support services whereas the framework conditions are the ones that allow or restrain human interaction.

The ecological perspective of the entrepreneurship ecosystems is given by Mason and Brown (2014) where particular environments can enable the creation of new business startups and high growth firms whereas Cavallo et al. (2018) claim that the biological or the ecological perspective of entrepreneurship can help one not only to analyze the structure of the ecosystem but also the relationships within it.

Furthermore, Kuckertz (2019) supports that the principles of the natural ecosystem management can also be applied to the entrepreneurial ecosystems.

The author mentions that the management of any ecosystem is quite difficult due to its nature which cannot be predicted and there is not a specific solution for all ecosystems, since the management of any ecosystem whether it is a natural or an entrepreneurial ecosystem means essentially the replacement or the change of the self-regulating mechanisms that the ecosystem already has.

Specifically, the author suggests that the policies of the entrepreneurial ecosystems could be inspired by the approach of the natural ecosystem management which is the following: *“Natural ecosystem management (Grumbine, 1994: 31), integrates scientific knowledge of ecological relationships within a complex sociopolitical and values framework toward the general goal of protecting ecosystem integrity over the long term (see Long et al. (2015)).”*

The author proposes the following principles for the management of the entrepreneurial ecosystems:

1. Principle 1 (Protect evolutionary potential). The main goal of natural ecosystem management is to secure the existing ecosystems. Therefore, that should also be applied to the entrepreneurial ecosystems. Two elements that seem to be very important are: 1) the diversity of the species within the entrepreneurial ecosystems which can also strengthen their resilience and 2) their ability to learn. The entrepreneurial ecosystem management should establish general factors that facilitate entrepreneurship such as internet access, openness, inclusiveness and a culture of trust rather than promote specific types of entrepreneurship. In this way, the entrepreneurial ecosystem can evolve.

2. Principle 2 (Think holistically). Until now the entrepreneurial ecosystem metaphor places at the center the individual entrepreneur according to several authors. However, this should change and the entrepreneurial ecosystem management should apply more holistic perspectives where none stakeholder group is excluded. The involvement of stakeholders requires the abolition of the administrative boundaries and this perhaps could be succeeded through policy frameworks that promote the creation of entrepreneurial universities which run with economic promotion and aim to increase entrepreneurial activity.

3. Principle 3 (Support self-regulation). What is important for an ecosystem, whether it is a natural or an entrepreneurial ecosystem, it is the ability to remain stable after the external

disturbances. The self-regulating processes are the ones that can help in achieving this stability. The disturbances can help an entrepreneurial ecosystem move forward and evolve, therefore the uncertainty and the unpredictability that exist in these ecosystems should be embraced.

4. Principle 4 (Focus on weaknesses). It has been argued that not only the strengths of an ecosystem should be taken into consideration, but also the weaknesses. According to Audretsch and Belitski (2017) *“an entrepreneur needs access to all framework conditions of the ecosystem that are conducive to business with a minimum number of bottlenecks.”* In addition, the holistic perspective of the entrepreneurial ecosystem suggests that all components should be taken into consideration since they can facilitate the delivery of the desirable services.

5. Principle 5 (Think huge, but act in a minimally invasive way). It is important for an entrepreneurial ecosystem to adopt a holistic, non-exclusive perspective but also to act incrementally. According to Isenberg (2010) *“EEs should grow organically in order to avoid policy over-engineering”*, therefore in the same way that in the natural ecosystem management, learning is by doing and experimenting with interventions and results which is the adaptive management (DeFries and Nagendra, 2017; Grumbine, 1994), the same should be also applied to the entrepreneurial ecosystems.

There are many and different definitions for the entrepreneurial ecosystems, Table 2.1 presents some selected definitions of this concept.

Table 2.1. Selected definitions of entrepreneurial ecosystems.

Author	Definition
Stam and Spigel (2016, p. 1)	<i>“We define entrepreneurial ecosystems as a set of interdependent actors and factors coordinated in such a way that they enable productive entrepreneurship within a particular territory.”</i>
Mason and Brown (2014)	<i>“A set of interconnected entrepreneurial actors (both potential and existing), entrepreneurial organisations (e.g. firms, venture capitalists, business angels, banks), institutions (universities, public sector agencies, financial bodies) and entrepreneurial processes (e.g. the business birth rate, numbers of high growth firms, levels of ‘blockbuster entrepreneurship’, number of serial entrepreneurs, degree of sell-out mentality within firms and levels of entrepreneurial ambition) which formally and informally coalesce to connect, mediate and govern the performance within the local entrepreneurial environment.”</i>
Isenberg (2010, p. 4)	<i>“The entrepreneurship ecosystem consists of a set of individual elements – such as leadership, culture, capital markets, and open-minded customers – that combine in complex ways.”</i>
Stam (2015, p.1765)	<i>“The entrepreneurial ecosystem as a set of interdependent actors and factors coordinated in such a way that they enable productive entrepreneurship.”</i>

By having defined the concept of the entrepreneurial ecosystems in this section, it is interesting to present the analogy between the concepts of the natural and the entrepreneurial ecosystem (see Table 2.2).

Table 2.2. The analogy between a natural and an entrepreneurial ecosystem.

Basic Elements	Natural ecosystem	Entrepreneurial ecosystem
Actors	In this natural	In this entrepreneurial ecosystem which

	ecosystem the actors will be animals and more specifically rabbits and wolves.	is named Wines of Crete, the actors are many and different wineries of Crete.
Environment	The environment in this natural ecosystem is constituted of the sun, the plants as well as herbivores and carnivores.	The environment in this entrepreneurial ecosystem is based mainly on the island of Crete.
Resources/ Infrastructures/ Human capital	The plants and the trees are the ones that provide energy in the ecosystem where the herbivores and the carnivores are the ones that will consume the energy. More specifically the herbivores will eat plants where the carnivores will eat meat. Therefore, in this particular example, the rabbits will eat plants whereas the wolves will eat rabbits.	The resources can be found from each winery member as well as through programs either national or regional. The infrastructures as well as the human capital that Wines of Crete use come from each winery that is part of this network. All the resources, the infrastructures and the human capital are a combination of what each winery applies in order to achieve the common goals which are the promotion and the recognition of the Cretan wine inside and outside of Greece as well as the creation of wine tourism in Crete.
Equilibrium/ Stable conditions	In this ecosystem the goal is to maintain the living resources, the habitat as well as the residents. For example it is very important that the environment has plants so rabbits can eat them in order to continue existing which eventually will lead the wolves to eat rabbits. In this way there will not be an extinction that could affect the entire ecosystem.	In this ecosystem the goal is to maintain the wineries as well as the environment which helps in the production of quality wines as well as in the development of wine tourism in Crete.
Relations (3Cs)	Wolves can create packs in order to attack and eat the rabbits. This means that one wolf co-operates with the other wolves even though they are still competitors, co-evolves since it is now a part of the pack and co-specializes by adapting	At first each winery was a single business, which means that when the network Wines of Crete was created the wineries were still competitors, however, they now co-operate towards their common goals, they co-evolve since now they are a part of the network and they co-specialize by adapting their techniques towards their common goals.

	its behaviour towards the common goal which is the need for food.	
Flows (knowledge/commercial)	The main flow that exists in this natural ecosystem is the energy flow. Also, there is the knowledge flow where the animals have the basic knowledge of what to eat.	In this ecosystem both the knowledge as well as the commercial flow exists. As regards to the knowledge flow, each winery has its own knowledge for the production of wine, the basic processes that need to be followed, the tools that need to be used etc, whereas all this knowledge is now applied to the network. As regards to the commercial flow, the network takes the necessary steps to promote the Cretan wine in Greece and abroad as well as to increase the wine tourism in Crete through several actions such as for example through the creation of a common brochure, they participate in exhibitions, they have a portal etc.
Carrying capacity	In this ecosystem the maximum number of the population size of both wolves as well as rabbits should be sustainably supported.	In this ecosystem the maximum number of the population size of all wineries should be sustainably supported.

2.2 Characteristics of ecosystems

There are many and different kinds of ecosystems, but according to Whitman (2017) the boundaries for distinguishing ecosystems are subjective and are formed due to practical reasons each time. The main interest of scholars as regards to ecosystems is not to analyze separately each of the species that exist there, but to study all elements together as a system. The author claims that two are the basic characteristics of ecosystems: 1) energy flows and 2) material is cycled (see Fig. 2.3).

Odum (1969) supports that a group of biological organization composed of all organisms in a specific area which is also called a community is essentially an ecosystem or an ecological system where this community interacts with *“the physical environment so that a flow of energy leads to characteristic trophic structure and material cycles within the system.”*

Consequently, in an ecosystem the living organisms shape a community which is characterized by the appearance of different species and they interact with each other as actors as well as with the physical environment. Jones et al. (1994) report that *“interactions between organisms are a major determinant of the distribution and abundance of species”* whereas the authors define the actors of the ecosystem as follows: *“Ecosystem engineers are organisms that directly or in- directly modulate the availability of resources (other than themselves) to other species, by causing physical state changes in biotic or abiotic materials. In so doing they modify, maintain and/or create habitats.”*

Given that in an ecosystem various actors exist and interact in complex ways and due to the fact that energy flows and material is cycled, all these elements show that ecosystems have a dynamic nature and that all these complex interactions can lead to the disturbance of its environment whereas the stable condition of an ecosystem is called equilibrium.

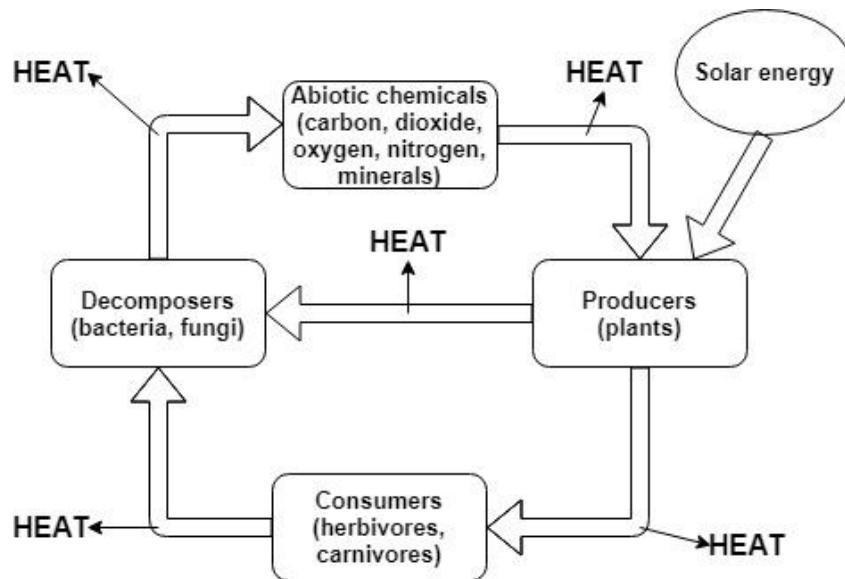


Figure 2.3. Energy flows and material cycles. Source: Whitman (2017).

Bear et al. (2013) explain the equilibrium state of an ecosystem as follows when all organisms are balanced with both the environment but also with one another. This creates a steady state of an ecosystem called equilibrium. Two elements in ecology are most used for measuring changes in ecosystems and these are resistance and resilience. Resistance is called the state when although there are disturbances in the ecosystem, it has the ability to remain at equilibrium. Resilience is called the state when although the ecosystem has been disturbed, the speed at which it returns to equilibrium. These two elements are significant when one takes into consideration human impact. The resilience of an ecosystem can be lost entirely when the nature of ecosystem changes in a significant degree. This can lead to either entirely destruction or inevitable change of the ecosystem.

In addition to resilience and resistance, other important elements for ecosystems are biodiversity which describes the various species and stability which is the equilibrium. Dybas (2007) reports that despite the fact that many experiments have shown how biodiversity can affect stability, scientists should focus more on stability, since humans can cause huge environmental changes that can affect the stability of ecosystems in many aspects and therefore the diversity.

In addition, Del Monte Luna et al. (2004) support that “*communities appear in each step of succession via re-colonization by species from surrounding areas, which jointly determine overall ecosystem diversity.*” This diversity creates a connection to carrying capacity which is the maximum number of species that can be supported in an ecosystem. In an ecosystem there are limited resources for both population and communities and in general for its species. Essentially the largest number of population size that an ecosystem sustainably can support is called carrying capacity. In nature this number is self-regulated and can be affected by various factors such as disease, competition etc.

Cardoso de Silva and Wheeler (2017) claim that the term ‘infrastructure’ was used only for assets that were made by humans but since the 1980s, scientists and conservationists propose that ecosystems are a type of infrastructure. They propose through their research that the term ‘green infrastructure’ could be better used to describe the ecosystem as an infrastructure and they define it as follows: “*a network of natural, semi-natural and restored areas designed and managed at different spatial scales (from local to global), that encompasses all major types of ecosystems (marine, terrestrial and freshwater), and that aims to conserve biodiversity, mitigate emissions of greenhouse gases, enable societal adaptation to climate change, and deliver a wide range of other ecosystem services.*”

According to Thomas and Autio (2020) four are the main characteristics of the ecosystem concept in management as follows:

1. Participant heterogeneity which include different participants that can come from different industries and sectors and take over various roles.
2. Ecosystem outputs which can be products or services as well as knowledge production.
3. Participant interdependence which can be technological, economic or cognitive.
4. Non-contractual governance where there is a co-alignment structure that allows participants to interact without formal contracts.

Other characteristics of ecosystems according to Phillips and Ritala (2019) are dynamics and co-evolution. As regards to dynamics the authors claim that there is consistent change in the system which varies if the stability or change is pursued as well as where this change takes place whether it is on relationships or structures and last but not least, also the nature of this change varies depending on the ecosystem lifecycle phase. The dynamics will result in the co-evolution where “*ecosystems co-evolve in alignment with their socio-technical environment (Walrave et al., 2018).*”

Furthermore, many scholars claim that the metaphor of the natural or biological ecosystems can be used in the field of management studies. Valkokari (2015) supports that this metaphor of the natural ecosystem can be applied to business, innovation and knowledge ecosystems. This metaphor can be also applied to the entrepreneurship ecosystem where according to Isenberg (2011a) there are elements that combine in complex ways. All these ecosystems present similarities (see Table 2.3) with the natural ecosystem where various actors exist, they have their own role, they interact in complex ways and they evolve in their own manner.

Table 2.3. The analogy between business, innovation, knowledge and natural ecosystems - adapted from: Valkokari (2015).

	Business ecosystems	Innovation ecosystems	Knowledge ecosystems	Natural ecosystems
Baseline of Ecosystem	Resource exploitation for customer value	Co-creation of innovation	Knowledge exploration	Natural processes and components that can provide goods or services
Relationships and Connectivity	Global business relationships both competitive and co-operative	Geographically clustered actors, different levels of collaboration and openness	Decentralized and disturbed knowledge nodes, synergies through knowledge exchange	Organisms coexist, collaborate and co-evolve via a complex set of symbiotic and reciprocal relationships, which together form a larger ecosystem. Flows of material can go beyond ecosystems' boundaries and connect them
Actors and Roles	Suppliers, customers and focal	Innovation policymakers, local	Research institutes, innovators and	Producers, consumers and decomposers that

	companies as a core, other actors more loosely involved	intermediators, innovation brokers and funding organizations	technology entrepreneurs serve as knowledge nodes	allow energy transfer and matter cycling
Logic of Action	A main actor that operates as a platform sharing resources, assets and benefits or aggregates other actors together in the networked business operations	Geographically proximate actors interacting around hubs facilitated by intermediating actors	A large number of actors that are grouped around knowledge exchange or a central non-proprietary resource for the benefit of all actors	A community of biotic (living organisms) and abiotic (chemical and physical) components in a specific area that interact with each other in complex ways

Jackson (2011) reports that one expects an analogy to exist between the innovation ecosystem and the biological ecosystem. The author claims that a biological ecosystem is a complicated group of relationships between living resources, habitats and residents in a specific area who try to preserve the equilibrium state. On the contrary, innovation ecosystems focus more on the economic rather than the energy dynamics of the complicated relationships between actors or entities who try to facilitate the creation of technology and innovation.

In addition, Shaw and Allen (2016) support that there is relevance between natural and innovation ecosystems and common points can be found. First, natural and innovation ecosystems are both systems that are constituted of different entities that can be found in different geographical areas and they develop relationships such as they compete, attack, consume and benefit each other at specific situations.

Both systems use resources and information that can drive behaviours, enhance the state of the ecosystem and help it move forward such as for example in the natural ecosystem the solar energy is essential for the living, growth of nutrients and their reproduction whereas in the innovation ecosystem physical energy is used in order to enhance processes and allow value creation.

Second, both natural and innovation ecosystems are phenomena with diversity and different scales and in order to be studied specialization is needed. For example, technologies such as cloud computing and social media as well as technologies such as big data and internet of things create phenomena on bigger scales. Both ecology and business studies rely on information gathering, however, in both studies errors can occur.

Third, both systems interact to internal and external disruption and this leads them to change at different scales, where different levels of analysis need to take place. The common point that can be found in both natural and innovation ecosystems is adaption which is not happening at the same level in both ecosystems, but it can be similar and it could be applied from one ecosystem to another while gaining useful insights.

Finally, another common point for natural and innovation ecosystems is the management of their outputs. Often at natural ecosystems the wrong term 'ecosystem services' is used which does not explain the role that these ecosystems have in producing resources and outputs. According to the authors the natural and innovation ecosystems are locked together, where

the idea is that complex systems produce an array of complex outputs which have greater complexity and this can lead to the solution of more complex problems for the customers.

Furthermore, Moore (1993) shows how this analogy of a biological ecosystem can be applied to business ecosystems, let's think one grassland that has conifers over time this will evolve into a more complicated forest of hardwoods. Business ecosystems concentrate capital, customer interest and talent which are created by a new innovation, in the same way successful species appear from the natural resources of sunlight, water and soil nutrients.

According to O'Connor et al. (2018) an ecological perspective can also be adapted to entrepreneurial ecosystems where these can be seen as *"ecosystems which are in constant change and there are shifts between levels of complexity."* This means that as in the biological ecosystems where the survival, the actors cooperation as well as external factors have great importance and are elements that can contribute to the development and change of an ecosystem in the same way they can affect the entrepreneurial ecosystem. These elements can maintain both the ecosystems' equilibrium as well as the ecosystems' change.

The first and intermediary output for an entrepreneurial ecosystem is the entrepreneurial activity generated by different actors that form various relationships where they recognize and pursue chances for innovation that will add value to the society which is the ultimate goal for an entrepreneurial ecosystem. The authors also point out the differences (see Table 2.4) between entrepreneurial ecosystems and other approaches based on the work of Acs et al. (2017b).

Table 2.4. Differences between entrepreneurial ecosystems and other approaches. Source: O'Connor et al. (2018).

Approach	Industrial district, cluster, innovation system, triple helix	Innovation ecosystem	Entrepreneurial ecosystem
Main focus	Economic and social structures of a place that influence overall innovation and firm competitiveness. In many cases, little distinction made between (fast growing) startups and other types of organizations	Creating customer value through a chain of interdependent organizations, with differential value capture by different players in the ecosystem	Startups explicitly at center of ecosystem. Seen as distinct from established large firms and (lower-growth) SMEs in terms of conceptual development and policy formation
Locus of action	Private firms and state is primary locus of action in building and maintaining industrial district/cluster/innovation system. Little room for individual agency in their creation	One large firm as orchestrator of the ecosystem, with many other firms co-innovating or involved in the adoption of innovation	Entrepreneur is the core actor in building and sustaining the ecosystem. While state and other sources might support ecosystem through public investment, entrepreneurs retain agency to develop and lead the ecosystem

Like the natural or the biological ecosystems, the business, innovation, knowledge and entrepreneurial ecosystems are constituted by different actors that coexist in a given environment, they have their own role, they interact in complex ways, they utilize their available resources and the flows that exist in their environment whether these are knowledge, learning etc and they combine them with the appropriate infrastructures and human capital to execute processes such as co-operation, co-evolution, co-specialization that will lead them for example to an economic impact.

2.3 Classification of ecosystems

There are many and different kinds of ecosystems, thus the existence of a general classification for ecosystems is necessary not only to increase knowledge, but also to be able to gain a deeper understanding of ecosystems.

Whitman (2017) supports that there are various ecosystems, such as for example rain forests and tundra, coral reefs and ponds, grasslands and deserts and that these various types of ecosystems are generated due to the fact that there are climate diversifications among countries.

The dominant vegetation is what influences the appearance of terrestrial ecosystems whereas the 'biome' is used for the description of a large vegetation type such as for example tropical rain forest, grassland, tundra, etc that expands into a broader geographic area but this word cannot be used for aquatic systems, such as ponds or coral reefs since "*it always refers to a vegetation category that is dominant over a very large geographic scale, and thus is somewhat broader geographically than an ecosystem.*"

Klinka (2008) reports that Krajina and his students (1949-1975) developed the following classification for ecosystems, based on their research on ecosystems across British Colombia:

1. Environmental approach (soil, landform and site classification).
2. Vegetation approach (vegetation classification).
3. Combined approach (ecosystem or ecological classification).

Furthermore, the author defines the local and the regional ecosystem as follows: "*A local ecosystem is a landscape segment relatively uniform in climate, soil, vegetation, animals, and microorganisms. A regional ecosystem is a group of contiguous local ecosystems affected by the same regional climate.*"

The European Commission (2013a) reports that two are the main principles as regards to the global classification and mapping approaches for ecosystems: 1) typological where nature is divided into ecosystem types or classes at many geographical locations such as for example temperate broadleaf and mixed forests and 2) regional where ecosystems are described from a regional perspective such as for example dinaric mixed forests or a combination of both.

However, it should be mentioned that within each ecosystem type there is similarity as regards to the following elements in general: the climatic and the geophysical conditions, the dominant use by humans, the surface cover (based on the type of vegetative cover in terrestrial ecosystems or on fresh water, brackish water, or salt water in aquatic ecosystems), the species composition, as well as the resource management systems and institutions (as cited in European Commission, 2013a).

What can be observed from the above is that geography plays an important role when one wants to analyze an ecosystem. The geography of a region such as the example of British Colombia shows that each ecosystem is unique and this is due to its unique factors that exist in this specific area such as climate, vegetation, soil, temperature etc. All these factors can contribute to the development of a unique ecosystem in a specific region.

Although, geography is an important element of ecosystems, another element which is important as well, is the type of the ecosystem. The type of the ecosystem can be different such as for example freshwater ecosystems, software ecosystems etc, and it can be observed that the type of an ecosystem can be defined based on the sector in which the ecosystem belongs. For example, if one wants to analyze the freshwater ecosystems they will study the environmental perspective, whereas if one wants to analyze the software ecosystem they will study the information technology sector.

In addition, as described above, based on the geography and the sector in which the type of the ecosystem belongs, a combination of these two criteria can exist. For example one can analyze the freshwater ecosystem or the software ecosystem of British Colombia which although both exist in the same region, the sector in which they belong is different and thus the type of the ecosystem is different. It can be concluded that depending on what one wants to achieve they should carefully choose the criteria with which they will define, analyze or even compare ecosystems.

Finally, Lugo et al. (1999) support that an ecosystem classification system must have the following qualities:

1. Based on geo-referenced quantitative data.
2. As objective as possible.
3. Reflect as closely as possible the forces driving ecosystems.
4. Hierarchical.
5. Convenient for expanding or contracting complexity scales.
6. Useful for anticipating global climate change.
7. Applicable to the entire world.
8. Demonstrably valid.
9. Conform to principles of climatic classification and vegetation function.
10. Accepts new data as a means to sharpen the analysis.

It is also interesting to present a classification for the entrepreneurial ecosystems. According to Spigel and Harrison (2017) there is not a single agreed-upon definition or typology for the entrepreneurial ecosystems. However, Spigel (2017) claims that there are elements that compose an entrepreneurial ecosystem and these can be categorized as cultural, social or material.

As regards to cultural elements, these represent the attitudes towards entrepreneurship such as the positive or negative attitude towards entrepreneurship. As regards to social elements, these represent various resources such as risk capital, talented workers etc, which can be assessed through social networks. As regards to material elements, these represent the institutions and organizations that are established in a specific place and support high-growth entrepreneurship.

All these elements, according to Spigel and Harrison (2017), cannot be fully understood within the context of the entrepreneurial ecosystems because there is little empirical evidence to date regarding their importance or role. However, on the other hand, major research traditions in entrepreneurship, economic geography and regional science have been heavily studied. More specifically, the study of industrial clusters and regional innovation systems can help research in entrepreneurial ecosystems since these can be considered as their conceptual antecedents.

Recent work in entrepreneurial ecosystems, according to the authors, show that these are linked to the clusters theory, for instance both Isenberg and Feld cite the work of Porter's (1998) on clusters. Entrepreneurial ecosystems are built on the following clusters' principles:

1. The presence of other firms whether they operate in the same or different sector is a source of a competitive advantage of new ventures where entrepreneurs use their connections to gain market intelligence, initial customers or insert themselves into existing supply chains.
2. Cluster theory is used in entrepreneurial ecosystems to highlight the fact that entrepreneurs use knowledge outside their firms to increase their competitiveness.
3. Ecosystem theory adopts the cluster perspectives which recognize that knowledge processing and creation are key elements on the success of firms and this is also supported by the close proximity between firms.

Cooke et al. (1997) divided the concept of the regional innovation systems (RIS) into three elements: region which is a container for innovation activity, innovation which does not happen solely within a firm but innovative firms gain knowledge by other organizations such as universities and other firms regardless their sector and system where the elements of RIS work together to create innovation and economic growth.

Moreover, Cooke (2007) created the concept of the entrepreneurial regional innovation systems (ERIS) which is different due to the presence of pools of venture capital, market-focused serial entrepreneurs and disruptive innovation driven by internal networks.

Entrepreneurial ecosystems can be built on the concepts of RIS and ERIS as follows:

1. The formation of networks which can allow the interactive learning and innovation within the entrepreneurial ecosystems.
2. The importance of universities and other organizations which are fundamental sources of knowledge production and workforce training.
3. The role of policy in creating supportive environments for innovative entrepreneurship.

2.4 Types of ecosystems

Scaringella and Radziwon (2017) report the main ecosystem concept types, as follows: business, innovation, entrepreneurial/entrepreneurship and knowledge ecosystem. By having defined and analyzed the innovation and the entrepreneurial ecosystem in a previous section, the definitions of the business and the knowledge ecosystem will be given here.

First, as regards to the business ecosystem, Moore (1993, p. 26) claims that in order to further the systemic to strategy approach, a company should be seen as a part of the business ecosystem since it passes over a range of industries and not as a single entity. In the business ecosystems there is the co-evolution of companies as regards to their capabilities around a new innovation where they work cooperatively and competitively in order to establish new products that will fulfill customers' needs and finally integrate new innovations.

Also, Moore (1996, p. 26) supports that when interacting organizations and individuals support an economic community, this community will produce valuable products to customers whether these are goods or services and customers themselves are also members of the ecosystems. Other members are suppliers, lead producers, competitors and other stakeholders. As time passes by, all these members co-evolve around both their capabilities and roles in order to be aligned with one's or more central companies' directions (see Fig. 2.4).

Iansiti and Levien (2004, p. 2) define the business ecosystem as follows: *“Loose networks – of suppliers, distributors, outsourcing firms, makers of related products or services, technology providers, and a host of other organizations – affect, and are affected by, the creation and delivery of a company's own offerings. Like an individual species in a biological ecosystem, each member of a business ecosystem ultimately shares the fate of the network as a whole, regardless of that member's apparent strength.”*

Whereas Li (2009, p. 380) defines the business ecosystem as follows: “A *business ecosystem* is an emerging concept analogized from biology. Business ecosystems move beyond market positioning and industrial structure by having three major characteristics: symbiosis, platform, and co-evolution.”

Moore (1993) parallelized the business ecosystem with a biological counterpart where there is the business environment in which firms interact with each other and aim for new innovations.

But what are the characteristics of a business ecosystem? First, Li (2009) claims that there are three characteristics as follows:

1. A loose network or horizontal and vertical actors.
2. A platform.
3. An evolution/ co-evolution of these actors.

Similarly, according to Clarysse et al. (2014) there are two characteristics as follows:

1. A loose network of interconnected participants (Iansiti and Levien, 2004).
2. An orchestrator or a keystone company which has many connections and can help in both developing and maintaining the ecosystem as well as in improving the participants’ performance (Iansiti and Levien, 2004; Moore, 1996) (as cited in Scaringella and Radziwon, 2017).

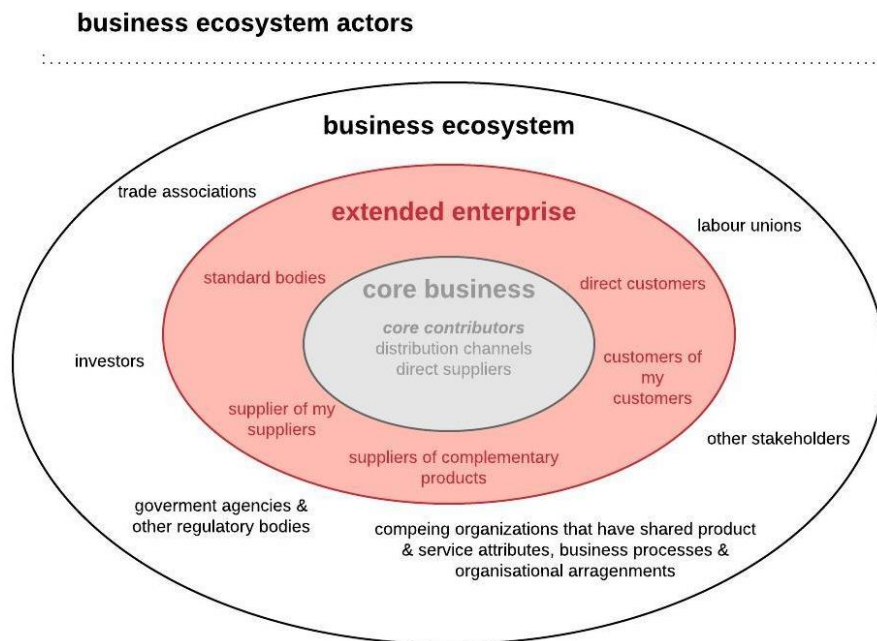


Figure 2.4. The Business Ecosystem. Source: Moore (1996).

Furthermore, according to Iansiti and Levien (2004), four are the main ecosystem roles: keystone, niche player, dominator and hub landlord, all these could be maintained by stakeholders that don’t have a direct relationship with business such as for example government and industry associations (Moore 1993).

According to Moore (1993) in the business ecosystem various organizational members are included and because they interact nearby the inter-organizational networks are developed and in addition, coopetition relationships exist through which firms can collaborate and compete at the same time. On the one hand, Iansiti and Levien (2004) report that scholars indicate the “*business ecosystems as networks of companies located in fairly close proximity*

to each other” or according to Kanter (2012) “*simply as inherently local*” (as cited in Scaringella and Radziwon, 2017).

The business ecosystem is constituted by many layers that complement the “*differing levels of commitment to the business*” according to Moore (1993). However, the most important business layer of the ecosystem is constituted by different groups that shape the business itself and this is the business network actors such as for example the suppliers, a focal firm, the distributors and the customers.

In the context of the business ecosystem approach, likewise as business (Halinen and Törnroos 2005) networks, the business ecosystem can be observed as an association of companies and organizations that functions with a focal firm or is connected to a platform (Milinkovich 2008) and at the same time it uses and integrates the available resources which will lead it to the creation and the capture of value (as cited in Valkokari, 2015).

Then, as regards to the knowledge ecosystem, Clarysse et al. (2014, p. 1) give the following definition: “*The flow of tacit knowledge between companies and the mobility of personnel have been advanced as the main advantages of geographic colocation which characterize these hotspots. Such hotspots have been characterized as knowledge ecosystems where local universities and public research organizations play a central role in advancing technological innovation within the system.*”

Shrivastava (n.d.) defines knowledge ecosystems as follows: “*Like natural ecosystems, these knowledge ecosystems have inputs, throughputs and outputs operating in open exchange relationship with their environments. Multiple layers and levels of systems may be integrated to form a complete ecosystem. These systems consist of interlinked knowledge resources, databases, human experts, and artificial knowledge agents that collectively provide an online knowledge for anywhere anytime performance of organizational tasks. The availability of knowledge on an anywhere-anytime basis blurs the line between learning and work performance. Both can occur simultaneously and sometimes interchangeably.*”

Moreover, Osborne (2017) reports that at the core of the knowledge ecosystem (see Fig. 2.5) there are the following elements: education, research, innovation and industry. The interactions that exist here are as follows: education interacts with research and innovation interacts with industry.

Thereinafter, Clarysse et al. (2014) report the differences of the knowledge and the business ecosystems as follows:

1. The focus activity of the ecosystem, where in the knowledge ecosystem the focus activity is on knowledge generation whereas in the business ecosystem the focus is on the creation of value for the customer.
2. The connectivity of the players, where in the knowledge ecosystem they are geographically clustered whereas in the business ecosystem they are represented by value networks.
3. The key player, where in the knowledge ecosystem it can be a university whereas in the business ecosystem it can be a large company.

Valkokari (2015) claims that the main focus of the knowledge ecosystem is to explore new knowledge and not to exploit it, whereas according to Quin et al. (1998), this is also supported that the main outcome can be new knowledge by identifying network nodes where new knowledge is generated and absorbed. Moreover, according to Koenig (2012), open source communities can help on the knowledge exchange and they are an example of the knowledge ecosystem whereas Coughlan (2014) supports that “*co-location can also mean virtual proximity, like emotional closeness, between the actors*” (as cited in Valkokari, 2015).

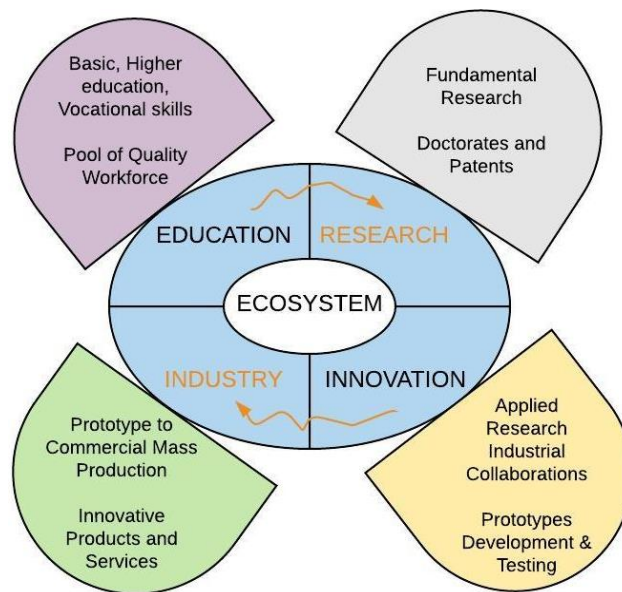


Figure 2.5. The Knowledge Ecosystem. Source: Osborne (2017).

But what are the similarities and the differences between the business and the knowledge ecosystems? Based on the above, these can all be found in Table 2.5.

Table 2.5. Similarities and differences of business and knowledge ecosystems.

Similarities of Business and Knowledge Ecosystems	Differences of Business and Knowledge Ecosystems
The business and the knowledge ecosystems are constituted of different actors that interact in complex ways and will lead them to value capture and creation in the first case and to creation of new knowledge in the second case.	The business ecosystem focuses on companies whereas the knowledge ecosystem focuses on universities.
The business and the knowledge ecosystem can be enabled by the use of new technologies such as ICT technologies and Web 2.0.	The business ecosystem functions with a focal company or it is connected to a platform whereas the knowledge ecosystem functions with the network of neighboring companies that are geographically clustered/localized.
The business and the knowledge ecosystem can affect the economic environment.	The business ecosystem needs resources whereas the knowledge ecosystem needs knowledge.

Besides the main ecosystem types, there are various types of ecosystems that belong to different sectors (see Table 2.6). The most important sectors that were studied are the following:

1. Ecology that includes the following types of ecosystems: Ecosystem as a term, Human ecosystems, Urban ecosystems.
2. Environment that includes the following types of ecosystems: Freshwater ecosystems, Terrestrial ecosystems, Air ecosystems and Marine ecosystems.
3. Agriculture that includes the following type of ecosystem: Agricultural ecosystems.

4. Information Technology that includes the following types of ecosystems: Software ecosystems, Social-Media ecosystems, E-learning ecosystems, Digital ecosystems and Mobile ecosystems.
5. Health that includes the following types of ecosystems: Digital health ecosystems and e-Health ecosystems.
6. Economy that includes the following types of ecosystems: Public sector ecosystems and Private sector ecosystems.

Table 2.6. Definitions of ecosystems across sectors.

Sectors	Types of ecosystems	Definition	Authors
Ecology	Ecosystem (term)	<i>“It is the systems so formed which, from the point of view of the ecologist, are the basic units of nature on the face of the earth. Our natural human prejudices force us to consider the organisms (in the sense of the biologist) as the most important parts of these systems, but certainly the inorganic " factors" are also parts-there could be no systems without them, and there is constant interchange of the most various kinds within each system, not only between the organisms but between the organic and the inorganic. These ecosystems, as we may call them, are of the most various kinds and sizes. They form one category of the multitudinous physical systems of the universe, which range from the universe as a whole down to the atom.”</i>	A. G. Tansley, 1935
		<i>“Any system composed of physical-chemical-biological processes, within a space-time unit of any magnitude.”</i>	R. L. Lindeman, 1942

	Human ecosystems	<i>“The new thing about human ecosystems is that they contain elements and relations/fluxes of a technical-cultural type. Technical-cultural producers are factories for goods for example, technical-cultural consumers are mass or energy-consuming things like refrigerators, machines, cars etc., technical-cultural reducers are wastewater-treatment plants, biogas-plants or composting-sites. Technical energy can be electricity, technical matter maybe produced goods like cars, technical information shows up as internet and telephone etc.”</i>	Geller and Glücklich, 2012
	Urban ecosystems	<i>“Urban ecosystems apply the ecosystem approach to urban areas. Urban ecosystems are dynamic ecosystems that have similar interactions and behaviours as natural ecosystems. Unlike natural ecosystems however, urban ecosystems are a hybrid of natural and man-made elements whose interactions are affected not only by the natural environment, but also culture, personal behaviour, politics, economics and social organisation.”</i>	Srinivas, n.d.
Environment	Freshwater ecosystems	<i>“Freshwater ecosystems including lakes, ponds, rivers, streams, springs and wetlands are home to approximately 126,000 species. In addition to being an important home for biodiversity, these aquatic ecosystems provide provisioning, supporting, regulating and</i>	Aylward et al., 2005

		<i>cultural ecosystem services that underpin the health, livelihoods and wellbeing of billions of people.”</i>	
		<i>“Freshwater ecosystems can be found in streams, rivers, springs, ponds, lakes, bogs and freshwater swamps. They are subdivided into two classes: those in which the water is nearly stationary, such as ponds, and those in which the water flows, such as creeks. Freshwater ecosystems are home to more than just fish: algae, plankton, insects, amphibians and underwater plants also inhabit them.”</i>	Harris, 2017
	Terrestrial ecosystems	<i>“An ecosystem is a collection of communities of both living and non-living things that are interrelated. While many ecosystems exist on land and in the waters of the world, terrestrial ecosystems are those that are found only on land. The biotic, or living things found in an ecosystem, include various life forms, such as plants and animals. The abiotic, or non-living things found in an ecosystem, include the various land-forms and the climate.”</i>	Arrington, n.d.
	Air ecosystems	<i>“An air ecosystem is a community of living organisms in conjunction with the non-living components of their environment in the air, interacting as a system. In the case of air ecosystems, the organisms that make up it can make life in the air. Many species arrive in this aerial environment thanks to the wind. In</i>	Armstrong, 2017

		<p><i>addition, the first plant colonization on Earth was due to the fact that the wind acted as a transport for mosses and their spores. The wind acts as a means to transport seeds, which is why many plants use it, including orchids. Many insects make life in the air ecosystem, such as beetles. There are usually two large groups of animals that accompany insects in the air: birds and bats."</i></p>	
	Marine ecosystems	<p><i>"Marine ecosystems are complex adaptive systems with physical and biological processes operating on a vast array of spatial and temporal scales."</i></p>	Levin, 1998
		<p><i>"Marine ecosystems differ from freshwater ecosystems in that they contain saltwater, which usually supports different types of species than does freshwater. Marine ecosystems are the most abundant types of ecosystems in the world. They encompass not only the ocean floor and surface but also tidal zones, estuaries, salt marshes and saltwater swamps, mangroves and coral reefs."</i></p>	Harris, 2017
Agriculture	Agricultural ecosystems	<p><i>"A typical example of artificial ecosystem is a cultivated field or agro-ecosystem. This is a natural system altered by men through agricultural activity. It's different from a natural ecosystem for four main characteristics: 1) simplification: a farmer favours a plant species removing all other animal or plant species which could damage it, 2) the</i></p>	eniscuola.net, 2013

		<p>energy intake employed by men in the form of machinery, fertilizers, pesticides, selected seeds, processings, 3) the biomass (harvest) which is removed when ripe. This makes the ecosystem an open system, which means it depends from external processes to reintroduce fertilizing substances suitable to nourish a new growth and development process of organic material (plants). A natural ecosystem, instead, self-fertilizes as the biomass remains in its original setting, 4) the introduction of pollutant substances which, in the case of intensive agriculture, are chemical fertilizers, antiparasitics and other chemical non-biodegradable substances which accumulate in the ecosystem or which seep in the subsoil, in some cases getting to the point of seriously polluting groundwaters, seas and rivers.”</p>	
Information Technology	Software ecosystems	<p>“A set of businesses functioning as a unit and interacting with a shared market for software and services, together with relationships among them. These relationships are frequently underpinned by a common technological platform and operate through the exchange of information, resources and artifacts.”</p>	Messerschmitt and Szyperski, 2003
	Social-Media ecosystems	<p>“Users involved in conversations and interactions with various device type (laptop, desktop, tablet, smartphones) as well as more sophisticated usages (publishing, sharing,</p>	Cavazza, 2012

		<i>playing, networking, buying, and localization) on various niche services or on generic social platforms (Facebook, Twitter, Google+)."</i>	
	E-learning ecosystems	<i>"E-Learning ecosystem is the term used to describe all the components required to implement an e-learning solution. These components fall into three categories: content providers, consultants, and infrastructure"</i>	Brodo, 2002
	Digital ecosystems	<i>"A digital ecosystem is a self-organizing digital infrastructure aimed at creating a digital environment for networked organizations that supports the cooperation, the knowledge sharing, the development of open and adaptive technologies and evolutionary business models."</i>	Uden et al., 2007
	Mobile ecosystems	<i>"To understand the ecosystem, one should keep in mind that there are certain functional groups within the ecosystem classified by the roles they play within the ecosystem. The keystones focus on creating platforms and sharing core resources and solutions throughout the network (Iansiti & Levien, 2004). It should be noted that the keystones are platform providers. They provide platforms that the niches can use to create value through innovation. According to Song (2010, p.9), a keystone strategy can be most effectively carried out if a keystone's "business is at the center of a complex network of asset-sharing</i>	Yang et al., 2018

		<i>relationships and operates in a turbulent environment.”</i>	
Health	Digital Health ecosystems	<i>“In Digital Health Ecosystems, species and services are heterogeneous in nature; namely, species comprise hospitals, pharmacies, clinics, health practitioners, and definitely individuals, etc., and services refer to services provided or requested by these species.”</i>	Hadzic et al., 2008
	e-Health ecosystems	<i>“In order to define an e-health ecosystem we suggest that it is necessary to incorporate the characteristics of the socio-economic and technical contexts. It is also important to understand the interactions among all the stakeholders involved in the system. These interactions are particularly important for the health sector because they will be crucial to determine the ecosystem's life cycle. We propose an e-health ecosystem, which considers three principal aspects: human, economic and technological.”</i>	Rojas-Mendizabal et al., 2013
Economy	Public sector - Government	<i>“The open government ecosystem envisions government organizations as central actors, taking the initiative within networked systems organized to achieve specific goals related to innovation and good government.”</i>	Harrison et al. 2012
	Private sector – Civil Society	<i>“While descriptions vary across institutions and countries, the “civil society ecosystem” typically includes: 1) NGOs, non-profit</i>	World Economic Forum, 2013

		<p><i>organizations and civil society organizations (CSOs) that have an organized structure or activity, and are typically registered entities and groups, 2) Online groups and activities including social media communities that can be “organized” but do not necessarily have physical, legal or financial structures, 3) Social movements of collective action and/or identity, which can be online or physical, 4) Religious leaders, faith communities, and faith-based organizations, 5) Labour unions and labour organizations representing workers, 6) Social entrepreneurs employing innovative and/or market oriented approaches for social and environmental outcomes, 7) Grassroots associations and activities at local level, 8) Cooperatives owned and democratically controlled by their members.”</i></p>	
--	--	--	--

By having defined the different types of ecosystems across sectors it is interesting to present some studies on ecosystems across the following sectors: health, environment, agriculture, information technology, ecology and economy.

As regards to the health sector, Rojas-Mendizabal et al. (2013) propose a new e-health ecosystem which focuses on user acceptance and more specifically on the quality of experience and quality of services. In their study, the authors take into consideration the human, economic and technical dimensions that exist in e-health services. The authors suggest that when creating e-health projects one should focus on the patients, medical and specialist needs.

Regarding the environment, Harris (2017) explains the types of environmental ecosystems and claims that two are the main categories of environmental ecosystems as follows: 1) terrestrial ecosystems which concerns land-based ecosystems and 2) aquatic ecosystems which concerns water-based ecosystems. Harris (2017) gives the definition and an explanation for the major types of ecosystems which are forest, grassland, dessert, tundra, freshwater and marine ecosystems.

Regarding agriculture, the agricultural ecosystem according to eniscuola.net (2013) consists an artificial ecosystem or otherwise it can be considered as a cultivated field. In agricultural

ecosystems both the environment and climate can have a huge impact on the products that are being generated whereas new technologies have made cultivation a lot easier. However, agriculture itself has a great impact on environment since it is calculated that it is the third most important factor to greenhouse gasses emissions and also consumes 70% of the water drawn in the whole world from lakes, rivers etc. Last but not least, an important element for agricultural ecosystems is agrobiodiversity which is necessary not only for agriculture itself but also for humans and perhaps genetic diversity could help in expanding production.

As regards to information technology, the future of e-learning can be found according to Uden et al. (2007) to e-learning ecosystems and in their study they analyse the limitations of the current e-learning systems and how e-learning can benefit organizations and create e-learning systems. Uden et al. (2007) support that the e-learning ecosystem is constituted of three components as follows: 1) Content providers who provide content for learning solutions, 2) Consultants who are different types such as for example Information Technology consultants and 3) Infrastructure which is constituted of the learning content management system, content delivery system and tools.

As regards to the benefits that the e-learning ecosystems can offer to organizations, the authors claim that they can benefit not only employees who can for example attend learning programs, but also training officers who can manage the learning activity of the entire business.

As regards to ecology, Srinivas (n.d.) analyzes the urban ecosystems where these ecosystems have both natural and man-made elements and can be effected not only by the natural environment but also by culture, behaviour etc. The author claims that urban ecosystems cannot be seen as a different entity from the environment and they are constituted of the following systems: 1) the natural environment, 2) the built environment and 3) the socio-economic environment. This approach encourages the adjustment of cities to natural ecosystems in order for people to utilize the resources, processes and products as well as to create less waste.

Finally, as regards to economy, Harrison et al. (2012) support that in open government ecosystems the government organizations will have the key roles as actors within the ecosystem and they can exploit opportunities in cooperation with other actors within organized networked systems in order to complete their common goals as regards to innovation and good government. Three are the main properties of an open government ecosystem that can be found on mutual domains of actors which interact with each other in various ways, as follows: 1) government policies and practices, 2) user, businesses and civil society and 3) innovators.

2.5 Entrepreneurship vs Innovation ecosystems

Ecosystems can be categorized into different types and two fundamental concepts that should be mentioned and defined here are innovation and entrepreneurial ecosystems. As regards to the innovation as well as the entrepreneurial ecosystems there are many and different definitions whereas here the definitions of these concepts will be given first and then they will be analyzed.

It is interesting to present the different ecosystem approaches as regards to the innovation and entrepreneurial ecosystem (see Table 2.7) as proposed by Pilinkienė and Mačiulis (2014) based on economic determinants and levels of impact. The authors also claim that the first biological analogies in the economic field was conducted by Rothschild (1990) who relates the global economy to a biological system where both of them are systems with stakeholders interacting with each other.

Table 2.7. Comparison of innovation and entrepreneurship ecosystem analogies - adapted from: Pilinkienė and Mačiulis (2014).

Ecosystem analogies	Innovation ecosystem	Entrepreneurship ecosystem
Authors	Adner, 2006; Wessner, 2007; Yawson, 2009.	Isenberg, 2010.
Environment	From local to global; Interorganizational, political, economic and technological environment.	Local; Specific location.
Actors	Entrepreneur; Large and small enterprises; Educational institutions; Research institutes and laboratories; Venture capital firms; Financial markets; Government institutions.	Financial capital; Educational institutions; Culture; Support measures; Human capital; Markets; Government institutions; Nongovernment institutions; Entrepreneur; Large and small enterprises.
Micro level impact	Value and innovation creation; The level of firms' productivity; Influence to innovation performance.	Affecting entrepreneurial activity; Encourages business creation and development.
Macro level impact	Enhance competitiveness; Effect on innovation index;	Improve entrepreneurship level.
Key determinants affecting ecosystem performance	Resources, governance, strategy and leadership, organizational culture, technology; Interaction between ecosystem actors.	Opportunities, skilled people and resources; Interaction between ecosystem actors.

On the one hand, as regards to the entrepreneurship or entrepreneurial ecosystem, the antecedents of these ecosystems can be considered according to Cavallo et al. (2018) the city/regional/national innovation systems and according to Cooke et al. (1997) these indicate the networks and institutions which connect centers that create knowledge such as universities and public research labs to innovative businesses within a city or region or even a nation. These connections support knowledge spill over among diverse organizations and in this way the overall innovativeness of a region can be expanded.

Kansheba and Wald (2020) conducted a systematic literature review on the emerging topic of the entrepreneurial ecosystems. The authors report that the concept has gained attention from 2000s, however, more publications can be found between 2015 and 2019. The authors studied 51 articles as regards to entrepreneurial ecosystems in two phases, in the first phase a descriptive analysis was implemented and in the second phase a content analysis was implemented.

As regards to the descriptive analysis the results revealed that the publication trend of entrepreneurial ecosystems emerged on mid-2000s and gained more attention from 2015 and on. The methodological approaches that are used deploy a case study approach (19 studies), following by conceptual work which means contributions without empirical data (16 studies). These results, according to the authors, show the lack of empirical studies on entrepreneurial

ecosystems. In addition, 39 studies revealed that as regards to the theoretical basis there is not a specified theory, only 7 studies focused on the entrepreneur and 10 studies at the firm level of SMEs.

Furthermore, the sector focus revealed to be general without a specific sector focus on 33 studies, only 12 studies focused on research, development and education whereas 6 studies focused on technology as well as the country focus revealed to be mainly on USA and Europe. Last but not least, as regards to the theoretical foundation of this phenomenon the results revealed that there is lack of explicit theoretical foundation since 39 studies do not refer to any study.

In terms of the content analysis (see Table 2.8) the authors first organized thematic descriptions of common patterns of themes to first order themes according to Isenberg (2010) and then to second order themes according to Matthews et al. (2018). In conclusion, the authors found that entrepreneurial ecosystems are an under-researched phenomenon and there is a need for empirical research.

Table 2.8. Thematic analytical categorization of entrepreneurial ecosystem. Source: Kansheba and Wald (2020).

Descriptive statement	First Order	Second Order
The society that embraces success and failure entrepreneurial stories Entrepreneurs' adaptability and ability to track results and reward performance working motivational orientations and attitude	Entrepreneurial Culture	Antecedents of Entrepreneurial Ecosystem
Focal point and drivers of within entrepreneurial ecosystem Initiators of entrepreneurial decisions such as investment, innovation, starting the business or expanding it	Entrepreneurs	
Infrastructures and amenities such as good working spaces and transportation and other physical infrastructures	Entrepreneurial Infrastructures	
Institutions and organizations that play an intermediary role eg Banks and Microfinances, R&D Institutions, Universities	Entrepreneurial Institutions	
Various entrepreneurial support services such as product and service, promotions and marketing, mentorship, information access, professional advisory experts such as law, accountings, taxes	Entrepreneurial Support Services	
Entrepreneurial policy and regulatory frameworks Presence of vibrant leaders who are committed to foster entrepreneurial performance Government intervention and support	Entrepreneurial Policies and Regulations	

Efficient entrepreneurial processes and activities Birth rate of new innovative ventures individual and high growth firms Increased job creation opportunities and reduction of unemployment	Increased and efficient Entrepreneurial activities and process (Productive Entrepreneurship)	Entrepreneurial Ecosystem Outputs
Aggregate value creation (improved social welfare of people) Creation of capital wealth, prosperity and value creation Improved competitive advantages and capabilities	Entrepreneurial Economic Outcomes	Entrepreneurial Ecosystem Outcomes
Diffusion of technology among entrepreneurs that results to invention of innovative products and services	Entrepreneurial Technological Outcomes	
Non-monetary outcomes among entrepreneurial ecosystem members through delivered new products and services	Entrepreneurial Social Outcomes	

In addition, Alvedalen and Boschma (2017) in their study compare the term Entrepreneurial Ecosystem (EE) to the term Entrepreneurial System (ES) and support that the term EE has only recently gained attention and the publications for this term cover the last 17 years whereas the publications for the term ES cover the last 44 years. However, the authors mention that although there are scholars that separate ecosystems and systems, until now in the literature there is not a clear distinction between these terms and they are used mutually.

The authors through their study reveal the following weaknesses that exist in the Entrepreneurial Ecosystem literature:

1. There is not an explicit framework up until now that can explain which are the cause and the result in an entrepreneurial ecosystem.
2. It cannot always be understood clearly how the components of an entrepreneurial ecosystem connect and which of these synergies count the most.
3. It has not been clarified which institutions and at which spatial scale can influence both the structure and the performance of the entrepreneurial ecosystems.
4. The studies about entrepreneurial ecosystems have a case study perspective rather than comparative and multi-scalar perspective.
5. The entrepreneurial ecosystems' literature focuses more on the static framework rather on how this has evolved over time.

To tackle these weaknesses the authors make some useful suggestions. First, they suggest that network analysis could help in deciding whether an ecosystem can be defined as an entrepreneurial ecosystem or not, how strong or weak this ecosystem is, as well as network analysis allows the comparative analysis of different types of entrepreneurial ecosystems. All these can provide greater understanding of entrepreneurial ecosystems and can lead to the development of a more analytical framework.

Second, the authors propose that institutions should be taken more into consideration as regards to the entrepreneurial ecosystem literature. More specifically, institutional change should be given more attention as it can help in the development of new institutions or in the

adaption of the existing institutions that can facilitate entrepreneurship. Then, emphasis should be given at the institutional entrepreneurship at the micro level which can help in understanding which and why some agents are more successful in institutional change as well as if there are specific conditions at a region that allow this change. In addition, priority should be given on elements such as power and vested interests that can block institutional change and can further lead to dynamic entrepreneurial ecosystems.

Finally, the authors recommend that both the dynamic and the evolutionary perspectives of entrepreneurial ecosystems should be given more importance. The dynamic perspective should focus on institutional change, institutional entrepreneurship and institutions that question and block institutional change. The evolutionary perspective should focus on the evolution of these ecosystems over time and this perspective will allow the comparison of different ecosystems as regards to their evolution and performance.

According to Thomas and Autio (2019) *“entrepreneurial ecosystems are distinctive type of innovation ecosystem that facilitate business model innovation instantiated by new ventures as their ecosystem-level output.”* Entrepreneurial ecosystems could be considered as a specific type of cluster which is different from terms such as knowledge clusters, regional and national systems of innovation because the emphasis here is placed on the entrepreneurial agents and on the business model innovation.

What makes the entrepreneurial ecosystems a regional phenomenon is due to the fact that geographical proximity can enable more easily collective discoveries and knowledge sharing as well as the necessary resources such as venture funding etc, which can be found in the specific region.

According to Autio et al. (2018a) the participants in entrepreneurial ecosystems can investigate and find new business model innovation opportunities that are facilitated by digital technologies and infrastructures in order to create a new learning dynamic which is at a specific cluster-level by developing and scaling-up new ventures. Moreover, according to the authors, due to the fact that digitalization plays an important role on business model innovation opportunities within entrepreneurial ecosystems, these entrepreneurial opportunities are not specific to industry sectors or technology domains, allowing them to be found outside the cluster.

Autio et al. (2018a) support that in the entrepreneurial ecosystems different community members can be found that cannot be found in other types of ecosystems such as *“new venture accelerators, coworking spaces, makerspaces, start-up academies, university entrepreneurship programs, crowdfunding, angel investors, business angels, venture capital, and mentors”*, whereas the co-alignment structure of these ecosystems are mostly cognitive and economic due to the fact that research up until now has focused more on how a particular role can have an impact within the entrepreneurial ecosystem.

Prahalad (2005, p. 65) defines the entrepreneurial ecosystem as *“the market-based ecosystem allows private sector and social actors, often with different traditions and motivations, ad of different sizes and areas of influence, to act together and create wealth in symbiotic relationship. Such an ecosystem consists of wide variety of institutions coexisting and complementing each other.”*

According to Isenberg (2011a) there are six general domains that can be used in order to group the entrepreneurship ecosystem's elements since it consists of hundreds of specific elements. These six general domains are the following:

1. Conducive culture.
2. Enabling policies and leadership.
3. Availability of appropriate finance.
4. Quality human capital.

5. Venture-friendly markets for products.

6. Range of institutional and infrastructural supports.

As Isenberg (2011a) points out there are some characteristics in entrepreneurship ecosystems. First, what needs to be understood is the uniqueness of every entrepreneurship ecosystem. This means that every ecosystem is constituted by hundreds of elements that interact with complicated and distinctive ways. The author presents the example of the Ireland ecosystem which was developed in the 1980s *“in the context of free education, native English, foreign multinationals, and proximity to the European market.”*

Then, it is claimed that the specification of root causes of the entrepreneurship ecosystem does not have much practical value. What has value is the evidence from the results of how many variables are working together towards time. Therefore, it has great value to evaluate each regional entrepreneurship ecosystem to determine casual paths at particular points in time. Also, someone should take into consideration the fact that either one or two even more or less successes that happened in a random way can be occasional in the evolvement of the ecosystem. An example given here is how Skype impacted Estonia's ecosystem. Finally, it is claimed that entrepreneurship ecosystems can become relatively self-sustaining if government involvement could be reduced. The general six domains, mentioned above, are powerful enough, they are jointly strengthened and public leaders can contribute very little in order to maintain them. The programs of entrepreneurship should be created in such a way that they are designed to be self-liquidating to further develop sustainability to the environment.

Fuentelsaz et al. (2018) also claim that an entrepreneurial ecosystem is constituted of many and different elements as well as environmental factors that can affect entrepreneurship. In addition, previous research has revealed that there are similar factors or elements that can have an impact on an entrepreneurial ecosystem.

The authors introduce the institutional theory to study the environmental factors from an institutional perspective and according to the work of Bahrami and Evans (1995), Neck et al. (2004) and Isenberg (2010, 2011b) these can be either formal or informal institutions and six are the types of institutions that can be found in an entrepreneurial ecosystem, the first four types are formal institutions and the last two types are informal institutions, as follows:

1. Institutions linked to venture creation. According to Bahrami and Evans (1995) these institutions can be universities and research institutions, according to Neck et al. (2004) these can be formal networks and according to Isenberg (2010, 2011b) these can be institutions that facilitate policies.

2. Support organizations where according to Bahrami and Evans (1995) these can be support infrastructure, where Neck et al. (2004) suggests physical infrastructure while Isenberg (2010, 2011b) suggests both support infrastructure and institutions.

3. Institutions which focus on the financing of entrepreneurial projects and these according to Bahrami and Evans (1995) are private financing markets, Neck et al. (2004) suggests spin-offs and Isenberg (2010, 2011b) suggests financing.

4. Other infrastructures such as leader users according to Bahrami and Evans (1995), incubators according to Neck et al. (2004) and innovative products according to Isenberg (2010, 2011b).

5. The first informal institution is related to people, their ties and relationships where according to Bahrami and Evans (1995) it can be a talent base, informal networks according to Neck et al. (2004) and human resources according to Isenberg (2010, 2011b).

6. The second informal institution is related to the culture of the ecosystem where according to Bahrami and Evans (1995) it can be the entrepreneurial spirit and the culture according to both Neck et al. (2004) and Isenberg (2010, 2011b).

Other important elements for the entrepreneurial ecosystems can be the quality of these ecosystems as well as the entrepreneurial initiative. Pita et al. (2021) in their study used the data from GEM for the years 2010 and 2016 in order to conduct an analysis with two measures: 1) entrepreneurial ecosystem quality and 2) individual entrepreneurial initiative to create an entrepreneurial ecosystem taxonomy. This taxonomy is basically a framework which can both provide insights from the research field of entrepreneurship as well as it can add contributions within an entrepreneurship policy framework. The results revealed the four following groups:

1. The Die-Hard group refers to countries with lower levels of both entrepreneurial ecosystem quality and individual entrepreneurial initiative. The characteristics found in this group are adverse context conditions, limited entrepreneurial initiative as well as fear of failure which prevents individuals from acting towards entrepreneurship. Therefore, in order to tackle these characteristics, the entrepreneurial culture should be strengthened through necessary actions such as economic incentives and moreover, governments should also take action such as through support programs, etc, as well as education and training should be enhanced.
2. The Go-Getter group refers to countries with higher individual entrepreneurial initiative and a poorer entrepreneurial ecosystem quality. The characteristics found in this group are higher entrepreneurial initiative, the lack of entrepreneurial support conditions as well as the fact that in this group, education seems not to be as important as in the first group. Entrepreneurs in this group evaluate more the location and the entrepreneurship support with conditions such as talent, support industries, or venture capital, in order to act and thrive.
3. The Sugar-Coated group refers to countries with better entrepreneurial ecosystems, however, the empirical results revealed that better entrepreneurial ecosystems' conditions cannot be directly related to entrepreneurial initiative. Individuals in this group have lower desire of becoming entrepreneurs due to jobs market dynamics and the economic perspectives that favor them. One way to increase their desire for entrepreneurship could be the possibility of creating a social business which can have a positive social impact. Governments could use accelerator programs to train individuals on this field.
4. The Front-Runners group refers to countries with superior performance to both entrepreneurial ecosystem quality and entrepreneurial ecosystem initiative. In this group entrepreneurship policies should focus on how to exploit the full potential of these entrepreneurial ecosystems and becoming more sustainable.

Daniel et al. (2018) support that in entrepreneurial ecosystems *“the complementarity of capabilities within a permeable boundary (i.e. place) is sought by actors adopting collective political intentions”*. This boundary, which can be for example a specific place, can help actors decide which capabilities are complementary as well as how resources need to be applied to improve future capabilities while the political intentions of the actors reveal their self-interest and there is continuous dynamic between the collectives and the actors.

The purpose of an entrepreneurial ecosystem is to have a diverse team of actors or a community that interact with each other and support different ventures. This actor interaction can be found in a context of a network or a system and the aim is to accomplish a goal where interventions are also necessary since they can lead the changes to specific and interdependent actors/levels.

Entrepreneurial ecosystems themselves can be seen as an intervention instrument where an actor based on their own distinctive objectives can try to resolve a collective outcome, by setting the boundary of a place and create complementary capabilities across private and public entities which can lead in changing the direction of the ecosystem.

Furthermore, as reported by Mason and Brown (2014), the model of entrepreneurial ecosystems has a dynamic nature. An entrepreneurial ecosystem cannot emerge anywhere but in places that are judged to be attractive areas, which include the presence of one or more technology-rich organizations that act as talent magnets, attracting skilled workers to the area.

The purpose of an ecosystem policy is to accomplish its aim with the improvement of the environment that encloses such firms according to Mason and Brown (2014). They suggest the following general policies:

1. Entrepreneurial ecosystems are based on pre-existing assets, so governments could implement investment policies in order to contribute to the pre-conditions for the emergence of these ecosystems.
2. Entrepreneurial ecosystems are dynamic and complex organisms so policy approaches need to evolve over time.
3. Every entrepreneurial ecosystem is unique so it needs a different approach, customized to local circumstances.
4. Initiatives for entrepreneurial ecosystems cannot be isolated; therefore policy implementation has to be holistic.
5. In order to create entrepreneurial ecosystems both approaches of 'top down' and 'bottom-up' are needed as well as appropriate framework conditions.
6. It is important to recognize the distinction between small business policies and entrepreneurship policies (as cited in Carayannis et al., 2018).

The entrepreneurial dynamics of the entrepreneurial ecosystem can be explained according to Cavallo et al. (2018) as the phases of a startup lifecycle which are the new venture creation, the new venture growth and the new venture stability or exit phase.

Moreover, Gartner (1985) claims that the development of the entrepreneurial dynamics is the result of actors and factors interacting with each other. The governance of the entrepreneurial dynamics is an issue that still needs to be resolved and according to Cavallo et al. (2018) many scholars suggest different actors as follows: *"nothing/nobody; Isenberg's (2010) 'invisible hand'; policymakers; (Stam 2015); universities (Miller and Acs 2017b); large corporations (Bhawe and Zahra 2017), investors (Colombo and Murtinu 2017); and joint ventures (Audretsch and Link 2017)."*

In addition, Auerswald (2015) supports that an entrepreneurial ecosystem can be enabled by applying the following strategies:

1. Favor incumbents less because policies and regulations that favor the existing dominant companies create barriers to the entrance of new firms and restrict competition.
2. Listen to entrepreneurs, policymakers should engage in person with entrepreneurs in order to develop and implement practically focused policies.
3. Map the ecosystem by creating an inventory or graph that indicates who the participants in the ecosystem are and how they are connected.
4. Think big, start small, move fast, this simple rule, which applies to entrepreneurial ventures, also holds true for strategies to enable local entrepreneurial ecosystems.
5. Avoid artificially segmenting one's community or one's strategies by expecting participants in entrepreneurial ecosystems to be playing multiple roles and make sure to make the most of the unique skillsets of one's most versatile community members.
6. Prepare to capitalize on crisis, economic disruption creates entrepreneurial opportunities, so someone needs to be ready in order to exploit them (as cited in Carayannis et al., 2018).

The entrepreneurial ecosystem can be differentiated from the other types of ecosystems according to Scaringella and Radziwon (2017). Since it combines many stakeholders and these according to Autio et al. (2014) are individuals, entrepreneurial groups, companies and organizations that support all these and regardless the differences they may have on what they expect, they all collaborate for economic growth, according to Suresh and Ramraj (2012).

Moreover, Cavallo et al. (2018) provide the following guidelines for understanding deeper the entrepreneurial ecosystem:

1. Study the main entrepreneurial dynamics and their governance.
2. Analyze sub-systems of the wider entrepreneurial ecosystem.
3. Focus on innovative and growth-oriented entrepreneurship.
4. Focus on a specific territory.

Wurth et al. (2021) propose a new entrepreneurial ecosystem research program which is divided into the following research streams: context, structure, microfoundations and complex systems as well as it has the following cross-sectional themes: methodologies and measurements, theory, critical research and transdisciplinary research. This new research program is based on the gaps that were found through the authors' review and it can also stimulate future research on ecosystems. Regarding the research streams, these can be described as follows:

1. Context. Entrepreneurial ecosystems, according to the authors, are open systems which can be influenced by outside conditions, therefore the first research area should be ecosystems as contexts and the context of ecosystems. It should be taken into consideration *“if the (current) entrepreneurial ecosystems concept is capable of explaining entrepreneurial dynamics in a variety of contexts or whether it is limited to a small number of regions in high-income countries?”*
2. Structure. Entrepreneurial ecosystems besides an economic phenomenon can be also seen as a social phenomenon where networks and connectedness play an important role. Although research has been done as regards to network analysis, further research should focus on the cognitive and the relational aspects of these networks.
3. Microfoundations. The processes at the micro level, the microfoundations of ecosystems should be analyzed more in future research since this will allow to understand better how these actors co-evolve in these ecosystems as well as how they can be connected to the resulting forms of entrepreneurship in their community.
4. Complex systems. The nature of the entrepreneurial ecosystems should be explored as complex systems since there are studies that isolate elements of these ecosystems and place more attention on the entrepreneurial output (e.g., Hechavarria and Ingram, 2019). The approaches of complex systems can help in better understanding the nature of these ecosystems.

Regarding the cross-sectional themes, these can be described as follows:

1. Methodologies and measurements. Until now in the research of the entrepreneurial ecosystems, methods that focus more on observation and case studies are mainly used. Future research should focus on experimentation as well as mixed-method approaches and replication studies. Another issue is the measurement and evaluation of the policies for these ecosystems. Future research should focus on combining academic studies and the work that is conducted both by NGOs and private organizations such as the Kauffman Foundation, etc.
2. Theory. The concept of entrepreneurial ecosystems has been studied with different theories such as empirical, theoretical and conceptual and this concept can be also seen as a combination of existing theories. Future research should focus on integrating more these theories into this concept and also other theories such as institutional, evolutionary and social capital theories should be studied to discover how these could be applied to the concept of entrepreneurial ecosystems.
3. Critical research. Future research should include more critical perspectives in order to better understand if and how entrepreneurial ecosystems grow in fact the propensity and the social welfare of regions or if they strengthen the wealth only in a small group of society.

4. Transdisciplinary research. Originally the work on entrepreneurial ecosystems was conducted mainly by practitioners and later academic literature was conducted. According to Wurth et al. (2021) *“there is a shift from research on ecosystems and policy to research for policy and practice.”* Future research should focus on how to integrate both research and practice into the concept of entrepreneurial ecosystems which is *“an organizing concept at the heart of a transdisciplinary.”*

On the other hand, as regards to innovation ecosystems, Adner (2006, p. 1) defines them as follows: *“The collaborative arrangements through which firms combine their individual offerings into a coherent, customer-facing solution. Enabled by information technologies that have drastically reduced the costs of coordination, innovation ecosystems have become a core element in the growth strategies of firms in a wide range of industries.”*

Jackson (2011, p. 2) claims that an innovation ecosystem shapes the economic dynamics and not the energy dynamics of complicated relationships among actors or entities who have as a purpose to facilitate both the creation of technology and innovation. In these circumstances the actors include both the material resources (e.g., funds) and the human capital (e.g., faculty staff). Both the material resources and the human capital constitute the institutional actors that also take part in the ecosystem, an example is business firms.

Carayannis and Campbell (2009) propose and define the 21st century innovation ecosystem as follows: *“A 21st Century Innovation Ecosystem is a multi-level, multi-modal, multi-nodal and multi-agent system of systems. The constituent systems consist of innovation meta-networks (networks of innovation networks and knowledge clusters) and knowledge meta-clusters (clusters of innovation networks and knowledge clusters) as building blocks and organised in a self-referential or chaotic fractal (Gleick, 1987) knowledge and innovation architecture (Carayannis, 2001), which in turn constitute agglomerations of human, social, intellectual and financial capital stocks and flows as well as cultural and technological artifacts and modalities, continually co-evolving, co-specializing, and co-opeting. These innovation networks and knowledge clusters also form, re-form and dissolve within diverse institutional, political, technological and socio-economic domains including Government, University, Industry, Non-governmental Organisations and involving Information and Communication Technologies, Biotechnologies, Advanced Materials, Nanotechnologies and Next Generation Energy Technologies.”*

Oh et al. (2016) report that the term innovation ecosystems has become well-known in fields such as industry, academia and government, however, they note that through their research on academic literature review on this term they found few academic papers since most of the papers do not differentiate innovation ecosystem from an innovation system.

Furthermore, Ritala and Almpantopoulou (2017) report that although innovation ecosystems have been discussed on the fields of policy and business, there have been case studies conducted by academics, as well as conceptualizations and different approaches to gain a better understanding of them, there is a problem regarding the unity of the way that innovation ecosystem are defined, their scope, their boundaries and even their theoretical roots.

Therefore, Granstrand and Holgersson (2020) highlight in their study the need for a new definition of innovative ecosystems and they suggest the following definition: *“an innovation ecosystem is the evolving set of actors, activities, and artifacts, and the institutions and relations, including complementary and substitute relations that are important for the innovative performance of an actor or a population of actors.”*

The authors in their study as regards to the existing definitions of the innovation ecosystem they concluded that there is more attention on collaboration/complements and actors and less on competition/substitutes and artifacts whereas the authors also mention that there is no definition that involves replacement among artifacts. The authors suggest that an innovation ecosystem should consist of an actor system with both cooperative and competitive relations

with or without a focal business and an artifact system with both cooperative and competitive relations.

It is interesting to see the specific features that recent publications report as regards to the ecosystem and what does the innovation ecosystem include and differentiate it from concepts such as regional innovation systems, innovation clusters etc. According to Oh et al. (2016) the innovation ecosystem is now more systemic. Rogers (1962) stressed that innovation can be distributed through a social system. Moreover, the innovation ecosystem literature takes more into consideration the way through which innovation actors are connected. *“Enumerating the interactions among the ecosystem's component organizations (as Fetters et al. (2010, p.181)) have done, in the case of university entrepreneurial ecosystems) highlights the richness and diversity of actors that can, in principle, give rise to emergent behaviour.”*

Then, digitalization plays an important role to the innovation ecosystem as well, since the information and communication technologies (ICT) can be found in new products and services and through these the connections of innovation actors can be seen more evidently. Furthermore, through open innovation which includes borrowing, licensing, open-sourcing and alliances, ideas from different sources can be integrated and result into new products and services. The term innovation ecosystem is appealing more and it is used more by the news media and this shows that this term has more value at the field of public relations rather than in research (as cited in Oh et al., 2016).

Also, Jackson (2011) reports the features of the innovation ecosystem as follows, first a significant feature is that the resources of the knowledge economy are linked to those developed from the commercial economy which have been created as parts of the commercial's economy profits. Then, another feature is that the innovation ecosystem is created with a strategic perspective around a particular technology. When the resources from the knowledge economy are replaced by the innovations created from the advanced profits in the commercial economy, then the innovation ecosystem can be considered successful and healthy. At this specific point these economies are found in balanced equilibrium and there is no other choice for the innovation ecosystem rather to be healthy.

According to Oh et al. (2016) there is more attention on the separated roles or “niches” that are engaged on the organizations and industries. These can be found in Frenken et al. (1999) and Raven (2005) and show the links that exist in the value chains of an industry. This attention is opposed to *“the more amorphous “It takes a village to raise an entrepreneur” and “Everybody in the community pull together” approaches taken by past technopolis initiatives.”* It should also be mentioned that there is currently more attention on market forces which are related to the government or non-governmental organizations-push.

Moreover, the authors distinguish the different types of innovation ecosystems as follows:

1. Corporate (open innovation) innovation ecosystems.
2. Regional and national innovation ecosystems.
3. Digital innovation ecosystems.
4. City-based innovation ecosystems and innovation districts.
5. High-tech SMEs centered ecosystems.
6. Hyper-local ecosystems.
7. University-based ecosystems (as cited in Oh et al., 2016).

In addition, Thomas and Autio (2020) suggest that there are three types of innovation ecosystems:

1. Business ecosystems, which emphasize the broader community within a focal firm operates.

2. Modular ecosystems, which emphasize the collective co-production of an ecosystem value offering directed at a defined audience.

3. Platform ecosystems which emphasize the coordination of technological interdependencies, generally through platforms.

Yaghmaie and Vanhaverbeke (2019) conducted a systematic literature review on innovation ecosystems in order to compare the different approaches that exist in the literature. The authors analyzed 30 publications from 2004 to 2018 and classified them according to eight categories.

As regards to the industry classification of the studies the results revealed that innovation ecosystems have been discussed in primary industries, manufacturing, services, as well as high-tech industries. Regarding, the level of analysis, 24 studies concern the ecosystem level, while 7 studies refer to the ecosystem and firm level and only one study adopts a multi-level approach.

As regards to the contents of these studies, the results showed that most of the studies have focused on management strategies that describe how to manage an innovation ecosystem, as well as on orchestration strategies that describe how processes are applied by orchestrators within the ecosystem. Moreover, the frameworks which are developed in these publications also focused on managing and orchestrating ecosystems.

These publications also demonstrated that mostly the types of actors within the innovation ecosystems were studied from the perspective of the industrial firm, whereas they focused on large firms rather than SMEs and only 4 studies included all actors.

Furthermore, the role of the orchestrator was discussed at the majority of the papers (i.e., 24 papers), justifying the importance of its role. As regards to the success of innovation ecosystems it was discussed at 19 papers. In addition, 18 discussed different aspects of the innovation ecosystems and only 2 papers discussed the factors that can lead these ecosystems to fail.

The UK Department for Business Innovation and Skills (2011) reports that there are principles that show both the role and the value of interactions and relationships which can be found within an innovation ecosystem (see Fig. 2.6).

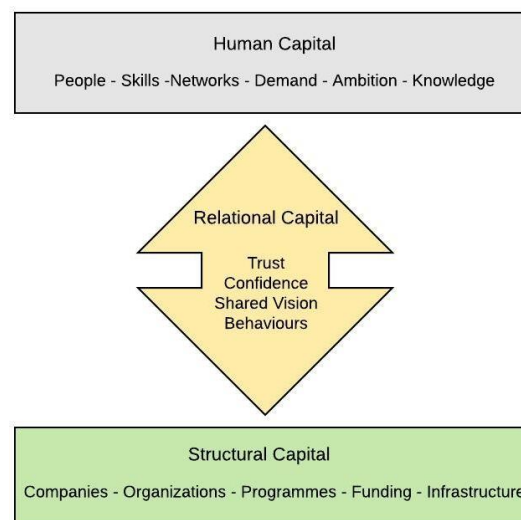


Figure 2.6. The principles of an innovation ecosystem. Source: UK Department for Business Innovation and Skills (2011).

First, there is the human capital that includes people, skills, networks, demand, ambition and knowledge. Then, there is the relational capital that includes trust, confidence, shared visions,

behaviours and last but not least, there is the structural capital that includes companies, organisations, programmes, funding and infrastructure. All these elements interact, are connected to each other and contribute to the innovation ecosystem.

Markman (2012) supports that an innovation ecosystem can be created, at a company or an organization level, since innovation can be also applied in this level besides the individual level. First, the right team needs to be hired that can cover essential positions at a company, such as technical experts, leaders that have been involved with innovations, people that can fund different projects and external consultants. Then, there should be a development of the innovators' network, as well as with the lead innovators with other employees at a company through meetings, events and talks to share their experiences on innovative projects and to give advice on how to tackle potential problems. Finally, an important element is education, through which all employees including leaders can perhaps follow a series of lessons in order to be able to better develop their ideas into innovative projects.

Wright (2014) reports that research as regards to the innovation ecosystems has begun to be more evident only recently. The actors that exist and are co-dependent in the innovation ecosystem are the following: "*firms, non-governmental organizations (NGOs), governmental organizations, and other types of resource providers (like funders)*" (Adner, 2006; Carayannis and Campbell, 2009; Li and Garnsey, 2014; Wright, 2014). All these actors seem to have different roles on the process of creating value (Adner and Kapoor, 2010; Eisenhardt and Galunic, 2000; Moore, 1993; van der Borgh et al., 2012; West and Bogers, 2014) (as cited in Scaringella and Radziwon, 2017).

Moreover, Jackson (2011) claims that the actors found in an innovation ecosystem are the following: academia, small businesses, the investor community, as well as the commercial industry. All these actors interact in complex ways and are responsible for completing the processes from the discovery to commercialization that lead them to technology development and innovation.

In addition, Dedehayir et al. (2018) conducted a systematic literature review with 60 articles in order to address the roles that exist in the innovation ecosystem genesis. The authors found several roles that were grouped thematically in four groups according to their activities:

1. Leadership roles where here two roles can be distinguished, ecosystem leader and dominator. The ecosystem leader is responsible for the overall governance of the ecosystem by initiating, maintaining and developing the ecosystem's functionality, for the development of partnerships by creating a network through different actions, for platform management by providing technical basis for the market to function as well as for value management where value is created and captured through different actions. As regards to the dominator, this role provides a different style of ecosystem governance by conducting merges and acquisitions in related fields.
2. Direct value creation roles where here four roles can be distinguished, supplier, assembler, complementor and user. The supplier delivers important items by supplying for example materials, etc that can be used in the ecosystem whereas the assembler provides products and services, following that, the complementor provides complementarities and the user is the one who contributes to the value creation.
3. Value creation support roles where here two roles can be distinguished, expert and champion. The expert supports the primary value creation through for example consultation, expertise, encourages technology transfer etc, and the champion supports the ecosystem construction by building connections between actors, providing access to markets etc.
4. Entrepreneurial ecosystem roles where here three roles can be distinguished, entrepreneur, sponsor and regulator. The entrepreneur starts new venture around a vision, the sponsor supports new venture creation and the regulator provides the appropriate conditions for the support of the entrepreneurial activity and the ecosystem's emergence.

Rabelo and Bernus (2015) attempted to systematize the phases and the stages of innovation ecosystem building holistically. According to the authors the building of an innovation ecosystem is not an easy task since this ecosystem is constituted of numerous and different elements that need to create the favorable conditions for innovation to be cultivated, developed and preserved. The authors propose that six are the essential phases for the innovation ecosystem building.

First, there is the Analysis Phase where the decision is taken to create an innovation ecosystem at a specific region often by universities or government. This phase includes the definition of strategic policies and principles where all stakeholders discuss the key parameters for the creation of the ecosystem as well as the ecosystem strategic analyses where the implementation of the ecosystem, the steps and the timing take place. The first phase essentially produces the decision of whether or not to establish the ecosystem at the specific region as well as the deployment model and the requirements of regulations, actors and infrastructures.

Then, there is the Project Phase where the design and the preparations of all favorable conditions for building the ecosystem takes places and this phase is also taking into consideration the outputs of the first phase as described above. This phase includes the ecosystem design where all elements of the ecosystem such as actors, infrastructures etc, are discussed as well as which actions should be taken to prepare the ecosystem to meet specific requirements and further evolve. The second phase essentially produces the low level expectations and prepares the ecosystem's environment.

Following that, there is the Deployment Phase where the designed ecosystem is established, specifications are turning into infrastructures and actors make their appearance. The attraction and the recruitment of qualified actors can take place through marketing actions or through formal and informal recruiting methods, the physical building construction that can enable and support the necessary actions for the innovation life cycle as well as the establishment of the ecosystem foundation. The third phase essentially produces the attraction and recruitment of actors, builds the necessary infrastructure and sets up the ecosystem.

In the Execution Phase the management and the operation of the entire ecosystem take place. The fourth phase essentially produces management initiatives, reports, performance indicators and a friendly working environment where all actors can participate.

In the Conclusion Phase the issues related to the continuation of the ecosystem are discussed and more specifically the ecosystem's metamorphosis and decommission take place. The fifth phase essentially produces the suggestions of requirements for the "*new version*" of the ecosystem as well as the factors that can have impacted the ecosystem in a negative way such as actors are no longer committed etc, and for this reason the whole or part of the ecosystem are decided to be deactivated.

Finally, in the Sustenance Phase the evolution and the sustainability of the ecosystem are being handled and feedback is provided to all stakeholders and managers.

Furthermore, Meng and Ma (2018) used the methods of main path and content analysis in order to analyze the research on innovation ecosystem and classified the development of an innovation ecosystem framework using six aspects (see Fig. 2.7).

As regards to the perspective of innovation, first the evolutionary economics perspective was widely used to describe the innovation ecosystem in terms of the evolution and development of technology and organization. Furthermore, early research also focused on the innovation system and strategic management perspective whereas after 2015 scholars focused on the ecological perspective of innovation where the interaction of technology, knowledge process and economic society were studied.

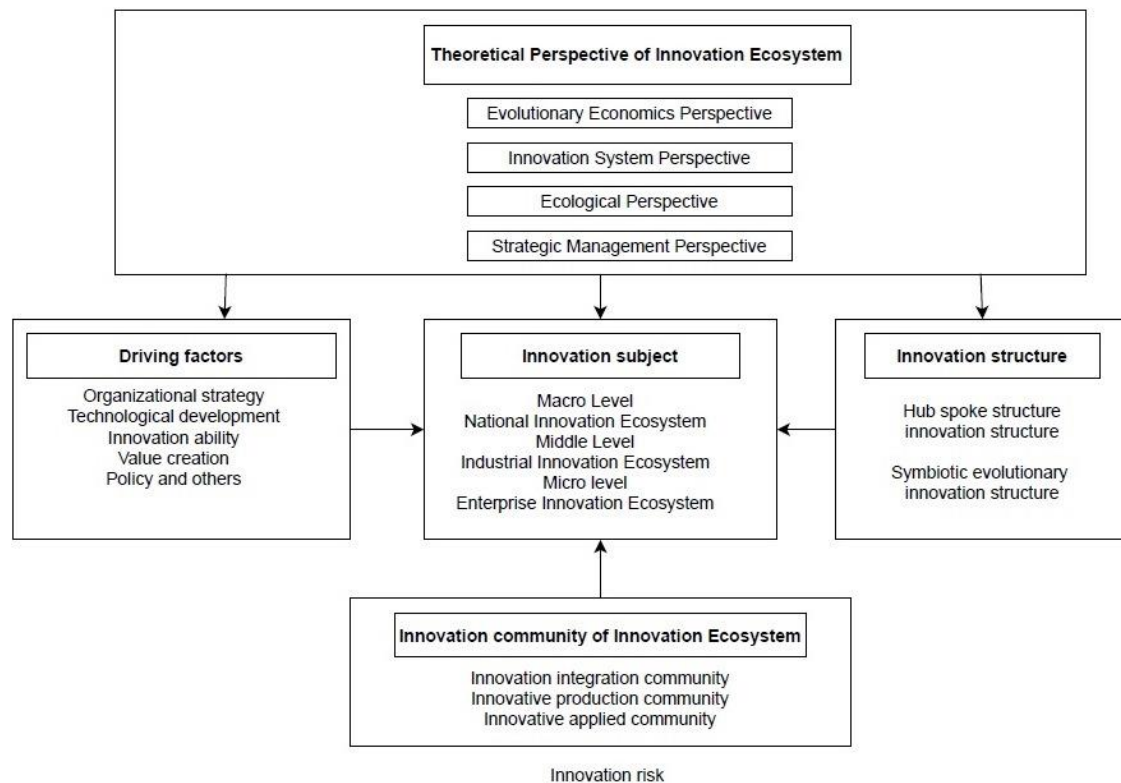


Figure 2.7. Theoretical framework of innovation ecosystem. Source: Meng and Ma (2018).

Moreover, as regards to the driving factors, the original focus was on organizational strategy and over time the focus changed to technology development, innovation ability, policy and recently to value creation.

In terms of the main subject of innovation, it is divided into the following levels: 1) macro level where there is the national innovation ecosystem, 2) the middle level where there is the industrial innovation ecosystem and 3) the micro level where there is the enterprise innovation ecosystem.

Moving forward, in terms of the innovation structure of the ecosystem, it has evolved from the hub spoke development to the symbiotic evolutionary structure.

As regards to the innovation community, it focused on the innovation integration community which includes the industry chain, intermediary etc. Recently, scholars have also focused on the innovative integration community which includes R&D enterprises, scientific research institutions, etc, as well as on the innovative applied community which includes the innovation environment, policy etc.

Finally, an important factor is the innovation risk where several studies have shown that it can be as one of the factors that can lead the development of the innovation ecosystem to failure. There is research on this factor, however, in the following years this factor should be studied more but not independently. The authors also highlight that innovative ecosystems is an emerging field that is developed rapidly and will expand in the future.

Klimas and Czakon (2021) found that no previous literature review has focused on the development of an innovation ecosystem typology whereas there is not a set of specific differentiation criteria. Therefore, the authors developed an innovation ecosystem typology (see Table 2.9) through a thematic analysis of literature review for 34 different types of innovation ecosystems.

The authors expanded these types of innovation ecosystems of previous studies by adding new ones, identified and analyzed thematically the 14 criteria used in the literature until now

to provide useful insights as well as they proposed a categorization of innovation ecosystems into 5 categories which are: 1) life cycle that focuses on how the ecosystem is created and in what phase it can be found, 2) structure that focuses on the structural perspective of ecosystems, 3) innovation focus within the innovation ecosystem, 4) scope and 5) performance.

Table 2.9. Typology of innovation ecosystems. Source: Klimas and Czakon (2021).

Criteria Category	Typology criteria	Types of Innovation Ecosystem
Life cycle: genesis and existence of innovation ecosystem	Ecosystem birth	International (deliberate, planned) Emergent (implicit)
	Governance mechanism	Orchestration (hierarchy) Collectively coordinated (hierarchy) Self-coordination
	Life cycle stage	Emerging Ecosystems Developmental Mature Declining Death
Structure of innovation ecosystem	Actors	Symmetrical Actors Asymmetrical Actors Centralized Decentralized
	Innovation co-creation relationships	Ego-centric Eco-centric
Innovation focus within the innovation ecosystem	Innovation scope	Microscopic Middlescopic Macroscopic
	Innovation type	Focused on disruptive innovation Focused on radical innovation Focused on incremental innovation Focused on social innovation Focused on path-breaking innovations
	Intensity of co-innovation process	Narrowed to co-Discovery Narrowed to co-Development Narrowed to co-Deployment Narrowed to co-Delivery Narrowed to co-Dissemination Adopting a multi-stage co-innovation focus

Scope of innovation ecosystem	Technological scope	High-tech Medium-tech Low-tech Mono-platform Multi-platform
	Spatial range	City-based/innovation districts Local Regional National International Global
	Physical scope	Digital (clicks only) Bricks & clicks
Performance of the innovation ecosystem	Innovation performance	Successful (strong) Unsuccessful (weak) Promising
	Economic performance	Profitable Unprofitable
	Strategic performance	Sustainable Unsustainable

By having analyzed both innovation and entrepreneurship ecosystems, it is interesting to present the similarities and the differences between these ecosystems. These can all be found in Table 2.10.

Table 2.10. Similarities and differences of innovation and entrepreneurship ecosystems.

Similarities of Innovation and Entrepreneurship Ecosystems	Differences of Innovation and Entrepreneurship Ecosystems
The innovation and the entrepreneurship ecosystem are constituted of different actors that interact in complex ways and will lead them to innovation in the one case and to entrepreneurship in the other case.	The innovation ecosystem focuses more on technology development and innovation whereas the entrepreneurship ecosystem focuses more on entrepreneurship.
The innovation and the entrepreneurship ecosystem can be enabled by the use of new technologies such as ICT technologies and Web 2.0.	The innovation ecosystem includes the knowledge and the commercial economy whereas the entrepreneurship ecosystem can help in exploring the economies of scale.
The innovation and the entrepreneurship ecosystem can affect the social and the economic environment.	The innovation ecosystem can refer to regions, platforms or industries whereas the entrepreneurship ecosystem can refer to a network or an organization that is constituted by many entities.

Both in the innovation and in the entrepreneurship ecosystem the elements of knowledge and learning exist as well as these ecosystems foster the 3C's processes (co-evolution, co-operation and co-specialization).	The innovation ecosystem needs the resources from the knowledge economy to be connected with the resources from the commercial economy whereas the entrepreneurship ecosystem seeks to attract new ventures whereas one necessary characteristic is the entrepreneurial drive.
---	--

The innovation and the entrepreneurship ecosystem have as common elements knowledge and learning, since both ecosystems can foster and be enabled by the 3C's processes which are the following: co-opetition, co-evolution and co-specialization.

In this context, Carayannis (2014a) defines knowledge and learning as follows: *“Knowledge is the content of learning and a firm gains competitive superiority either by knowing something that its competitors do not know or by having a certain type of knowledge that cannot easily be replicated. Learning is the process of gaining new knowledge, so that the firm is constantly accumulating and assimilating knowledge and this becomes the basis for creating and improving organizational routines.”*

According to Stam and Spigel (2016) knowledge can vary between ecosystems and can play a significant role. However, there are two traditional models of knowledge, technical knowledge which concerns the creation of new products or innovations and market knowledge which determines the succession of new products in the marketplace (Cooke, 2001). One should not forget the emergence of a new knowledge which focus on the entrepreneurial processes themselves.

On the one hand, knowledge is essential to innovation ecosystems and more specifically Valkokari (2015) suggests that the exploration of new knowledge can support the development of innovation ecosystems. On the other hand, knowledge is essential also to entrepreneurship ecosystems and more specifically Stam and Spigel (2016) claim that not only market and technical knowledge is necessary but also entrepreneurial knowledge which can focus on the entrepreneurial processes in order to be shared between different actors such as entrepreneurs, mentors through networks, organizations and courses.

Then, Carayannis et al. (2015a) note that *“organizations are open systems operating under conditions of substantial turbulence, risk (known unknowns) and uncertainty (unknown unknowns) and seeking to balance stability and coherence with flexibility and change in pursuit of higher levels of efficacy and organizational sustainability.”*

Moreover, Carayannis et al. (2015b) support that the concept of Strategic Knowledge Arbitrage and Serendipity (SKARSE) are real option drivers triggered from the 3C's processes. According to Carayannis (2001) *““Mode 3” model is the knowledge production system architecture that engages actively higher order learning (learning, learning to learn, learning to learn how to learn), in a multi-lateral, multi-nodal, multi-modal, and multi-layered manner involving thus entities from government, academia, industry, and civil society, as well as driving co-opetition (competition- cooperation), co-specialization, and co-evolution resource generation, allocation, and appropriation processes (3C's) that result in the formation of modalities such as innovation networks and knowledge clusters.”*

It is interesting to present the definitions of these terms in order to gain a better understanding. On the one hand, according to Carayannis (2014a) Strategic Knowledge Serendipity can be defined as follows: *“This term refers to the unintended benefits of enabling knowledge to “spill over” between employees, groups and functional domains (“happy accidents” in learning). More specifically, it describes the capacity to identify, recognize, access, and integrate knowledge assets more effectively and efficiently to derive, develop and capture non-appropriable, defensible, sustainable, and scalable pecuniary benefits.”*

On the other hand, Strategic Knowledge Arbitrage can be defined, according again to Carayannis (2014a) as follows: *“This refers to the ability to distribute and use specific knowledge for applications other than the intended topic area. More specifically, it refers to the capacity to create, identify, reallocate, and recombine knowledge assets more effectively and efficiently to derive, develop, and capture non-appropriable, defensible, sustainable, and scalable pecuniary benefits.”*

Carayannis et al. (2015b) report that companies take into consideration the *“new knowledge derived through the healthy balance between competition and cooperation involving employees and business partners”* when they define their real options which can help them not only in the process of decision making but also in order to obtain their benefits of flexibility which is incorporated in their investments. When firms act on their options, they change the parameters of their stable ecosystem which is only temporary and now an unstable environment has been created. Then, when the co-opetition process is completed the firms develop *“new knowledge through a series of interactions and changes at various levels of the organization, spurred by the co-generation and complementary nature of that knowledge”*, which according to Carayannis and Campbell (2009) is called *“strategic knowledge co-evolution.”* Finally, firms through innovation *“undergo strategic knowledge cospecialisation, “learning and knowledge which encourages individuals or groups to expand their roles into new areas and new domains, in a complementary and mutually-reinforcing fashion.”*

In addition, Thomas and Autio (2020) support that two aspects of the ecosystems’ dynamics is competition and co-evolution. As regards to competition, the authors mention that in general little is known about how ecosystems compete. Also, they mention that although the properties of entrepreneurial and knowledge ecosystems are methodologically measured, inadequate literature exists for how these ecosystems compete. When the ecosystems are limited geographically the competition is more likely to happen on the supply side rather the demand side, in this way the entrepreneurial ecosystems compete for venture capital, angel investors, mentors and entrepreneurs. When the ecosystems are not limited geographically the competition happens in the ecosystems’ outputs that are *“subject to competing value offerings”* given the fact that there is a market context.

As regards to co-evolution, the authors mention that as in the field of biology where ecosystems are not static, the same also applies in the field of management, *“ecosystems ‘co-evolve’ (Basole, 2009; Moore, 1993) through a process where environmental changes and changes in the ecosystem participants mutually influence each other, prompting mutual adjustments (Lewin & Volberda, 1999; Merry, 1999; Van De Ven & Garud, 1994).”*

The authors explain that Moore (1993) was one of the first scholars in the innovation ecosystem literature who stated that *“ecosystems co-evolve capabilities around a new innovation”* which means that participants in the ecosystem should adapt their investment and choices in the course of time to preserve their interdependence with other participants, technologies and institutions.

Knowledge and learning are two necessary assets for both innovation and entrepreneurial ecosystems. These two elements can lead any company or any organization to a better sustainable competitive advantage. Coupling with the SKRASE concept, companies can be better equipped in performing their 3C’s processes. All these elements are useful to companies in order to continue to exist in the present environment which is characterized by many changes and can be affected by various factors such as for example the economic crisis.

All these changes and factors have affected globally the way that firms operate, regardless their sector, both in their external, as well as their internal environment, the way they choose their partners, how they compete, how they co-evolve and how they coexist. Additionally, the evolution of technology, as well as the shift to innovation has changed the business environment since firms try to find and combine all the necessary resources in a better way to continue to coexist, compete and co-evolve.

In the innovation ecosystem the goal is to achieve innovation and technology development through the complex interaction of various and different actors and through the proper combination of the resources from the knowledge economy as well as from the commercial economy. In the entrepreneurship ecosystem the goal is to achieve entrepreneurship through the complex interaction of various and different actors that have the entrepreneurial drive and will lead them to the attraction of new ventures. Consequently, knowledge and learning are two valuable assets that can help in the co-opetition, co-evolution and co-specialization that take place both within the innovation and the entrepreneurship ecosystem.

2.6 Entrepreneurial ecosystems and the QIH model

What is interesting and should be mentioned is that the concept of ecosystems can be found in the Triple Innovation Helix Model, as well as the Quadruple Innovation Helix Model. A brief definition of these models will be given here.

First, regarding the Triple Innovation Helix Model, Carayannis and Campbell (2009) report that: *“The ‘triple helix’ model of knowledge, developed by Henry Etzkowitz and Loet Leydesdorff (2000) (pp. 111–112), stresses three ‘helices’ that intertwine and, by this, generate a national innovation system: academia/universities, industry, and state government. Etzkowitz and Leydesdorff are inclined to speaking of ‘university industry–government relations’ and networks, also placing a particular emphasis on ‘tri-lateral networks and hybrid organizations’ where those helices overlap.”*

It is important to take into consideration that the Triple Innovation Helix model can support entrepreneurial activities. In fact, in the study of Chinta and Sussan (2018) the Triple Innovation Helix model is explored and the authors support that the current trends have led to the change of triple helix relationships where each partner has now different roles and can contribute to both the supply and the demand side of entrepreneurial activities (see Table 2.11).

From the supply side, universities can support R&D of a new product where both businesses and government can provide funding. From the demand side, universities, businesses, as well as government can serve as a customer base.

Table 2.11. Productive triadic entrepreneurial activities in the digital economy. Source: Chinta and Sussan (2018).

Triple Helix Innovation Model	Supply	Demand
University	R&D (e.g., Google was started by PhD students at Stanford)	Customer base (Facebook at Harvard, Ofo at Peking University)
Business	Funding (Alibaba, Baidu, Tencent are successful digital businesses that are funding many Unicorns in China)	Customer (Alibaba is also customer of many Unicorns it funds)
Government	Funding (e.g., NSA CIA funded Google; CIA funds Palantir, Fuel3d; Singapore government funds Xiaomi in China; Chinese government funds Alibaba affiliate Alibaba Ant Financial)	U.S. intelligence agencies as customer of entrepreneurs they fund (Palantir, Fuel3d) Chinese government as customer of entrepreneurs they found (Alibaba Ant Financial build national credit rating system for government)

Furthermore, Carayannis and Campbell (2009) define the Quadruple Innovation Helix model as follows: “*Quadruple Helix, in this context, means to add to the above stated helices a ‘fourth helix’ that they identify as the “media-based and culture-based public”. This fourth helix associates with ‘media’, ‘creative industries’, ‘culture’, ‘values’, ‘life styles’, ‘art’, and perhaps also the notion of the ‘creative class’ (a term, coined by Florida, 2004). This should emphasize that a broader understanding of knowledge production and innovation application requires that also the public becomes more integrated into advanced innovation systems.*”

What can be observed is that the three helices that exist both on the Triple Innovation Helix model and on the Quadruple Innovation Helix model can be matched with the ecosystems that have been defined here (see Fig. 2.8). The academia helix can be matched with the knowledge ecosystem, the industry helix can be matched with the business ecosystem and the government can be matched with the public sector ecosystem, as well as the civil society can be matched with the private sector ecosystem.

The matched helices with the ecosystems can be analyzed as follows:

1. The academia helix can be matched with the knowledge ecosystem through which universities can generate new knowledge with education, training and research, also this knowledge can be transferred and further lead to an economic impact.
2. The industry helix can be matched with the business ecosystem through which the appropriate resources can be combined in order to capture and create value for the customers.

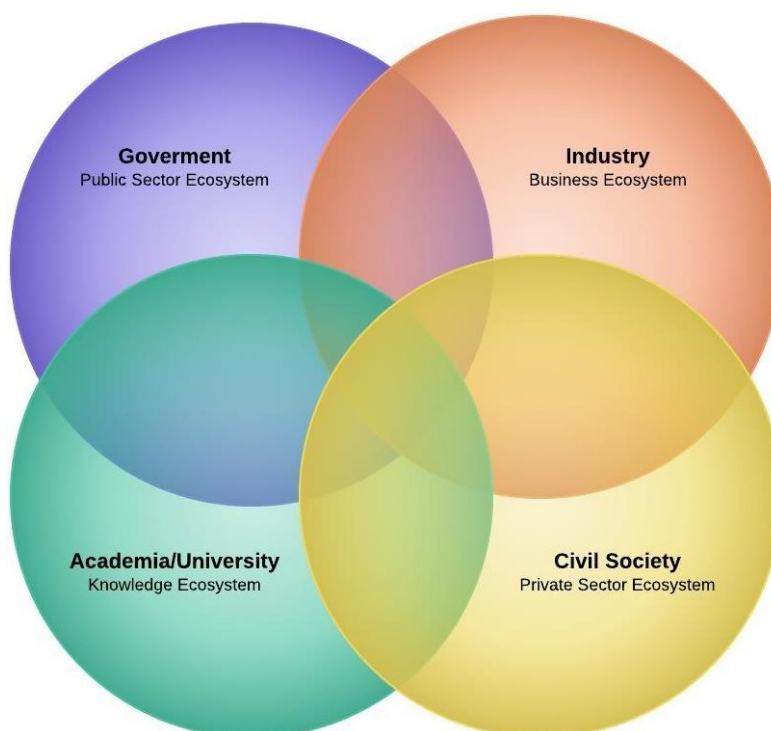


Figure 2.8. The helices of the QIH model matched with the ecosystems.

3. The government can be matched with the public sector ecosystem through which government can facilitate innovation through support structures, funding, by providing business advice, by formulating appropriate policies for innovation and by creating and supporting incubators for innovation.
4. The civil society can be matched with the private sector ecosystem through which different entities of civil society are connected and collaborative. Civil society refers to “*media-based and culture-based public*”, according to Carayannis and Campbell (2012), and all entities collaborate and participate to new ways of thinking by trying to find solutions to various

problems that affect the society. Also, civil society is influenced by culture and values, there are the non-profits organizations and citizens initiatives that can face social challenges as well as there are the platforms through which technology enable the exchange of ideas and open data.

The entrepreneurial ecosystem can emerge when the actors of the national and the individual level interact successfully and this according to Nambisan and Baron (2013) is an *“intersection of national culture and political and legal systems and entrepreneurial cognition.”* In addition, Suresh and Ramraj (2012) support that the actors’ personality and behaviour are two necessary elements that can enhance this interaction. This unique combination overcomes the relationship that exist on the Triple Innovation Helix model of Etzkowitz and Leydesdorff (2000) and goes towards to the Quadruple Innovation Helix model of Carayannis and Campbell (2012), where there the civil society helix is added to the existing helices, university, industry and government (as cited in Scaringella and Radziwon, 2017).

Furthermore, Carayannis et al. (2017) explored and analyzed how the Quadruple and the Quintuple Innovation Helix models could serve as enablers for the regional co-opetitive entrepreneurial ecosystems.

More specifically, the authors analyze how the Quadruple Innovation Helix model can allow the creation of regional policies for example the Research and Innovation Strategy for Smart Specialization (RIS3). It should be noted that recently the European Commission included in its ‘RIS3 Guide’ the QIH model since according to the authors it *“can serve as an architectural innovation blueprint that engages simultaneously four sectoral perspectives. The inter-sectoral and intra-sectoral, as well as the inter-regional and intra-regional knowledge and learning interfaces that are embedded in the Quadruple Helix architectural blueprint determine its efficacy and sustainability.”*

Carayannis and Rakhmatullin (2014b) support that the combination of these perspectives can help to conceptualize, contextualize, design, implement and evolve the growth-driven entrepreneurship and innovation systems at the regional level.

The authors also mention some examples of how Nordic countries have used this model. These examples include the Startup Sauna of the Aalto University which is a business accelerator and provide a variety of services related to entrepreneurship. Moreover, the Linas Matkasse of Niklas Aronsson follows the IKEA’s do it yourself model where families receive all the ingredients so they can cook for themselves. Also, the Asunto Oy Helsingin Loppukiri is a Finnish company where they renovate houses for retired people who are actively involved in designing common areas and eat together once a week. Last but not least, the Rovio Entertainment has created the game Angry Birds and the company’s purpose is to expand this game as much as possible for example it created licensed agreements for other companies to create products, toys, etc.

Carayannis et al. (2017) also describe how the co-creation of regional business models can be achieved within a Quadruple Innovation Helix model. The Living Lab approach involves all four actors of the QIH model industry, academia, government and civil society who participate actively. Relative examples include the Laurea R&D oriented University in Helsinki, the Alcotra Innovation Strategic Project and the Artic Smart City Living Lab.

Besides the Living Lab approach, there is also the Open Innovation 2.0 paradigm which according to the European Commission (2015) is based on the QIH model and has led to the creation of new business models, such as social innovation for example the enterprises Malo and the Ashoka initiative, open business models, as well as crowdfunding.

Moreover, the study of Carayannis et al. (2018) show that a new type of university the Mode 3 University can perform within a Quadruple Helix Innovation System. Carayannis and Campbell (2006) define the Mode 3 systems approach as follows: *“‘Mode 3’ is a multi-lateral, multi-nodal, multi-modal, and multi-level systems approach to the conceptualization,*

design, and management of real and virtual, 'knowledge-stock' and 'knowledge-flow', modalities that catalyze, accelerate, and support the creation, diffusion, sharing, absorption, and use of co-specialised knowledge assets. 'Mode 3' is based on a system-theoretic perspective of socio-economic, political, technological, and cultural trends and conditions that shape the co-evolution of knowledge with the "knowledge-based and knowledge-driven, gloCal economy and society."

The authors claim that the Quadruple and Quintuple Helix Innovation Systems *"are clearly designed to refer to an extended, profound and functional complexity in knowledge production, transfer, absorption and application (innovation), thus, the functional architecture of these models is fundamentally altered and advanced."*

Carayannis et al. (2017) also claim that *"the 'Mode 3' and the Quadruple / Quintuple Innovation Helix Innovation System Framework could serve as the foundation for diverse smart specialization strategies as they place a stronger focus on cooperation in innovation, and in particular, the dynamically intertwined processes of co-opetition, co-evolution and co-specialization."*

Furthermore, the study of Carayannis et al. (2019) propose a new framework for social innovation that is based on the Quadruple Innovation Helix model. More specifically, the authors propose that at the heart of the Quadruple/Quintuple Innovation Helix model is social entrepreneurship and the four helices as follows:

1. Government which provides support structures, funding, business advice, incubators for social innovation.
2. Academia which provides education and training, research and knowledge development and transfer.
3. Industry which can promote the development of product and services addressed to social needs, create partnerships as well as networks and clusters.
4. Civil Society which is intertwined by the above three helices and is effected by social norms, culture and value and can enable social innovation through collaboration and participation of all citizens as well as non-government organizations to start initiatives as regards to social innovation.

On the above four helices of the Quadruple Innovation Helix model, the authors have added a fifth helix creating a Quintuple Innovation Helix model which is the Environment and according to Carayannis and Campbell (2010) this fifth helix *"stresses the socioecological perspective of the natural environments of society, focusing on the interaction, co-development and co-evolution of society, and nature."*

In this proposed Quadruple/Quintuple Innovation Helix model all the helices, as well as social entrepreneurs interact in various ways whereas two are the most important elements innovation and knowledge. This interaction according to Carayannis (2001) *"is a dynamically intertwined process of co-opetition, co-evolution, and co-specialization, resulting not only to economic, but also to sustainable growth."*

Another study that explores the relationship of the QIH model of entrepreneurship with the stages of economic development is the study of Galvão et al. (2017). The authors studied the relationship of the four dimensions of the QIH model with the three types of economy defined by GEM (i.e., innovation-driven economies, efficiency-driven economies and factor-driven economies). The authors used data from GEM for the year 2015 and for 58 countries in order to explore the aforementioned linkages.

The results revealed that for the dimension Government the variables *"Government Support and Policies"* and *"Tax and Bureaucracy"* were found to have greater influence on innovation-driven and factor-driven economies, rather than efficiency-driven economies, whereas the variable *"Government Programs"* was found to have greater influence only on

the innovation-driven economies. As regards to the dimension Government and the variables used for this model, the hypothesis that *“Efficiency-driven economies have a more significant influence of government in stimulating entrepreneurship and innovation, with a view to economic development”* could not be confirmed.

Moreover, for the dimension University the variable *“Post-school Entrepreneurial Education and Training”* was found to be similar in all types of economies (i.e., innovation-driven, efficiency-driven and factor-driven economies). The variable *“R&D Transfer”* was found to have greater influence on innovation-driven economies, whereas the variable *“Entrepreneurial Intention”* has less influence on innovation-driven economies and more influence on factor-driven economies.

For the dimension Industry the variable *“Know Startup Entrepreneur Rate”* has greater influence on the factor-driven economies, whereas the variables *“Internal Market Openness”* and *“Financing for Entrepreneurs”* have greater influence on the innovation-driven economies.

Last but not least, for the dimension Civil Society the variables *“Informal Investors Rate”*, *“Cultural and Social Norms”*, *“Media Attention for Entrepreneurship”* and *“High Status Successful Entrepreneurship”* seem to have greater influence on the factor-driven economies.

Chapter 3. Assessing Entrepreneurial Ecosystems

3.1 Assessment frameworks at macro level

According to the European Commission (2018a), the European Innovation Scoreboard (EIS) can be used not only for the assessment of innovation performance of EU and non EU countries but also it allows comparisons and reveals the strengths and the weaknesses of their innovation systems. In this way countries can take specific actions to improve their innovation performance.

Carayannis and Bakouros (2010) report that there was a great need for measuring innovation and that innovation indexes constitute a metric for measuring innovation. The European Innovation Scoreboard has been developed in 2000 and it is available in a yearly basis in the last 20 years, with several, however, revisions and modifications. This report shows at which level each European country is as regards to innovation.

The EIS covers in total 36 countries from which 28 are EU countries and non-European countries, Iceland, Israel, Former Yugoslav Republic of Macedonia, Norway, Serbia, Switzerland, Turkey and Ukraine. The measurement framework of the European Innovation Scoreboard is constituted by different domains which include different indicators that can change each year (see Table 3.1). More specifically the European Innovation Scoreboard of 2019 is constituted of 27 indicators. Four are the main domains as follows:

1. The domain Framework Conditions shows the innovation drivers outside the firm and can have an impact on the innovation performance. It includes the following indicators: Human Recourses, Attractive research systems and Innovation-friendly environment, in total 8 variables are measured here.

Table 3.1. The EIS measurement framework. Source: European Commission (2018a).

European Innovation Scoreboard 2018	
FRAMEWORK CONDITIONS	
Human resources	New doctorate graduates
	Population aged 25-34 with tertiary education
	Life-long learning
Attractive research systems	International scientific co-publications
	Top-10% most cited publications
	Foreign doctorate students
Innovation friendly environment	Broadband penetration
	Opportunity-driven entrepreneurship
INVESTMENTS	
Finance and support	R&D expenditure in the public sector
	Venture capital expenditures
Firm investments	R&D expenditure in the business sector
	Non-R&D innovation expenditures
	Enterprises providing training to develop or upgrade ICT skills of their personnel

INNOVATION ACTIVITIES	
Innovators	SMEs introducing product or process innovations
	SMEs introducing marketing or organisational innovations
	SMEs innovating in-house
Linkages	Innovative SMEs collaborating with others
	Public-private co-publications
	Private co-funding of public R&D expenditures
Intellectual assets	PCT patent applications
	Trademark applications
	Individual design applications
IMPACTS	
Employment impacts	Employment in knowledge-intensive activities
	Employment in fast-growing firms of innovative sectors
Sales impact	Medium and high-tech product exports
	Knowledge-intensive services exports
	Sales of new-to-market and new-to-firm innovations

2. The domain Investments shows the investments both in public and business sector. It focuses on indicators such as Finance and support as well as Firm investments whereas in total 5 variables are evaluated here.

3. The domain Innovation Activities concentrates on the innovation aspects of the business sector. The indicators such as Innovators, Linkages and Intellectual assets are measured here, in total with 9 variables.

4. The domain Impacts captures the effects of innovation activities in the firm with emphasis in the following indicators: Employment impacts and Sales impacts where in total 5 variables are estimated here.

Hollanders (2009) used the data of the EIS in order to measure innovation and analyzed eight reports of the EIS as regards to rationale, use of innovation, methodology and results.

Moreover, the Global Innovation Index (GII) (see Fig. 3.1), according to Cornell University et al. (2018), measures the innovation performance of 126 countries and economies with the use of 80 indicators. It is published in cooperation with many and different organizations such as the Cornell University, the INSEAD and the World Intellectual Property Organization (WIPO). Through this index one can see the countries' rankings for their innovation capabilities and results whereas it is available every year from 2007.

Basically this index is the overall GII Score which is the simple average of the Innovation Input Sub-Index which shows the economy of a nation and how innovative its activities are and the Innovation Output Sub-Index which shows the results of these activities in the economy. Each one of these sub-indexes is then constituted of different pillars. Also, there is the Innovation Efficiency Ratio which is simply the ratio of the Output Sub-Index over the Input Sub-Index.

As regards to the Innovation Input Sub-Index it is constituted of the following pillars:

1. Institutions which show the institutional framework of a country through the measure of its sub-pillars, Political Environment, Regulatory Environment and Business Environment, in total 7 variables are measured here.

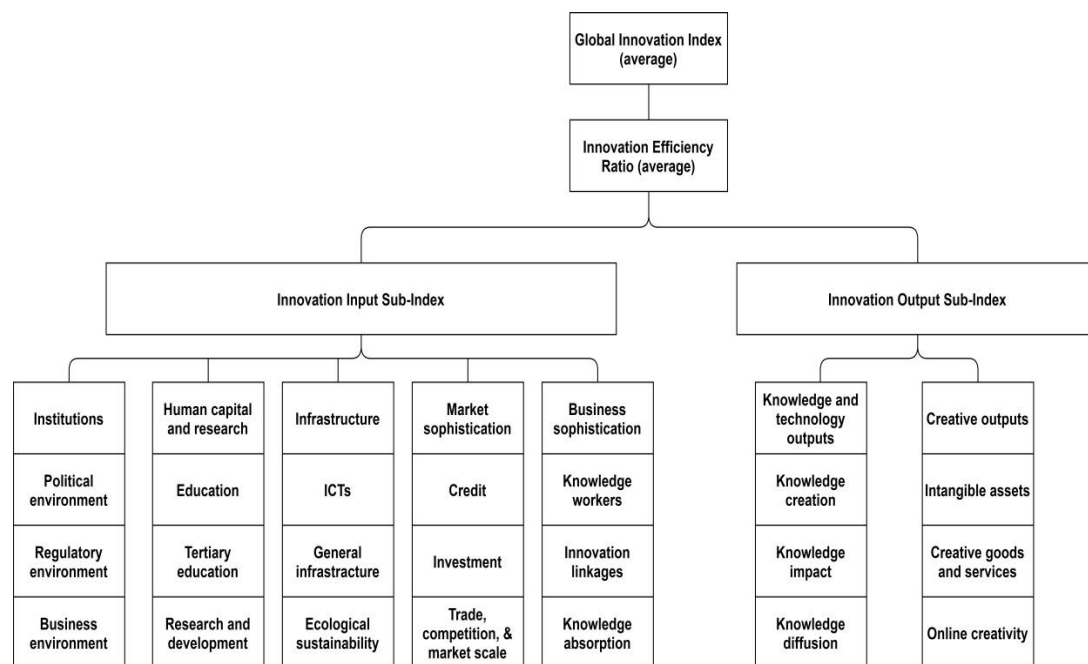


Figure 3.1. The Global Innovation Index Framework. Source: Cornell University et al. (2018).

2. Human capital and research which shows the level and standard of education and research activity of a country through the measure of its sub-pillars, Education, Tertiary Education and Research and Development, in total 12 variables are measured here.

3. Infrastructure which shows the basis that a country offers in different aspects for increasing productivity and efficiency through the measure of its sub-pillars, ICTs, General Infrastructure and Ecological sustainability, in total 10 variables are measured here.

4. Market sophistication which shows the markets conditions and the total level of transactions of a country through the measure of its sub-pillars, Credit, Investment and Trade, competition and market scale, in total 9 variables are measured here.

5. Business sophistication which shows how conducive firms are to innovation activity within a country through the measure of its sub-pillars, Knowledge workers, Innovation linkages and Knowledge absorption, in total 15 variables are measured here.

As regards to the Innovation Output Sub-Index it is constituted of the following pillars:

1. Knowledge and technology outputs which capture the results of innovations and inventions of a country through the measure of its sub-pillars, Knowledge creation, Knowledge impact and Knowledge diffusion, in total 14 variables are measured here.

2. Creative outputs which show the role of creativity for innovation within a country through the measure of its sub-pillars, Intangible assets, Creative goods & services and Online creativity, in total 13 variables are measured here.

Jankowska et al. (2017) have used the GII in their study in order to measure the efficiency of national innovation systems and they performed cluster analysis for 228 countries based on the hypothesis that “the higher the innovation input, the higher the innovation output attained by a country.” The authors presented an in-depth analysis of two countries: Poland and Bulgaria where the results revealed that “a higher innovation input does not necessarily result in a higher innovation output”. On the one hand, the innovation results of Poland are not

adequate, despite the fact that there are great innovation efforts. On the other hand, the innovation output of Bulgaria is adequate despite the fact that the innovation input is not well developed.

Another index for measuring innovation is the Bloomberg Innovation Index (see Fig. 3.2). This index ranks countries that have the ability to innovate and presents the top 50. Six equally weighted metrics were considered and their scores combined to provide an overall score for each country from zero to 100 as follows:

1. Research & Development (R&D) which includes the R&D expenditure as a percentage of GDP.
2. Manufacturing which includes the manufacturing value-added per capita.
3. High-tech companies which includes the number of domestically domiciled high-tech public companies, such as aerospace and defense, biotechnology, hardware, software, semiconductors, Internet software and services and renewable energy companies, as a share of the world's total high-tech public companies.
4. Postsecondary education which measures the education level of a country's workforce in the following four ways: 1) the number of secondary graduates enrolled in postsecondary institutions as a percentage of cohort, 2) the percentage of labor force with tertiary degrees, 3) the annual science and engineering graduates as a percentage of the labor force and 4) the annual science and engineering graduates as a percentage of total tertiary graduates.
5. Research personnel who include the professionals, including Ph.D. students, engaged in R&D per 1 million population.
6. Patents which include the resident utility patent filings per 1 million population and per \$1 million of R&D spent and utility patents granted as a percentage of the world total (as cited in Bloomberg 2015).

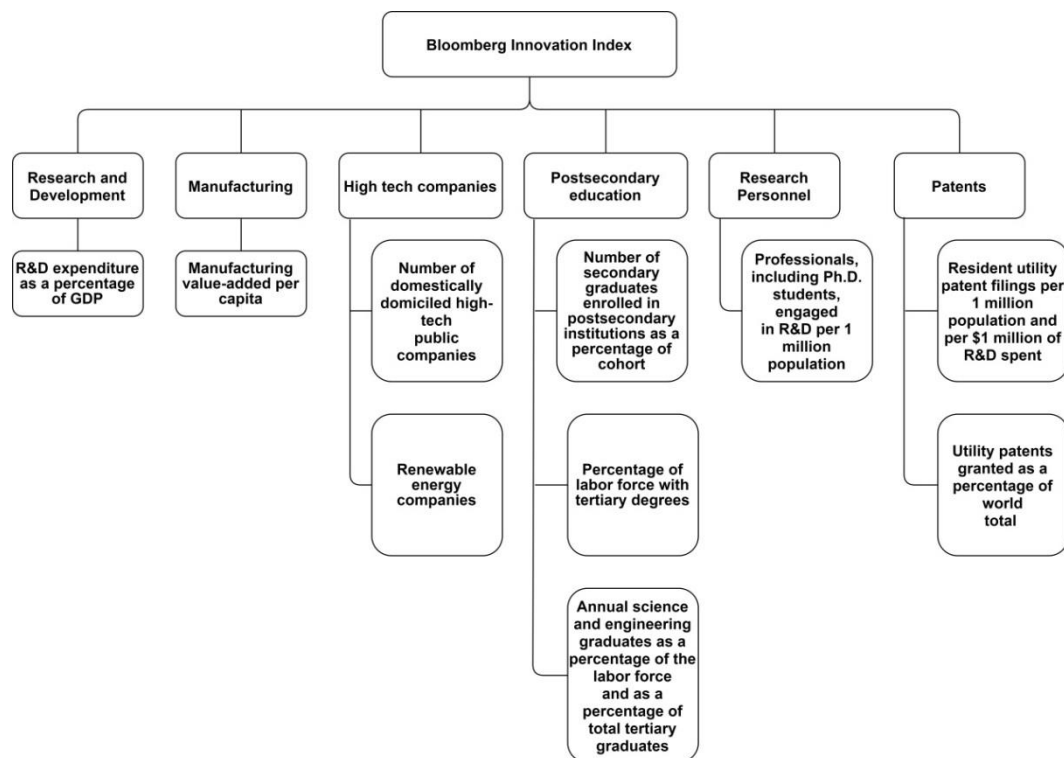


Figure 3.2. The Bloomberg Innovation Index. Source: bloomberg (2015).

Wolniak and Grebski (2018) have used this index in their study in order to analyze its sub-indexes as a tool to measure economic growth from an innovation perspective. More specifically, they analyzed R&D, manufacturing, post-secondary education, research personnel and patents.

An important index for measuring entrepreneurial ecosystems at the macro level is the GEDI methodology. The Global Entrepreneurship Index (GEI) was developed by the Global Entrepreneurship and Development Institute. According to thegedi.org (n.d.) it is available every year and measures how healthy an entrepreneurial ecosystem is and overall it assesses and ranks 137 countries. In this way in both domestic and international context one can see how a country is performing.

The GEDI methodology, according to Acs et al. (2017a) *“measures both the quality of entrepreneurship and the extent and depth of the supporting entrepreneurial ecosystem.”* The GEDI methodology uses 14 pillars (see Table 3.2) in order to calculate the following:

1. The overall Global Entrepreneurship Index.
2. The scores for individuals and institutions.
3. The pillar level scores.

Table 3.2. The 14 pillars of the Global Entrepreneurship Index. Source: Acs et al. (2017a).

Component of the entrepreneurial ecosystem	What does it measure?
Pillar 1: Opportunity Perception	Can the population identify opportunities to start a business and does the institutional environment make it possible to act on those opportunities?
Pillar 2: Startup Skills	Does the population have the skills necessary to start a business based on their own perceptions and the availability of tertiary education?
Pillar 3: Risk Acceptance	Are individuals willing to take the risk of starting a business? Is the environment relatively low risk or do unstable institutions add additional risk to starting a business?
Pillar 4: Networking	Do entrepreneurs know each other and how geographically concentrated are their networks?
Pillar 5: Cultural Support	How does the country view entrepreneurship? Is it easy to choose entrepreneurship or does corruption make entrepreneurship difficult relative to other career paths?
Pillar 6: Opportunity Perception	Are entrepreneurs motivated by opportunity rather than necessity and does governance make the choice to be an entrepreneur easy?
Pillar 7: Technology Absorption	Is the technology sector large and can businesses rapidly absorb new technology?
Pillar 8: Human Capital	Are entrepreneurs highly educated, well trained in business and able to move freely in the labor market?
Pillar 9: Competition	Are entrepreneurs creating unique products and services and able to enter the market with them?
Pillar 10: Product Innovation	Is the country able to develop new products and integrate new technology?

Pillar 11: Process Innovation	Do businesses use new technology and are they able access high quality human capital in STEM fields?
Pillar 12: High Growth	Do businesses intend to grow and have the strategic capacity to achieve this growth?
Pillar 13: Internationalization	Do entrepreneurs want to enter global markets and is the economy complex enough to produce ideas that are valuable globally?
Pillar 14: Risk Capital	Is capital available from both individual and institutional investors?

The GEI reports are available on the GEDI site for 137 countries and from the following years, 2013 to 2018.

Szerb and Trumbull (2015) used the GEI in order to measure entrepreneurship in the V4 countries which are Czech Republic, Hungary, Poland and Slovakia. The results showed that although these countries have a level of entrepreneurship that matches other similar developed countries, they still have weak points that need to be enhanced.

Moreover, another framework, the Global Entrepreneurship Monitor (GEM) represents a unique attempt that both provide homogeneous cross-country measures of entrepreneurial activity and ascertain the relationship between entrepreneurship and economic development. One of the better known outcomes of the GEM project is an estimate of a nation's entrepreneurial activity, the Total Entrepreneurship Activity (TEA) index, which is designed to overcome a number of concerns raised in prior research about the measurement of entrepreneurship (as cited in Justo et al. 2008).

These concerns have been expressed by various scholars, regarding the undercounting of new firm entries and exits in the market and the effect of this undercounting on the assessment of the impact of entrepreneurial activity (Bates, 2005; Birley, 1984; Davidsson, 2004; Dennis, 1997; Dennis, 1999; Williams, 1993) (as cited in Justo et al. 2008).

According to Schwab (2017) the conceptual framework (see Fig. 3.3) *“is based on the assumption that national economic growth is the result of the inter-dependencies between the entrepreneurial framework conditions and the personal traits and capabilities of individuals to identify and seize opportunities.”*

The GEM project uses many indicators. First, there are the entrepreneurial framework conditions which focus on the National Expert Survey. This survey emphasizes the environmental factors that can affect both entrepreneurial attitudes and activities rather than general economic factors. This indicator includes measures such as entrepreneurial financing, research and development transfer etc. Then, there are the societal values and perceptions where one through these elements can decide to participate in entrepreneurial activities and this indicator includes measures such as good career choice etc. Moreover, there are the individual attributes of a potential entrepreneur which include measures such as perceived opportunities, fear of failure etc. Last but not least, there are the entrepreneurial activity indicators which include measures such as the Total Entrepreneurship Activity index etc.

GEM has been used by many researchers and scholars in their studies. For example, Anokhin and Schulze (2009) used the data from the GEM project in order to test the hypothesis that the level of corruption can have an impact on entrepreneurial activity and innovation across nations. Their results revealed that *“there is a positive curvilinear relationship between the control of corruption and three independent measures of entrepreneurial and innovative activity across nations.”*

Another study that it is worth mentioning is the study of Justo et al. (2008) on 7000 Spanish respondents. In their study they used the data from the 2003 GEM project in order to test their

model which provides a different way of measuring entrepreneurial activity and it has the following two variables: 1) the entrepreneurial propensity of an individual which is the possibility to engage in venture development and 2) the social entrepreneurial environment of an individual which can affect the first variable.

The results indicated that an individual's personal background can play a significant role in participating in any kind of entrepreneurial activity and that it is a factor that should be taken into consideration since it can affect entrepreneurship in a country.

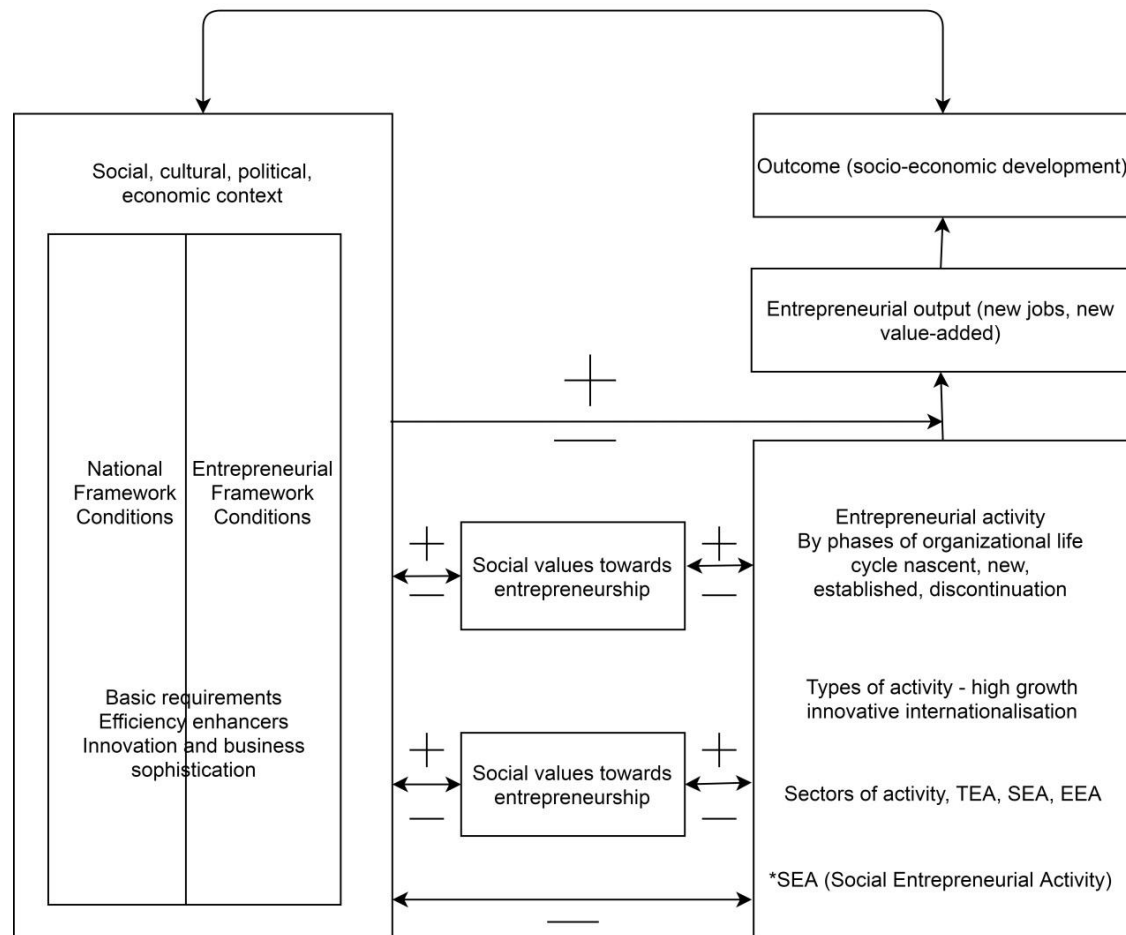


Figure 3.3. The GEM Conceptual Framework. Source: Schwab (2017).

According to Ahmad and Hoffman (2007) the OECD/Eurostat framework for Entrepreneurship Indicators can be used for the measurement of entrepreneurship in a country level. Through this framework one can see three different flows which although they are related to each other, these flows can also help in grouping, rating and evaluation of policy measures.

The Determinants flow, according to the authors shows the key factors that can have an impact on '*entrepreneurial performance*' whereas the Entrepreneurial performance flow shows the key indicators that according to policy makers can affect some or many ultimate objectives (impacts). Each one of these flows includes basic policy areas. It is worth mentioning that the data of the OECD/Eurostat Framework are available at different sources such as for example OECD site, World Bank etc. The factors that are included at each flow are the following:

1. Determinants flow includes the following factors: Regulatory Framework, R&D and Technology, Entrepreneurial Capabilities, Culture, Access to Finance and Market Conditions, whereas in total 35 variables are measured here.

2. Entrepreneurial performance flow includes the following factors: Firms, Employment and Wealth, whereas in total 18 variables are measured here.

3. Impact flow includes the following factors: Job Creation, Economic Growth, Poverty and Reduction.

Each one of these flows includes basic themes with several variables (see Table 3.3).

There are many studies that use the OECD/Eurostat framework and one study that should be mentioned is the study of Arruda et al. (2015) where the authors used the main six entrepreneurship determinants to map the Brazilian Entrepreneurial Ecosystem of Startups with the use of both quantitative and qualitative data. The results revealed that although the regulatory framework in Brazil has shown some improvements, there is a need for further improvement since there is an entrepreneurial movement that has a specific pace. As regards to the market in Brazil there is a huge number of potential customers.

Moreover, as regards to the access to finance, the Brazilian economy has created the circumstances for potential investors but further measures to this direction should be taken into consideration. The elements that also need more attention are knowledge creation and capacity-building professionals for the market whereas all entities in the ecosystem should participate in order to function efficiently. The authors also mention that “*entrepreneurial capacity building may influence a country’s culture change towards entrepreneurship, which would probably return as encouragement to advances in entrepreneurial capacity building investments.*” The study concludes that the Brazilian entrepreneurial ecosystem has shown great improvements and it is still growing, constituting it appropriate for investments.

Table 3.3. The OECD/Eurostat Framework for Entrepreneurship indicators – adding policy areas for entrepreneurial determinants. Source: Ahmad and Hoffman (2007).

Determinants	Regulatory Framework	Administrative Burdens for Entry
		Administrative Burdens for Growth
		Bankruptcy Regulations
		Safety, Health and Environmental Regulations
		Product Regulation
		Labour Market Regulation
		Court & Legal Framework
		Social and Health Security
		Income taxes; Wealth/Bequest Taxes
		Business and Capital Taxes
	R&D and Technology	R&D Investment
		University/ Industry Interface
		Technological Cooperation Between Firms
		Technology Diffusion
		Broadband Access
		Patent System; Standards
	Entrepreneurial Capabilities	Training and experience of entrepreneurs
		Business and Entrepreneurship Education (skills)

		Entrepreneurship Infrastructure
		Immigration
	Culture	Risk Attitude in Society
		Attitudes Towards Entrepreneurs
		Desire for Business Ownership
		Entrepreneurship Education (mindset)
	Access to Finance	Access to Debt Financing
		Business Angels
		Access to VC
		Access to Other Types of Equity
		Stock Markets
	Market Conditions	Anti-Trust Laws
		Competition
		Access to the Domestic Market
		Access to Foreign Markets
		Degree of Public Involvement
		Public Procurement
Entrepreneurial performance	Firms	-
	Employment	
	Wealth	
Impact	Job Creation	-
	Economic Growth	
	Poverty Reduction	

In addition, the World Economic Forum (WEF) measures the competitiveness of a country with an overall index called the Global Competitiveness Index (GCI) in the Global Competitiveness Report that is available every year and covers 141 countries. According to Schwab (2019) this index is constituted of 103 individual indicators that are collected from international organizations and the Executive Opinion Survey of the World Economic Forum.

It is worth mentioning that according to Schwab (2019) the report of 2019 provided information from a sample of 16,936 business executives in 139 economies. In total 12,987 responded and 59.1% of them responded online whereas the survey was available to 41 languages.

The overall score of the GCI is the average of the score of its 12 pillars. The framework of the GCI 4.0 (see Table 3.4) includes four main components which however are not measured in the overall GCI and these are the following:

1. Enabling Environment which is constituted of 4 pillars: Institutions, Infrastructure, ICT adoption and Macroeconomic stability, whereas in total 45 variables are measured here.

Table 3.4. The Global Competitiveness Index framework. Source: Schwab (2019).

Enabling Environment	Markets
Pillar 1 Institutions	Pillar 7 Product markets
Pillar 2 Infrastructure	Pillar 8 Labour markets
Pillar 3 ICT adoption	Pillar 9 Financial systems
Pillar 4 Macroeconomic stability	Pillar 10 Market size
Human Capital	Innovation Ecosystem
Pillar 5 Health	Pillar 11 Business dynamism
Pillar 6 Skills	Pillar 12 Innovation capability

2. Human Capital which is constituted of 2 pillars: Health and Skills, whereas in total 10 variables are measured here.

3. Markets which is constituted of 4 pillars: Product market, Labor market, Financial system and Market size, whereas in total 30 variables are measured here.

4. Innovation Ecosystem which is constituted of 2 pillars: Business dynamism and Innovation capability, whereas in total 18 variables are measured here.

Taskinsoy (2019) have used the GCI in order to compare Turkey's competitiveness to the competitiveness of G8 nations. The author found that the mean overall ranking of Turkey is significantly higher than countries such as Canada, France, Germany, Japan and the UK.

According to Acs et al. (2008) the World Bank Group Entrepreneurship Survey (WBGES) provides an alternative to self-reports of randomly selected individuals. It measures entrepreneurial activity based on official business registers and thus provides cross-national data on the number of newly registered businesses (as cited in Stenholm et al. 2013).

The Entrepreneurship Database and Doing Business have together created this methodology to help in the measurement of entrepreneurship activity with cross-country data. According to the doingbusiness.org (n.d.) the data were collected through telephone interviews and email correspondence with business registries whereas the Entrepreneurship Database covers data for the period 2006-2016 and are available on the site. The following variables are being used for the measurement of entrepreneurship activity:

1. Newly registered companies with limited liability: The main input for calculating the new business entry density rate is the number of newly registered companies with limited liability (or its equivalent), per calendar year. Importantly, limited liability is a concept whereby the financial liability of the firm's members is limited to the value of their investment in the company.

2. Business entry density rate: The number of newly registered firms with limited liability per 1,000 working-age people (ages 15-64) per calendar year.

3. Population: The main source of information for the population numbers used in the Entrepreneurship Database is the World Development Indicators. The working-age population is based on what the International Labour Organization defines as the economically active population. If the population data were not available in the World Development Indicators, other sources such as the CIA and the Index Mundi were used.

4. Offshore Financial Centers: Data collected from countries categorized as offshore financial centers by the IMF are marked as such and generally excluded from Entrepreneurship Database analysis since registered entities in these countries may not fit the definition of doingbusiness.org (n.d.) as regards to entrepreneurship. The information provided by these countries likely reflects a nontrivial amount of shell companies, defined as companies that are registered for tax purposes, but are not active businesses.

5. Time: Time is recorded in calendar years. The measure captures the new companies with limited liability that have been registered per calendar year, allowing the collection of periodical statistics for the period 2006-2016 (as cited in doingbusiness.org n.d.).

Klapper et al. (2010) have used the data from the World Bank Entrepreneurship Database in order to measure the entrepreneurship activity of 84 countries. The results showed that *“entrepreneurship, measured both in terms of new registrations and entry rates, is also positively correlated with economic growth.”*

Last but not least, another possible source that could be used for the assessment of entrepreneurial ecosystems at the macro level is the data from the International Monetary Fund (IMF) which can be categorized as follows:

1. Global data that concern data for countries such as statistics data or indicators.
2. IMF Financial data that concern all the financial data for countries.
3. Exchange Rate data.

3.2 Assessment frameworks at meso level

According to the European Commission (2018b) the Regional Innovation Scoreboard (RIS) is the extension of the European Innovation Scoreboard at the regional level (see Table 3.5), it assesses the regions' innovation performance. The RIS is available for the following years: 2009, 2012, 2014 and 2017. The RIS report for 2017 covers 220 regions across 22 EU countries, Norway, Serbia and Switzerland. In addition, Cyprus, Estonia, Latvia, Lithuania, Luxembourg and Malta are included at the country level. The measurement framework of the Regional Innovation Scoreboard is constituted by different domains which include different indicators and these are the following:

1. Framework Conditions which include Human Recourses, Attractive research systems, Innovation-friendly environment.
2. Investments which include Finance and support and Firm investments.
3. Innovation activities which include Innovators, Linkages, Intellectual assets.
4. Impacts which include Employment impacts and Sales impacts.

Table 3.5. Comparison of the indicators of the EIS 2017 and the RIS 2017. Source: European Commission (2018b).

	European Innovation Scoreboard 2017	Regional Innovation Scoreboard 2017
FRAMEWORK CONDITIONS		
Human resources	Doctorate graduates per 1000 population aged 25-34	No regional data
	Percentage of population aged 25-34 having completed tertiary education	Smaller age group 30-34
	Life-long learning, share of population aged 25-64 enrolled in education or training aimed at improving knowledge, skills and competences	Identical
Attractive research systems	International scientific co-publications per million population	Identical
	Scientific publications among the top-10% most cited publications	Identical

	worldwide as percentage of total scientific publications of the country	
	Foreign doctorate students as a percentage of all doctorate students	No regional data
Innovation friendly environment	Broadband penetration (Share of enterprises with a maximum contracted download speed of the fastest fixed internet connection of at least 100 Mb/s)	No regional data
	Opportunity-driven entrepreneurship (Motivational index)	No regional data
INVESTMENTS		
Finance and support	R&D expenditure in the public sector as percentage of GDP	Identical
	Venture capital expenditure as percentage of GDP	No regional data
Firm investments	R&D expenditure in the business sector as percentage of GDP	Identical
	Non-R&D innovation expenditures as percentage of total turnover	For SMEs only
	Enterprises providing training to develop or upgrade ICT skills of their personnel	No regional data
INNOVATION ACTIVITIES		
Innovators	SMEs introducing product or process innovations as percentage of SMEs	Identical
	SMEs introducing marketing or organisational innovations as percentage of SMEs	Identical
	SMEs innovating in-house as percentage of SMEs	Identical
Linkages	Innovative SMEs collaborating with others as percentage of SMEs	Identical
	Public-private co-publications per million population	Identical
	Share of private co-funding of public R&D expenditures	No regional data
Intellectual assets	PCT patent applications per billion GDP (GDP in Purchasing Power standards)	EPO patent applications
	Trademark applications per billion GDP (GDP in Purchasing Power	European trademark applications

	standards)	
	Individual design applications per billion GDP (GDP in Purchasing Power standards)	Design applications
IMPACTS		
Employment impacts	Employment in knowledge-intensive activities (manufacturing and services) as percentage of total employment	Employment in medium-high and high-tech manufacturing and knowledge-intensive services
	Employment in fast-growing firms of innovative sectors	No regional data
Sales impact	Medium and high-tech product exports as percentage of total product exports	Exports of medium-high and high-technology-intensive manufacturing industries
	Knowledge-intensive services exports as percentage of total service exports	No regional data
	Sales of new-to-market and new-to-firm innovations as percentage of total turnover	For SMEs only

Zollo et al. (2011) have used the data of RIS in order to investigate the performance and identify the strong and weak points of the Regional Innovation System in the Campania region of Italy. In addition, Carayannis and Bakouros (2010) have used RIS in order to measure innovation in the region of Western Macedonia. The results showed that the region of Western Macedonia performed at 50% of the average performance of Greece and at 28% of the average performance of Europe.

Another index that can be used for the assessment of innovation ecosystems at the meso level is the Innovation Index (see Fig. 3.4) by the Indiana Business Research Center that reflects a region's innovation activity and capacity. The Innovation Index shows the regional performance of America's regions and is calculated from the four component indexes which include several variables as follows:

1. Human Capital describes a county's population and labor force that can be employed with innovative activities and includes the following variables: Education, Population Growth Rate, Occupational Mix and High-Tech Employment.
2. Economic Dynamics describe the local business conditions and resources available to entrepreneurs and businesses whereas it includes the following variables: Venture Capital Investment, Broadband Density, Churn and Business Sizes.
3. Productivity and Employment describes the economic growth, regional desirability, or direct outcomes of innovative activity and includes the following variables: High-Tech Employment Share Growth, Job Growth-to-Population Growth Ratio, Patent Activity and Gross Domestic Product.
4. Economic Well-Being describes the situation through which the residents of an innovative economy can have a better living and includes the following variables: Average Poverty Rate, Average Unemployment Rate, Net Migration, Compensation and Growth in Per Capita Personal Income (as cited in statsamerica.org, n.d.).

This Innovation Index belongs to a project that is sponsored by the U.S. Economic Development Administration whereas according to the statsamerica.org (n.d.) *"the Rural*

Innovation team brought together academic and private-sector researchers with regional leaders in government, business and education to carry out this project.” The partner organizations include:

1. Purdue Center for Regional Development at Purdue University.
2. Indiana Business Research Center at Indiana University’s Kelley School of Business.
3. Strategic Development Group, Inc.
4. Economic Modeling Specialists, Inc.
5. Center for Regional Competitiveness at the University of Missouri’s Rural Policy Research Institute.

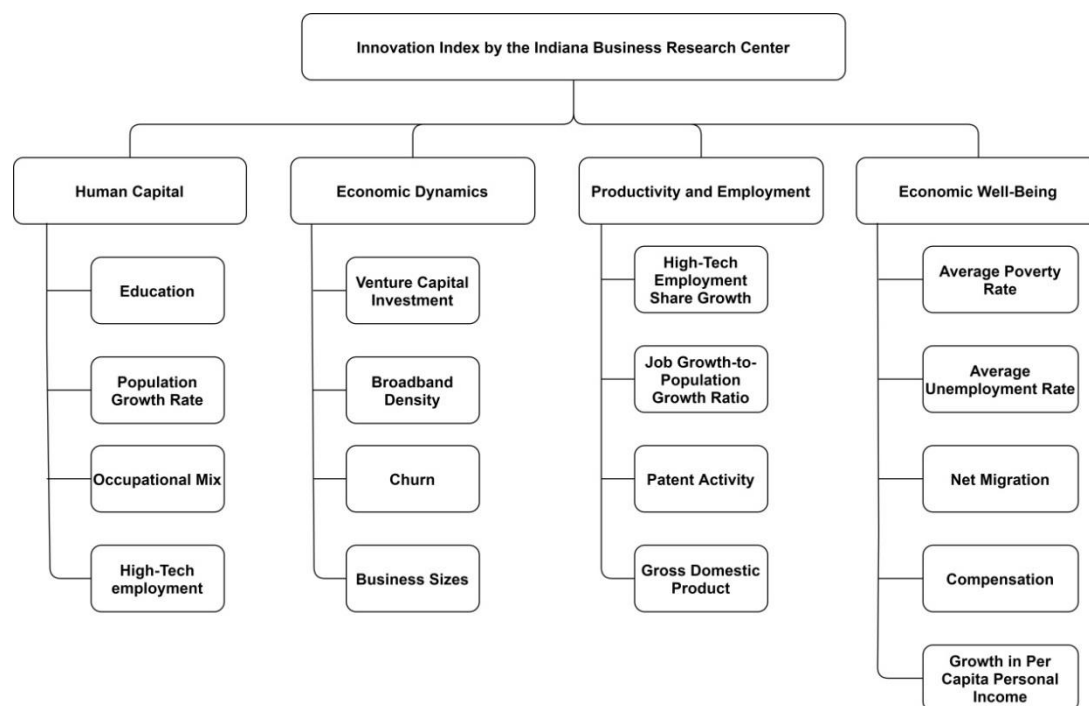


Figure 3.4. Innovation Index by the Indiana Business Research Center. Source: statsamerica.org (n.d.).

The data are available through the Innovation Index Mapping Tool on statsamerica.org and the reports with the maps are available for download for the following years: 2007 and 2009. Along with the Innovation Index Mapping Tool, Cluster Analysis and Investment Analysis tools are also available.

Furthermore, an index that is used for the assessment of entrepreneurial ecosystems at the meso level is the Regional Entrepreneurship and Development Index (REDI). According to theredi.org (n.d.) this index is part of the Europe 2020 agenda for strategy in order to enhance the capacity for smart, sustainable and inclusive growth. This strategy aims to boost the regional strategies as regards to innovation and smart specialization with a focus to entrepreneurial activities that can lead to economic recovery and employment growth. The REDI covers 27 EU member states and Croatia at the NUTS-2 level.

According to the European Commission (2013b) the REDI (see Table 3.6) is a super-index which is constituted by three sub-indices, each of one has pillars that is constituted by many variables. The main three sub-indices are the following:

1. Entrepreneurial Attitudes sub-index aims to identify the attitudes of a region’s population as they relate to entrepreneurship.

2. Entrepreneurial Abilities sub-index aims to identify the entrepreneurship abilities as they relate to nascent and startup business activities.

3. Entrepreneurial Aspirations sub-index aims to identify the entrepreneurship aspirations as they relate to nascent and startup business activities.

The data of REDI are available on the European Commission site but only for the following years: 2013 and 2014. Szerb et al. (2013) have used the Regional Entrepreneurship and Development Index in order to analyze the entrepreneurship level in 7 Hungarian NUTS 2 level regions. The results revealed that regions are weak as regards to entrepreneurial attitudes and aspirations, firm have reduced levels of innovation and Hungarian entrepreneurs do not have the necessary startup skills whereas in general they have a negative attitude towards entrepreneurship.

Table 3.6. The structure of the Regional REDI. Source: European Commission (2013b).

REGIONAL ENTREPRENEURSHIP AND DEVELOPMENT INDEX		
Entrepreneurial Aspirations Sub-Index	Financing	Informal Investment
		Financial Institutions
	Globalization	Export
		Connectivity
	High Growth	Gazelle
		Clustering
	Process Innovation	New Tech
		Technology Development
Product Innovation	New Product	
	Technology Transfer	
Entrepreneurial Abilities Sub-Index	Competition	Competitors
		Business Strategy
	Human Capital	Educational Level
		Education and Training
	Technology Adoption	Technology Level
		Absorption Capacity
	Opportunity Startup	Opportunity Motivation
		Business Environment
Entrepreneurial Attitudes Sub-Index	Cultural support	Career status
		Open Society
	Networking	Know Entrepreneurs
		Social Capital
	Risk acceptance	Risk acceptance
		Business Risk
	Startup Skills	Skills Perception
		Quality of education
Opportunity perception	Opportunity Recognition	
	Market Agglomeration	

Another framework for the assessment of entrepreneurial ecosystems at the meso level is the Asset Mapping Roadmap by the Council on Competiveness and the U.S. Department of Labor's Employment and Training Administration (ETA). According to the Council on Competiveness (2007) it is designed to give guidance to regions in order to enhance how competitive they are in the global economy. Through Asset Mapping a community can find the necessary resources and utilize them in order to support workforce and economic

development initiatives. The Asset Mapping Roadmap (see Fig. 3.5) is constituted by the following inputs and outputs variables:

1. The inputs variables are: Assets, Networks and Culture.
2. The outputs variables are: Innovation, Productivity and Prosperity.

These inputs and outputs variables are applied to each regional innovation environment that is examined each time. Only one report is available for the 2007 year entitled *“Illuminate. Asset Mapping Roadmap: A Guide to Assessing Regional Development Resources.”*

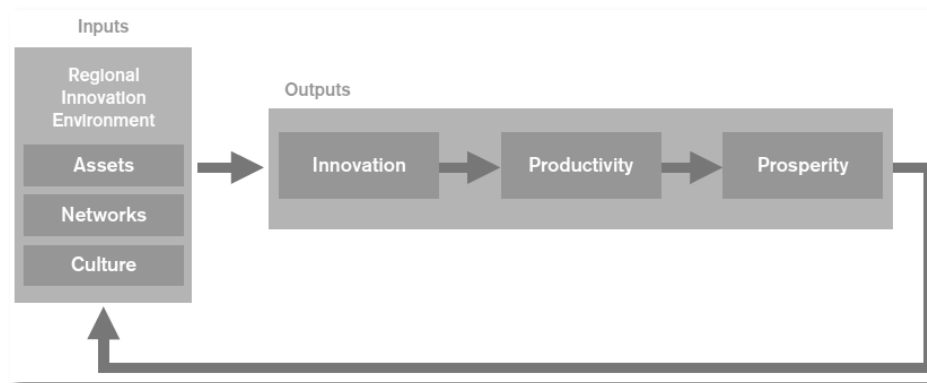


Figure 3.5. The Asset Mapping Roadmap by the Council on Competiveness. Source: Council on Competiveness (2007).

3.3 Assessment frameworks at micro level

The Innobarometer survey by the European Commission is an example of a framework for assessing innovation ecosystems at the micro level. According to the European Commission (2018c) this survey assesses the innovation activities and attitudes and is conducted on both public and European businesses in order to gather their opinions.

For example the Innobarometer 2016 captured the main behaviours and trends in innovation-related activities in EU businesses. The survey was designed in particular to collect information about:

1. Profiles of companies that have developed innovations since January 2013 and their plans for the future.
2. The impact of innovations on turnover and the proportion of turnover invested in innovation activities.
3. Barriers to commercialization of both innovative and non-innovative goods and services.
4. Preferred types of public support for the commercialization of goods or services.
5. The role of design and the use of advanced manufacturing technologies.
6. Skills for innovation.

The survey is carried out in the 28 Member States, as well as in Switzerland and in the United States. It is conducted with interviews through telephones and approximately 14.118 companies were interviewed, of which 13.117 across the EU28 Member States. The sample comprises companies employing 1 or more persons in manufacturing, services and the industry sector. There are several studies that use these data such as the study of Montresor and Vezzani (2016) where the authors have used the data of the 2013 Innobarometer in order to analyze the innovation impact of intangible investments in 36 countries.

Another survey that can be used for the measurement of innovation ecosystems at the micro level is the Community Innovation Survey (CIS) which is conducted by the European Commission every two years in order to measure the innovation activity in the enterprises of the EU countries and the European Social Survey (ESS) member countries. According to eurostat (n.d.) this survey can give information as regards to the innovativeness of sectors by the type of enterprises, on different types of innovations as well as the different aspects on the creation of innovations such as funding, expenditures etc.

The Community Innovation Survey “*provides statistics broken down by countries, type of innovators, economic activities and size classes*” whereas the data of the Community Innovation Survey are available to download at the eurostat site. There are several studies that use this survey’s data such as for example the study of Frenz and Ietto-Gillies (2009) where the authors have used these data in order to investigate the impact of innovation on different sources of knowledge.

Stenholm et al. (2013) report the existing entrepreneurship measures that can be found in the literature as regards to the measurement of the entrepreneurial activity that perhaps could be also used for the assessment of entrepreneurial ecosystems at the micro level.

Other measures include Eurobarometer, which provides annual figures on entrepreneurial activity among 25 European Union (EU) member states, along with Norway, Iceland and the United States as well as the Statistical Office of the European Communities, which publishes business startup, entry and exit rates for EU member states in the Eurostat database (as cited in Stenholm et al. 2013).

According to the European Commission (2012b) the Flash Eurobarometer 354 focuses on the following two questions: “*Why do so few Europeans set up their own business? Why are so few European businesses growing?*”

The survey took place at the 27 Member States of the European Union as well as in Croatia, Island, Israel, Norway, Switzerland, Turkey, Brazil, Russia, the United States, China, India, Japan and South Korea with over 42,000 respondents from different social and demographic groups which were interviewed via telephone in 2012. The data of the Eurobarometer are available on the European Commission site for the following years: 2000, 2001, 2003, 2007, 2009 and 2012. The main findings focused on the following themes:

1. Self-employment vs. employee status.
2. Drivers of entrepreneurship.
3. Perceptions of entrepreneurship and the role of education.
4. Entrepreneurs.
5. Employees.

One study that has used the data of the Eurobarometer survey is the study of Ester and Roman (2017) where the generalization approach is investigated in order to analyze better the female entrepreneurship.

According to Stenholm et al. (2013), the Observatory of European Small and Medium-Sized Businesses includes entrepreneurship related data from 27 EU member states, along with Norway, Iceland and Turkey. It is a survey that is focused on the economic performance of SMEs and more specifically large-scaled enterprises, employing at least 250 persons.

The most widely used tool is the SMEs Performance Review where according to the European Commission (2018d) it is a tool that allows monitoring the performance of the SMEs in EU and other countries. Also it is used for the progress assessment of countries implementing the Small Business Act (SBA). The reports on European SMEs and SBA country fact sheets are available yearly. The interactive SMEs database is constituted by the following:

1. The Key Figures of 2016 that include the different types of data such as the number of SMEs (% total number of enterprises) etc, the different sectors such as manufacturing and the different countries which include all EU countries.
2. The Trends where one can compare data from 2008-2017 on the number of SMEs, the number of people employed and the value added within a country.
3. The SBA profile where one can compare detailed data on the SBA principles between two countries and with the EU average.

The EIM Business and Policy Research organization provides data on business ownership across different OECD countries over the period 1972-2004. Their database, according to van Stel (2004), Comparable Entrepreneurship Data for International Analysis (COMPENDIA), uses the business ownership rate (the number of self-employed business owners as a proportion of the total labor force) as an indicator of entrepreneurial activity (as cited in Stenholm et al. 2013).

3.4 MCDM and entrepreneurship assessment

Other studies have used MCDM methods for the evaluation of the performance of innovation and entrepreneurial ecosystems.

At the macro level, most of the studies use the TOPSIS method for the assessment of ecosystems. For example, the studies of Kitsios and Sitaridis (2017), Silva et al. (2017), Silva et al. (2019), Kaynak et al. (2017) as well as Kabadurmus and Kabadurmus (2019) use the TOPSIS method while Sitaridis and Kitsios (2019) use both the TOPSIS method and Non-Weighted model (NWM).

Only three studies use different MCDM methods, such as Corrente et al. (2018) who use the Stochastic Multicriteria Acceptability Analysis approach (SMAA), Mujahid et al. (2019) who use the Analytical Process Hierarchy (APH) method and Zvirblis and Buracas (2011) who use the Simple Additive Weighting (SAW) method.

Kitsios and Sitaridis (2017) as well as Sitaridis and Kitsios (2019) used the Non-Weighted model (NWM), as well as twelve criteria from the National Expert Survey of GEM in order to rank and compare the Greek entrepreneurial ecosystem to 9 other countries (Argentina, Bulgaria, Croatia, Cyprus, Ireland, FYROM, Portugal and Turkey) that are geographically close to Greece and had also economic crisis. Moreover, Sitaridis and Kitsios (2019) compared the results of the NWM with two other MCDM methods: Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) and PROMETHEE II. The studies showed that the NWM is a quantitative method which can successfully be used for ranking and comparing entrepreneurial ecosystems as well as that when the criteria are equally important, these three methods produce very similar ranking results. One limitation of these studies can be considered the fact that only the 2016 GEM data were used.

Silva et al. (2017) used the TOPSIS method in order to analyze the innovation indicators of 22 countries in Latin America and Caribbean as well as to compare the results with the Global Innovation Index. The authors used as criteria the innovation indicators of the World Intellectual Property Organization (WIPO) which are the following: Institutions, Human capital and research, Infrastructure, Market sophistication, Business sophistication, Knowledge and technology outputs and Creative outputs. They also used the Porter's Diamond approach in the innovation indicators. The similarity in the rankings of TOPSIS and GII was confirmed by the high levels of Kendall and Spearman correlation. One limitation of this study can be considered the fact that only the 2015 WIPO and GII data were used.

Similarly, Silva et al. (2019) used the TOPSIS method in order to rank the seven innovation indicators of WIPO, as described above, for African, Asian and Oceanic countries for the year 2015. One limitation of this study according to the authors is the fact that only the data of

2015 WIPO'S GII were used due to the fact there are annual changes in the ranking of innovative countries.

Kaynak et al. (2017) used the entropy-based TOPSIS method in order to compare the innovation performance of the following countries: Macedonia (FYR), Iceland, Serbia and Turkey, by conducting four case studies with the use of different reports that evaluate innovation performance. The first case study used the Knowledge Assessment Methodology (KAM) with 16 different indicators from the Custom Scoreboards. The second case study used the Global Competitiveness Index 2014-2015 report with seven innovation variables. The third case study used the Innovation Union Scoreboard 2015 report with 8 different variables whereas the forth case study used the Global Innovation Index 2015 report with seven variables. The authors claimed that other weighting methods should be used in order to indicate better the importance of variables in the calculation process.

In addition, Kabadurmus and Kabadurmus (2019) used the TOPSIS method and the data from the Business Environment and Enterprise Performance Survey 2012-2016 (BEEPS) which is conducted by the World Bank in order to compare the innovation levels of 32 Eastern European and Central Asian countries as regards to four types of innovation: new product, new organization, new marketing and new process. The only limitation of this study is the fact that the BEEPS data set is used whereas other innovation data sets should be included in future studies.

In their study Corrente et al. (2018) used the SMAA approach for the evaluation and comparison of ecosystems in 2017. The authors used the twelve criteria from the National Expert Survey of the GEM framework to evaluate and compare the ecosystems of 23 European countries. The authors reported that although GEM is a reliable and valid source of data, there is an implicit bias due to the fact that the values of the entrepreneurial ecosystems factors for each country are evaluated by experts who can be subjective.

Mujahid et al. (2019) proposed a framework with the use of AHP that prioritized the dimensions and sub-dimensions of entrepreneurial ecosystems. The authors identified 63 dimensions of the entrepreneurial ecosystem through a literature review, which were later grouped into the following main categories: Markets, Finance, Human resource development, Support, Government role, Infrastructure, Industrial network development and Mentorship. The data were collected by 37 experts, entrepreneurs, policy advisers and investors who had experience in doing, dealing or advising entrepreneurship in Pakistan. The authors claimed that the results of this study could be improved if the number of experts increased since the results are based on their opinions.

Zvirblis and Buracas (2011) used the SAW method to assess the entrepreneurial level of Lithuania for the years 2009-2010. The criteria were identified and examined by experts, whereas three different pillars were used: 1) Competitive advantage indicators for goods and services, 2) Transformation indicators for goods and services markets and 3) SMEs working effectiveness indicators. Each pillar had typical primary indicators, in total there were 19 indicators. A limitation of this study, according to the authors, is the fact that the results from the experts' evaluations of the primary indicators can limit the reliability of the applied multicriteria method.

At the meso level for the assessment of regional ecosystems, the studies of Poledníková (2014) and Bilbao-Terol et al. (2019) use the TOPSIS method, in addition Poledníková (2014) also use AHP and SAW methods whereas Garcia-Bernabeu et al. (2020) use for the first time the Multi-Reference Point based Weak and Strong Composite Indicator approach.

Poledníková (2014) used the following multicriteria methods: AHP, SAW and TOPSIS in order to compare 35 regions of the Visegrad Four countries (-Czech Republic, Hungary, Poland and Slovakia) for the years 2000-2010, at NUTS 2 level as regards to their socio-economic development. The authors used as subcriteria three different types of regional disparities, economic, social and territorial disparities as well as eight different indicators

from Cohesion reports which are available in the Eurostat database. The authors found out that the methods SAW and TOPSIS in some cases did not have identical rankings in the examined period, due to own means of calculation of both methods.

Moreover, in their study Bilbao-Terol et al. (2019) used the TOPSIS method in order to measure the regional competitiveness in the regions of Spain at NUTS 2 level. They developed a new index called European Regional Sustainability Competitiveness Index (RSCI) by adding several environmental indicators to the existing index Regional Competitiveness Index (RCI). The authors used three pillars based on the RCI as follows: CO₂ Emission, Waste and Environmental Expenditure and Investment. One limitation found in this study is the fact that *“the compensatory feature of the aggregation procedure based on TOPSIS may prove unsuitable for social evaluation (Munda 2008)”* whereas a different MCDM method such as VIKOR could be applied according to the authors.

Garcia-Bernabeu et al. (2020) used the Multi-Reference Point based Weak and Strong Composite Indicator (MRP-WSCI) approach for the evaluation of regional innovation performance in Spain and more specifically in 17 regions for the year 2019 with criteria the 17 different indicators from the RIS framework. The authors claimed that this methodology is used for the first time in order to assess innovation performance.

Furthermore, at the micro level several studies have also used MCDM methods for the evaluation of innovation and entrepreneurship performance of SMEs. Adebisi et al. (2019), Vyas and Jain (2020), and Velimirović et al. (2019) used the AHP method while Oliveira Trindade and Almeida (2017) used both AHP and the TOPSIS method.

In addition, Sadeghi et al. (2012) used both FAHP and Fuzzy TOPSIS, Rezaei et al. (2013) used both AHP and FAHP while Rostamzadeh et al. (2014), and Bölükbaş and Güneri (2017) used the FAHP and VIKOR methods whereas Rostamzadeh et al. (2014) also used the TOPSIS method.

Other studies have used different MCDM methods, such as Gupta and Barua (2016) who used the Best-Worst method while Gupta and Barua (2017) who used both the Best-Worst method and the Fuzzy TOPSIS.

Moreover, Zvirblis and Buracas (2012) used the SAW method and the Complex Proportional Assessment (COPRAS) method. Gonçalves et al. (2018) used the MACBETH method while Sepúlveda and Vasquez (2014) used the FlowSort method. Last but not least, Kamariotou et al. (2018) used the Multicriteria Satisfaction Analysis (MUSA) method whereas Bayarçelik et al. (2014) used the Analytical Network Process (ANP) method.

Adebisi et al. (2019) tried to analyze the entrepreneurial orientation and business performance on a sample of 327 Nigerian entrepreneurs. More specifically, they conducted a questionnaire-based survey and they used the AHP method to analyze the data. The authors used the following criteria based on the literature review: Innovativeness, Proactiveness, Risk taking, Autonomy and Competitive aggressiveness as well as 27 sub-criteria identified through survey. One limitation of this study is the fact that experts evaluated the relevance of the criteria and the alternatives.

The study of Oliveira Trindade and Almeida (2017) used the methods AHP and TOPSIS to measure the innovation capacity and innovation performance of 30 SMEs located in Rio de Janeiro, Brazil. The authors used three main criteria based on literature: Governance and organization, People, Processes and Innovation Performance as well as 12 sub-criteria identified through survey. The authors claimed that this study covered only 30 SMEs that participated in the NAGI-PUC-Rio Program, a fact that can be considered as limitation.

Vyas and Jain (2020) used the AHP method in order to prioritize the financial performance determinants in Indian SMEs. As criteria three competitive strategies from the literature review were used as follows: Market orientation, Entrepreneurial orientation and Corporate social responsibility. Moreover, 11 sub-criteria were used which were selected by 15 experts

from different backgrounds such as academics, industry, trade association and small business owners. The authors mentioned that this study is a pilot study because it only concerned Indian SMEs. Therefore, future research should focus on including the opinions of other stakeholders as well as more SMEs should be examined in different geographical areas.

The study of Velimirović et al. (2019) used the AHP method to assess the risk failure for SMEs in Serbia. Three were the criteria based on the literature as follows: Demography, Professional experience and Failed SMEs as well as 9 sub-criteria were used. One limitation of this study is the fact that it focused only on the SMEs in Serbia.

In their study, Sadeghi et al. (2012) used the FAHP method to develop a model for the assessment of success factors on a sample of 17 Iranian high-tech SMEs located in the Bio-Technology Incubator of Karaj. The authors were able to identify the Critical Success Factors of high-tech SMEs and they also used the Fuzzy TOPSIS to evaluate and determine the ranking of these companies. As criteria the authors used 10 main factors as well as 47 sub-factors based on literature review and interviews with experts. The main factors were given as follows: Human resource, Strategic, Entrepreneurs characteristics, Organizational, Financial, Product characteristics, Firm expertise, Policies and regulations, Market characteristics and Technological. One limitation of this study according to the authors is that these methods require experts' judgments whereas the study took place only on SMEs located in the Bio-Technology Incubator of Karaj.

In addition, Rezaei et al. (2013) used both the AHP and the FAHP methods to measure the entrepreneurial orientation of 59 SMEs and more specifically startups SMEs in the Dutch ICT industry. The authors used the following criteria: Innovativeness, Risk-taking and Proactiveness as well as they used 8 sub-criteria, based both on literature review and three experts. The authors suggest that in future research other MCDM and fuzzy approaches should be used for the assessment of entrepreneurial orientation.

Rostamzadeh et al. (2014) evaluated the entrepreneurial intensity of 30 Malaysian SMEs in the manufacturing sector, located in the Skudai area, using a hybrid approach that combined FAHP in order to estimate the importance of evaluation criteria, VIKOR to rank the companies and then the TOPSIS method to find the differences in the ranking of these two methods. As criteria the authors used the following, based on literature and on experts: Autonomy, Innovativeness, Risk taking, Proactiveness and Competitiveness aggressiveness as well as they used 14 sub-criteria. As limitations of this study could be considered the facts that only 30 SMEs were evaluated and in the manufacturing sector. According to the authors the study should be applied to the whole country as well as in the service sector. Moreover, when comparing TOPSIS and VIKOR only seven items were compatible. For future research the authors claimed that other MCDM methods could be used in a fuzzy environment.

Bölükbaş and Güneri (2017) evaluated the technology competency performance of 450 Turkish SMEs manufacturing firms. The authors used the FAHP method to decide the weights of criteria and sub-criteria as well as the VIKOR method to rank the companies. Three experts decided on the weights of the criteria where 20 criteria were used and six dimensions based on the literature review as follows: Process management, Product competitiveness, Information and Communication Technologies, Marketing strategies, Innovation and entrepreneurship, as well as Research and Development. As limitation of this study could be considered the fact that the study took place only for the year 2015 and only in one sector. Moreover, the authors mentioned that other MCDM methods could be used in a fuzzy environment and that this study could be applied in more sectors.

In their study, Gupta and Barua (2016) used the Best-Worst method in order to describe the enablers of technological innovation for Micro and Small Medium Enterprises (MSMEs) in India. MSMEs in India concern only two sectors as follows: manufacturing sector (investment in plant and machinery), and service sector (investment in equipment). The authors used four main criteria based on the literature review and discussions with experts: Entrepreneur role, Linkage capability, Technological infrastructure and Government support as well as 13 sub-

criteria and inputs. In total, 16 experts participated with at least ten years of experience in academia or as owners or managers of MSMEs. According to the authors the major limitation of this study is the fact that the enablers were chosen based only on the experts' opinion whereas in future research a larger sample of various MSMEs should be examined.

In addition, Gupta and Barua (2017) used the MCDM methods in order to evaluate which SMEs can be suppliers to other firms based on their innovation ability. As a case study an automobile manufacturing company was selected. The Best-Worst method was used in order to rank and evaluate the criteria weights and the Fuzzy TOPSIS method was used in order to rank the suppliers and select the best one among the alternatives. In total, 5 main criteria were selected, based on the literature review and discussions with four decision makers, as follows: External linkages, Entrepreneur characteristics, Resources for innovation, Employee-related factors, Research and Development initiatives as well as 23 sub-criteria. The authors claimed that a major limitation of this study is the fact that it is restricted to a specific organisation which has a specific line of products. Also, although the method Best-Worst provided accurate results, the authors claimed that other MCDM methods could also be applied.

Zvirblis and Buracas (2012) used the SAW and the Complex Proportional Assessment (COPRAS) methods in order to explore the economic competitiveness of the Baltic countries for the year 2011-2012 using the data from the World Economic Forum. In addition, they proposed a global aggregated evaluation index of SMEs as regards to their competitive advantages and they applied this index in a set of Lithuanian SMEs. As criteria, seven professional experts decided the following: Extent of marketing sophistication, Production process sophistication, Pay and productivity, Capacity for production/services export, Capacity for innovation, Firm level technology absorption, Creating of value chain and breath, Corporate social responsibility and State of cluster development. This study focused only on the Baltic countries and more specifically in one country, Lithuania, a fact that can be considered as a limitation.

Furthermore, Gonçalves et al. (2018) used the MACBETH method in order to evaluate the competitiveness of SMEs. They also applied cognitive mapping approaches in order to gain a better understanding and define the set of criteria. As criteria, a panel of 5-7 experts who were entrepreneurs and senior managers of SMEs, decided to use the following variables: Infrastructure and Equipment, External Factors, Business and Marketing Strategies, Human Capital, as well as Management and Manager Profiles. The authors supported that future work should include different group of participants in different geographical locations. In addition, other MCDM methods could be implemented to develop comparative analyses.

Sepúlveda and Vasquez (2014) used the FlowSort method to determine the innovation capability of 9 SMEs in Chile. First they used organizational variables from the literature review to assess each company and then they classified each company in four categories as follows: passive, reactive, preactive and proactive. As criteria the authors used the following dimensions: Innovation culture, Concepts generation, Design/Engineering tools, Human resources management and Investment, Strategic management, Project management, Knowledge management and Capitalization/ROI. As limitations of this study could be considered the facts that only 9 SMEs were examined in one area, Chile and the study took place only for the year 2014.

Kamariotou et al. (2018) used the Multicriteria Satisfaction Analysis (MUSA) method in order to evaluate the performance of Information Systems, which can have an impact on the overall firm performance, in Greek SMEs with a use of questionnaire on a sample of 1246 executives where finally the respondents were 294. As criteria the authors used the following based on the literature review: Sales growth, Profitability, Market share, Innovation, Efficient work style, Flexible process for NPD and Customer's satisfaction. According to the authors one limitation of this study is the fact that this analysis concerned only one country, Greece. Therefore, a larger sample of SMEs in different countries as well as other MCDM methods could be also applied.

Bayarçelik et al. (2014) examined the factors that can lead Turkish SMEs in the manufacturing sector in successful innovation with the use of the Analytical Network Process (ANP) method. The authors examined 33 SMEs managers or owners in Istanbul. The following criteria based on the literature were used: Financial Factor, Firm Size, Institutional Factor, Technological Capability, Consumer Preferences, Market Orientation, Culture Factor, Management Skills, Learning Capability, Market Orientation and Competitive Advantage. The study focused only on Turkish SMEs and only in one sector, the manufacturing sector, all these can be considered as limitations of this study.

Last but not least, another MCDM method that is used for the assessment of innovation performance and competitiveness, is the Data Envelopment Analysis (DEA) method. Although DEA is a method that can handle many inputs and outputs, according to Jorda et al. (2012) it ignores the effect of exogenous variables on the operation as well as statistical errors. Moreover, according to the authors, this method does not indicate how to improve efficiency as well as it is difficult to perform statistical tests with the results.

3.5 Other approaches

UP Global (2014) suggests that five are the main elements which can support successful innovative ecosystems as follows:

1. Talent where countries should invest more in human capital to develop startup skills in order to lead them in the creation of new businesses.
2. Density which concerns talented human capital which is willing to take risks for business ventures. In order to do that countries should invest more in supporting them through clusters, physical hubs, media campaigns about entrepreneurship, building networks with mentors, as well as connecting academia with businesses.
3. Culture where countries should focus more on promoting an entrepreneurial culture, such as for example through promoting jobs for startups.
4. Capital where investors can help startup founders through financing and coaching, as well as policy makers should take better measures, such as for example on taxes to help startup businesses.
5. Regulatory Framework where governments should provide a more stable environment for entrepreneurs and investors, as well as better regulations on starting and closing business, tax policies, policies for intellectual property rights etc.

According to Stangler and Bell-Masterson (2015) the overall performance of the ecosystem can be measured in terms of outcomes and vibrancy. Four indicators (see Table 3.7) can be used for the measurement of the entrepreneurial ecosystem vibrancy, which are the following: Density, Fluidity, Connectivity and Diversity. The purpose is to answer the following questions from the ecosystem leaders: what do we measure and how do we measure it?

Also, the goal of these indicators is to capture the evolution and the vibrancy of entrepreneurial ecosystems. The four indicators can be explained as follows:

1. The density indicator measures the entrepreneurial density which means how many entrepreneurs are in a given city or region.
2. The fluidity indicator measures how fluid the entrepreneurial ecosystem is in order for the entrepreneurs to take the existing resources and recombine into new creations.
3. The connectivity indicator measures how the connection and the connectivity between programs, companies and individuals can have an impact on the entrepreneurial ecosystem.
4. The diversity indicator measures the diversity from specializations from the economic perspective, the attraction and assimilation of immigrants as well as the economic mobility.

The Aspen Network of Development Entrepreneurs (ANDE) and the UK Department for International Development (DFID) (2013) provide the following guidelines for conducting an assessment of an entrepreneurial ecosystem:

1. Geographic Unit of Analysis: As a first step, it is essential to identify the geographic region for study, which may be a metropolitan region, a state or province, or an entire country.

Table 3.7. Indicators for the measurement of the entrepreneurial ecosystem vibrancy. Source: Stangler & Bell-Masterson (2015).

Indicator	Measure	Possible Sources
Density	New and young firms per 1,000 people	Census Bureau, Business Dynamics Statistics (BDS)
	Share of employment in new and young firms	Census Bureau, BDS
	Sector density, especially high-tech	National Establishment Time Series (NETS)
Fluidity	Population flux	Internal Revenue Service
	Labor market reallocation	Quarterly Workforce Indicators (QWI)
	High-growth firms	Inc. 5000 and NETS
	Program connectivity	Under development
	Spinoff rate	Possibly: CrunchBase; LinkedIn
	Dealmaker networks	Private databases, including Capital IQ
Diversity	Multiple economic specializations	Quarterly Census of Employment and Wages (QCEW)
	Mobility	Equality of Opportunity project
	Immigrants	American Community Survey (ACS)

2. Depth of Analysis: Project scoping should also include the level of analysis that is needed to provide actionable recommendations to the relevant stakeholders. The Council on Competitiveness suggests 3 levels of analytical depth: Asset Identification, Basic Evaluation, Comprehensive Assessment.

3. Domains of Interest: While the ecosystem is inherently interconnected, there may be some elements that are of more interest than others, based on the kinds of interventions that are planned and/or possible.

4. Identifying and Rating Indicators: Despite the wide range of indicators available for entrepreneurship research, it is essential to identify the most relevant and accurate indicators available. The OECD has developed a framework to assess the quality of indicators, based on 3 dimensions: relevance, accuracy and availability.

5. Data Collection and Analysis: A comprehensive assessment typically involves a combination of primary and secondary data collection. Once the appropriate indicators have been identified, evaluators can identify the gaps in the ecosystem and develop potential interventions (as cited in ANDE, 2013).

Furthermore, the Babson Entrepreneurship Ecosystem Project (BEEP) (see Fig. 3.6) has been developed by the Babson College in 2010 and it tries to create new methodologies “for using entrepreneurship as an effective, results-oriented strategy for the development of economic prosperity” as well as it can be used for both national and regional ecosystems. This framework is constituted by the following pillars each of one is constituted by many variables:

1. Policy looks at both government regulations and support of entrepreneurship along with leadership.
2. Finance looks at the full spectrum of financial services available to entrepreneurs.
3. Culture accounts for both societal norms along with the presence of success stories to inspire the next generation of entrepreneurs.
4. Supports examine physical infrastructure, non-governmental institutions and the presence of supporting professions such as lawyers, accountants and investment bankers.
5. Human Capital examines both the quality of higher education system and the skill level of the work force.
6. Markets look at both entrepreneurial networks and the presence of early customers (as cited in ANDE 2013).

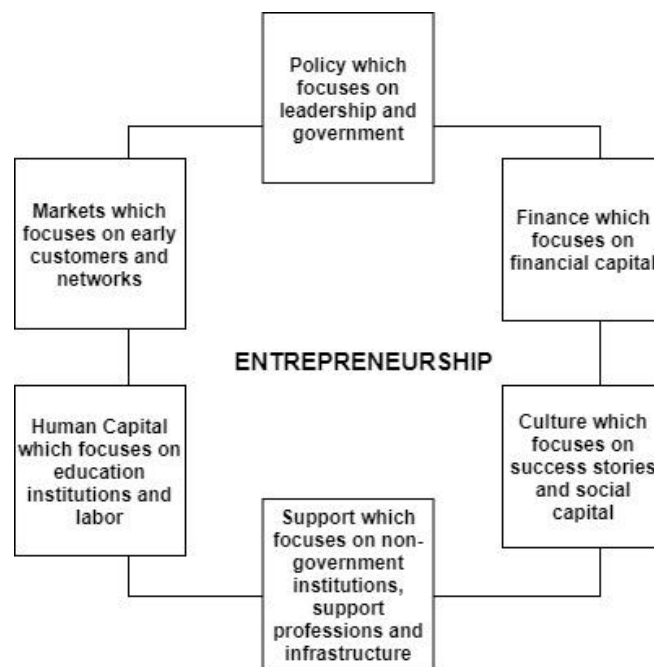


Figure 3.6. The BEEP project. Source: Babson College (n.d.).

Another framework that can be used for both national and regional ecosystems is the Six + Six model (see Fig. 3.7) by the Koltai and Company LLC.

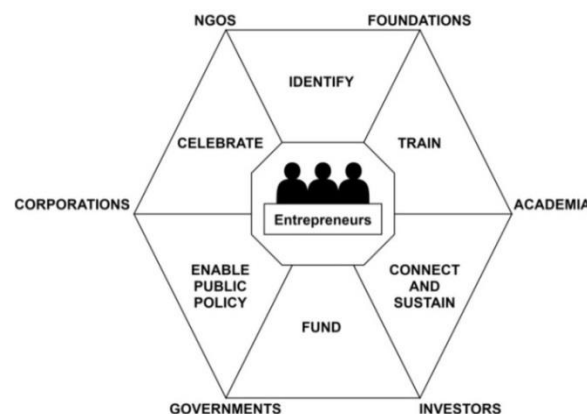


Figure 3.7. The Six + Six model of the Koltai and Company LLC. Source: koltai.co (n.d.).

According to the koltai.co (n.d.) the creation of entrepreneurship cannot occur only with one factor alone but when multiple sectors and actors work together for the creation of an environment that can support entrepreneurship. With this holistic approach progress can occur that can lead to a healthy entrepreneurial ecosystem.

In this model it can be seen not only the pillars but also the actors that play a significant role on this entrepreneurial ecosystem. It is worth mentioning the main six pillars which are the following: Identify, Train, Connect and Sustain, Fund, Enable Public Policy and Celebrate Entrepreneurs.

3.6 Comparison and discussion

When comparing the existing frameworks, it must be pointed out that they can be categorized based on the level of their assessment whether it is macro, meso or micro as well as on the evaluation they perform. Thus, there is not an appropriate framework that can be used for the assessment of the innovative entrepreneurial ecosystem that can cover the need for a multilevel assessment.

At the macro level as regards to the assessment of innovation, three are the main frameworks and indexes that are used. First, the EIS is a framework that evaluates the performance of national innovation systems, providing rich data coverage both on countries and years with many innovation indicators. Its methodology is quite simple where the Summary Innovation Index and the countries' scores are calculated. Moreover, it provides a classification scheme for countries based on their innovation performance to the following four categories: Innovation Leaders, Strong Innovators, Moderate Innovators and Modest Innovators. Hollanders (2009) used the data of the European Innovation Scoreboard in order to measure innovation and analyzed eight reports of the EIS as regards to rationale, use of innovation, methodology and results.

Then, the GII evaluates the innovation performance of a country and it provides rich data coverage both on countries and years with many indicators for innovation. Its methodology is quite simple where the overall GII score is the simple average of the Innovation Input Sub-Index and the Innovation Output Sub-Index. Also, it provides a ranking of countries' strengths and weaknesses. Jankowska et al. (2017) have used the Global Innovation Index in their study in order to measure the efficiency of national innovation systems.

The Bloomberg Innovation Index presents a ranking of the top 50 of countries that innovate, it only covers 60 countries as well as a six year period whereas it takes into consideration six equally weighted metrics and their scores were combined to provide an overall score for each country from 0 to 100. Wolniak and Grebski (2018) have used this index in their study in order to analyze its sub-indexes as a tool to measure economic growth from an innovation perspective.

The two most widely used frameworks for the innovation assessment at the macro level are the EIS and the GII due to the advantages they offer, for example they cover many countries and many years, they have a variety of innovation indicators as well as they provide classification and ranking for countries allowing to find their strong and weak points whereas the Bloomberg Innovation Index is less used since it has limited coverage of countries only 50.

At the macro level as regards to the assessment of entrepreneurship, three are the main frameworks and indexes that are used. First, the GEI evaluates the health of the countries' entrepreneurial ecosystems, it has rich data coverage on countries and uses both individual and institutional variables with many indicators for entrepreneurship whereas the overall GEI score is calculated both on these individual and institutional variables' scores. Szerb and Trumbull (2015) used the GEI in order to measure entrepreneurship in the V4 countries.

Furthermore, GEM provides a framework with two surveys, the National Expert Survey which is about the entrepreneurial framework conditions and it is conducted at the national level and the Adult Population Survey which is about the entrepreneurial behaviour and attitudes and it is conducted at the individual level. These surveys provide rich data coverage both on countries and throughout the years. In addition, both of these surveys are conducted by experts and with the use of questionnaires and can be also used for the assessment of entrepreneurship at the micro level. Justo et al. (2008) used the data from the GEM project to measure the entrepreneurial activity in Spanish respondents whereas Anokhin and Schulze (2009) also used the data from the GEM project in order to investigate if the level of corruption can have an impact on entrepreneurial activity and innovation across nations.

The OECD - Eurostat Entrepreneurship Indicators Programme is a framework which measures the entrepreneurial performance at the country level, it can help in grouping, rating and evaluation of policy measures, however, there is not enough coverage on data availability as regards to countries since it covers mostly 28 EU countries. This framework uses the three following flows which are related to each other: Determinants, Entrepreneurial Performance and Impact. Arruda et al. (2015) used the main six entrepreneurship determinants of the OECD - Eurostat Entrepreneurship Indicators Programme in order to map the Brazilian Entrepreneurial Ecosystem of Startups.

The most widely used frameworks for the entrepreneurship assessment at the macro level are GEI and GEM due to the advantages they offer, for example they cover many countries and many years, they have a variety of entrepreneurship indicators as well as the Global Entrepreneurship Index provides ranking for countries allowing to find their strong and weak points whereas the OECD - Eurostat Entrepreneurship Indicators Programme is less used since it has limited coverage of countries.

Other frameworks that are being used at the macro level are the GCI of the World Economic Forum and two databases, the Entrepreneurship Doing Business of the World Bank and the database of the IMF organization.

The GCI measures the competitiveness of one country, it provides rich data coverage both on countries and years as well as it ranks countries by presenting their key indicators, their performance overview as well as their most problematic factors for doing business. Also, its score is calculated based on the pillars as well as the stage of development of one country. Taskinsoy (2019) have used the GCI in order to compare Turkey's competitiveness to the competitiveness of G8 nations.

As regards to the databases, on the one hand, the Entrepreneurship Doing Business database measures the entrepreneurial activity of private enterprises around the world, it provides rich data coverage both on countries and years, mainly it uses only two variables and it does not measure innovation. This survey is about entrepreneurial activity where the data collection process involves telephone interviews and email correspondence with business registries. Klapper et al. (2010) have used the data from the World Bank Entrepreneurship Database in order to measure the entrepreneurship activity of 84 countries.

On the other hand, the IMF organization has different datasets and its main goal is to ensure financial stability to countries, it provides rich data coverage both on countries and years although there are many and different indicators, mainly they are economic indicators. The data collection takes place through three actions that IMF applies to countries which are surveillance, technical assistance and training as well as lending.

At the meso level as regards to the assessment of innovation, two are the main frameworks and indexes that are used. First, RIS evaluates the performance of a regional innovation system and it uses the NUTS classification for dividing the economic territory of EU as follows: NUTS 1 captures major socio-economic regions, NUTS 2 captures basic regions for the application of regional policies and NUTS 3 captures small regions for specific diagnoses. Although it provides rich data coverage on regions and more specifically 212 regions, it does

not provide rich data coverage on years since it covers a five year period whereas its methodology is similar to the EIS methodology. Zollo et al. (2011) have used the data of RIS in order to investigate the performance of the Campania region in Italy. In addition, Carayannis and Bakouros (2010) have also used RIS in order to measure innovation in the region of Western Macedonia.

Then, the Innovation Index by the Indiana Business Research Center evaluates the performance of a regional innovation system, however, the data coverage is only for the USA and it covers a two year period whereas it is calculated based on four component indexes which include many variables.

At the meso level as regards to the assessment of entrepreneurship, one is the main index that is used. The REDI evaluates the health of regional entrepreneurial ecosystems and it uses the NUTS classification for dividing the economic territory of EU as follows: NUTS 1 captures major socio-economic regions, NUTS 2 captures basic regions for the application of regional policies and NUTS 3 captures small regions for specific diagnoses. It has rich data coverage on regions but not on years since it covers one year as well as its methodology is similar to the GEI methodology. Szerb et al. (2013) have used REDI in order to analyze the entrepreneurship level in 7 Hungarian regions at NUTS 2 level.

Also, at the meso level, the Asset Mapping Roadmap framework by the Council on Competitiveness evaluates the competitiveness of regions, it provides a guidebook with three levels for mapping competitiveness as follows: 1) Asset Identification, 2) Basic Evaluation and 3) Comprehensive Assessment with different input and output variables as well as business regional surveys and interviews are conducted.

The most widely used framework for the innovation assessment at the meso level is RIS due to the advantages it offers, for example it covers many regions and many years, it has a variety of innovation indicators as well as it provides classification for regions allowing to find their strong and weak points whereas for the assessment of entrepreneurship the Regional Entrepreneurship and Development Index is used despite the fact that its data availability covers only one year.

Last but not least, at the micro level there are two surveys as regards to innovation, the Innobarometer and the CIS. As regards to entrepreneurship, there is the Eurobarometer and the SMEs Performance Review framework. Regarding the economic performance of SMEs, there is the Observatory of European SMEs Businesses as well as one database on business ownership which is the Comparable Entrepreneurship Data for International Analysis (COMPENDIA).

The survey Innobarometer focuses on current activities and attitudes related to innovation, it provides rich data coverage both on countries and years and it is conducted via telephone yearly to all enterprises from 1+ employee. Montresor and Vezzani (2016) have used the data of the Innobarometer 2013 in order to analyze the innovation impact of intangible investments in 36 countries.

The survey Community Innovation Survey measures the innovation activity in the enterprises of the EU countries and the ESS countries, it covers many countries and a five year period whereas it is conducted by the European Commission every two years with the use of questionnaire at the enterprise level in order to measure innovativeness across sectors and regions. Frenz and Ietto-Gillies (2009) have used the data of the Community Innovation Survey in order to investigate the impact of innovation on different sources of knowledge.

The survey Eurobarometer focuses on entrepreneurship, it provides rich data coverage on countries and on years, every year it examines different themes of entrepreneurship and the survey is conducted by experts via telephone. Ester and Roman (2017) have used the data of Eurobarometer where the generalization approach is investigated in order to analyze better the female entrepreneurship.

The framework SMEs Performance Review aims to improve entrepreneurship in SMEs in Europe through the creation of fact sheets, it provides rich data coverage on countries and more specifically it covers 28 EU member states but it only covers a two year period. These fact sheets focus on key performance indicators and national policy developments related to the SBA's 10 policy dimensions.

The database COMPENDIA provides data on business ownership across different countries. It provides rich data coverage as regards to countries since it covers OECD countries and the period 1972-2004. This database provides information on the following variables: the business ownership rate (the number of self-employed business owners as a proportion of the total labor force) as an indicator of entrepreneurial activity.

The most widely known surveys at the micro level for the innovation assessment are the Community Innovation Survey followed by the Innobarometer and the Eurobarometer for the entrepreneurship assessment.

It is also worth presenting the data availability (see Table 3.8) of the existing frameworks, surveys and datasets that were analyzed in this Chapter, throughout the years.

Table 3.8. Data availability throughout the years.

Frameworks	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
European Innovation Scorecard	x	x	x	x	x	x	x	x	x	x	x
Global Innovation Index	x	x	x	x	x	x	x	x	x	x	x
Bloomberg Innovation Index					x	x	x	x	x	x	x
Global Entrepreneurship Index	x	x	x	x	x	x	x	x	x	x	x
Global Entrepreneurship Monitor	x	x	x	x	x	x	x	x	x		
OECD - Eurostat Entrepreneurship Indicators Programme	x	x	x	x	x	x	x	x	x	x	
The Global Competiveness Index	x	x	x	x	x	x	x	x	x	x	x
World Bank Group Entrepreneurship Survey	x	x	x	x	x	x	x	x	x	x	x
IMF organization	x	x	x	x	x	x	x	x	x	x	x
Regional Innovation Scorecard		x			x		x		x	x	
Innovation Index by the Indiana Business Research Center		x									
Regional Entrepreneurship and Development Index						x					
Asset Mapping Roadmap by the											

Council on Competiveness											
Innobarometer		x	x					x	x		
Community Innovation Survey	x		x		x		x		x		
Eurobarometer	x	x	x	x	x	x	x	x	x	x	x
Observatory of European Small and Medium-sized Businesses											
SMEs Performance Review										x	x
Comparable Entrepreneurship Data for International Analysis	-	-	-	-	-	-	-	-	-	-	-

Other approaches for the assessment of innovation and entrepreneurial ecosystems, include the elements suggested by UP Global (2014) which can support successful innovative ecosystems, the four indicators proposed by Stangler & Bell-Masterson (2015) that can measure the overall performance of the ecosystem in terms of outcomes and vibrancy as well as the guidelines proposed by the ANDE and the DFID (2013) for conducting an assessment of an entrepreneurial ecosystem.

Furthermore, other studies have used MCDM methods for the evaluation of innovation and entrepreneurial ecosystems at the macro, meso and micro level and it can be concluded that these kinds of methods are appropriate for these assessments. However, these studies besides their contributions, they also have limitations (see Table 3.9).

Table 3.9. Contributions and Limitations of MCDM studies.

Author	Method	Level	Contributions	Limitations
Kitsios and Sitaridis (2017) Sitaridis and Kitsios (2019)	TOPSIS NWM	Macro level	Ranking and comparing the Greek entrepreneurial ecosystem to 9 other countries, that are geographically close and had economic crisis Data from the National Expert Survey of GEM	Small sample of countries and the studies used the GEM data only to cover the year 2016
Silva et al. (2017)	TOPSIS	Macro level	Analysis of innovation indicators for 22 Latin America and Caribbean countries Data from GII and WIPO, only 7 innovation indicators	Small sample of countries, the study used the GII and WIPO data, it only covers the year 2015
Silva et al. (2019)	TOPSIS	Macro level	Analysis of innovation indicators for African,	Large sample of countries but it does

			Asian and Oceanic countries Data from GII and WIPO, only 7 innovation indicators	not include EU countries, the study used only 7 innovation indicators from GII and WIPO whereas it only covers the year 2015
Kaynak et al. (2017)	TOPSIS	Macro level	Evaluation of innovation performance through case studies, in total 4 Data from GCI, Innovation Union Scoreboard and GII	Small sample of countries, only Macedonia (FYR), Iceland, Serbia and Turkey were evaluated, the study used data only for the year 2015
Kabadurmus and Kabadurmus (2019)	TOPSIS	Macro level	Comparison of innovation levels for 32 Eastern European and Central Asian countries as regards to four types of innovation Data from BEEPS	Large sample of countries but it does not include all EU countries, the study used only 4 types of innovation as well as the data from BEEPS only for the years 2012-2016
Corrente et al. (2018)	SMAA	Macro level	Evaluation and comparison of entrepreneurial ecosystems for 23 European countries Data from the National Expert Survey of GEM	Large sample of countries that include EU countries, the study used the data from GEM that cover only the year 2017 and there is an implicit bias due to the fact that the values of GEM are evaluated by experts who can be subjective
Mujahid et al. (2019)	AHP	Macro level	Prioritization of the dimensions and sub-dimensions of the entrepreneurial ecosystems, one case study in Pakistan Dimensions identified based on literature review The data were collected by 37 experts	Small sample of countries, only Pakistan and the results are based only on the experts' opinions, this study could be improved if the number of experts increased
Zvirblis and Buracas (2011)	SAW	Macro level	Assessment of entrepreneurial level, one typical case	Small sample of countries, only Lithuania, the study

			<p>Lithuania</p> <p>Criteria and primary indicators were identified and examined by experts</p> <p>Data from the World Economic Forum</p>	<p>covers the year 2009-2010, the reliability of the applied multicriteria method can be limited due to the experts' evaluations</p>
Poledníková (2014)	AHP SAW TOPSIS	Meso level	<p>Comparison of 35 regions of the Visegrad Four countries as regards to their socio-economic development</p> <p>The study covers the years 2000-2010</p> <p>Three different types as subcriteria: economic, social and territorial disparities and eight different indicators from Cohesion reports which are available in the Eurostat database</p>	<p>Small sample of regions due to the fact that only the Visegrad Four countries (Czech Republic, Hungary, Poland and Slovakia) were examined, the methods SAW and TOPSIS in some cases did not have identical rankings</p>
Bilbao-Terol et al. (2019)	TOPSIS	Meso level	<p>Measurement of regional competitiveness in the regions of Spain at NUTS 2 level</p> <p>Data based on the RCI and creation of a new index called European Regional Sustainability Competitiveness Index</p>	<p>Small sample of regions, 17 and only in Spain, emphasis on the environmental character rather than the innovative or entrepreneurial aspect, the data are based on the RCI of 2013</p> <p>The authors found out that TOPSIS due to its compensatory feature of the aggregation procedure may not be appropriate for social evaluation</p>
Garcia-Bernabeu et al. (2020)	Multi-Reference Point based Weak and Strong Composite Indicator (MRP-	Meso level	<p>Evaluation of regional innovation performance in Spain</p> <p>Data from RIS</p>	<p>Small sample of regions only 17 regions in Spain, the study covers the year 2019 and this is the first time this method is used for the assessment of</p>

	WSCI) approach			innovation performance
Adebiyi et al. (2019)	AHP	Micro level	<p>Analysis of entrepreneurial orientation and business performance on Nigerian entrepreneurs</p> <p>Data collected based both on literature review and from survey on 327 decision makers/experts/entrepreneurs</p>	<p>Large sample of 327 entrepreneurs, however the study took place only in one country, Nigeria and only for the year 2019</p> <p>Experts evaluated the relevance of the criteria and the alternatives which can involve subjectivity</p>
Oliveira Trindade and Almeida (2017)	AHP TOPSIS	Micro level	<p>Measurement of the innovation capacity and innovation performance of SMEs located in Rio de Janeiro, Brazil</p> <p>Data collection via survey instrument with questions based on literature</p>	<p>Small sample of companies only 30 SMEs in one country, Brazil, the study included only SMEs that participated in the NAGI-PUC-Rio Program and it covers the year 2017</p>
Vyas and Jain (2020)	AHP	Micro level	<p>Prioritization of the financial performance determinants in Indian SMEs</p> <p>Data collected based both on literature review and from 15 experts from different backgrounds</p>	<p>This study is a pilot study because it concerned only Indian SMEs, the opinions of more stakeholders should be included as well as more SMEs in different geographical areas</p>
Velimirović et al. (2019)	AHP	Micro level	<p>Assessment of risk failure for SMEs in Serbia</p> <p>Data from literature</p>	<p>Small sample of companies only 30 SMEs in one country, Serbia and the study covers only the year 2019</p>
Sadeghi et al. (2012)	FAHP Fuzzy TOPSIS	Micro level	<p>Development of a model for the assessment of success factors on Iranian high-tech SMEs</p> <p>Data from literature review and interviews</p>	<p>Small sample of companies, only 17 high-tech SMEs and in one country, Iran as well as these SMEs were located in the Bio-Technology</p>

			with experts	Incubator of Karaj These methods require experts' judgments which can be subjective
Rezaei et al. (2013)	AHP FAHP	Micro level	Measurement of the entrepreneurial orientation of SMEs and more specifically startups in the Dutch ICT industry Data from literature and from three experts	Large sample of SMEs, in total 59 but only in one country, Denmark and on sector, ICT industry The authors claim that other MCDM and fuzzy approaches can be used for the measurement of entrepreneurial orientation
Rostamzadeh et al. (2014)	FAHP VIKOR TOPSIS	Micro level	Evaluation of the entrepreneurial intensity of Malaysian SMEs in the manufacturing sector located in the Skudai area Data from literature and questionnaire's distribution to managers, assistant managers and analysts of companies	Small sample of companies, only 30 SMEs and in one country, Malaysia as well as these SMEs were located in the Skudai area and concerned only one sector, the manufacturing The authors support that the study should be applied to the whole country as well as in the service sector. Moreover, other MCDM methods could be used in a fuzzy environment
Bölükbaş and Güneri (2017)	FAHP VIKOR	Micro level	Evaluation of the technology competency performance of Turkish SMEs manufacturing firms Data collected from literature review and three experts' evaluations	Large sample of SMEs in total 450 but only in one country, Turkey and one sector, manufacturing, as well as the study took place only for the year 2015 The authors claim that other MCDM could be applied in fuzzy environments

				and this study should be applied in other sectors
Gupta and Barua (2016)	Best-Worst	Micro level	<p>Description of the enablers of technological innovation for Micro and Small Medium Enterprises (MSMEs) in India</p> <p>Data collected based both on literature review and discussions with 16 experts who had at least ten years of experience in academia or as owners or as managers of MSMEs</p>	<p>The study took place only in one country, India and with a small sample of MSMEs which concern only two sectors as follows: manufacturing sector (investment in plant and machinery) and service sector (investment in equipment)</p> <p>The identification of enablers was conducted based only on the experts' opinions</p>
Gupta and Barua (2017)	Best-Worst Fuzzy TOPSIS	Micro level	<p>Evaluation of which SMEs can be suppliers to other firms based on their innovation ability</p> <p>Data collected based both on literature review and discussions with experts</p>	A major limitation of this study is the fact that it is restricted to a specific organisation which has a specific line of products
Zvirblis and Buracas (2012)	SAW Complex Proportional Assessment (COPRAS)	Micro level	<p>Proposition of a global aggregated evaluation index of SMEs as regards to their competitive advantages and application of this index in a set of Lithuanian SMEs</p> <p>Data collected based on both the World Economic Forum and discussions with experts</p>	Small sample, only the SMEs in one country were examined, in Lithuania and only for the year 2011-2012
Gonçalves et al. (2018)	MACBETH	Micro level	<p>Evaluation of the SMEs' competitiveness</p> <p>Data collected from</p>	This study included 5-7 experts and future work should include different

			cognitive mapping approaches and discussions with decision makers	group of participants in different geographical locations and other MCDM methods could be implemented to develop comparative analyses
Sepúlveda and Vasquez (2014)	FlowSort	Micro level	Determination of the innovation capability of SMEs in Chile Data collected from literature review	Small sample of SMEs, only 9 and in one country, Chile whereas the study took place only for the year 2014
Kamariotou et al. (2018)	MUSA	Micro level	Evaluation of the Information Systems' performance, which can have an impact on the overall firm performance, in Greek SMEs Data collected from survey, criteria based on literature	One limitation of this study is the fact that this analysis concerned only one country, Greece A larger sample of SMEs in different countries as well as other MCDM methods could be also applied
Bayarçelik et al. (2014)	ANP	Micro level	Examination of successful innovation factors in Turkish SMEs in the manufacturing sector Data collected from literature and questionnaire	Large sample of SMEs in total 34 but only in one country, Turkey and on one sector, manufacturing

It can be observed from the examined studies presented in Table 3.9 that as regards to the assessment of innovation and entrepreneurial ecosystems either at the macro, meso or micro level, one of the most widely used MCDM method, is the TOPSIS method. Regarding the criteria and subcriteria, these studies used data based both on literature review as well as on frameworks which were analyzed in this chapter such as GII, GEI, etc. The new proposed framework uses data based both on existing studies and theories as well as most of the examined frameworks in this chapter.

None of the above studies have evaluated the innovation and entrepreneurial ecosystems at all levels, macro, meso and micro. This is a fact that shows the need for a new framework which can provide a complete multilevel assessment of these ecosystems. In addition, the existing studies focused on the assessment of large firms rather than SMEs whereas this thesis focuses on the assessment of SMEs at the micro level. The new proposed framework in this thesis, can provide a complete multilevel assessment of the innovative entrepreneurial ecosystems, with the use of the MCDM methods.

In addition, the studies that used methods such as for example AHP, etc, require experts' judgments which can be subjective. The new proposed framework has been implemented with the NWM and the TOPSIS method which can provide independence from subjective experts' judgments. These methods as far as it is known have been used by limited MCDM studies,

such as the studies of Kitsios and Sitaridis (2017), and Sitaridis and Kitsios (2019) where they evaluated the Greek entrepreneurial ecosystem compared to other 9 countries.

Moreover, another limitation of the examined studies is the fact that they use a small sample of countries such as for example only Latin America and Caribbean countries. A small sample of regions such as for example regions only in one country, Spain and a small sample of companies such as for example SMEs located in the Bio-Technology Incubator of Karaj. Also, most of the studies focused on one sector such as for example the manufacturing sector. The new proposed framework has been applied to 28 EU countries, 212 EU regions and to a sample of 120 companies in the Cretan Agrofood industry which focused on seven different categories such as Olive oil, Honey, Dairy products, Vegetables, Fruits, Wine and Other.

Another element which shows the need for the new proposed framework, is that none of the examined MCDM studies have linked their frameworks for the assessment of innovative entrepreneurial ecosystems with the QIH model. The new proposed framework allows the evaluation of different stakeholders and is connected to the different stakeholders of the QIH model, which are industry, academia, university and civil society.

Last but not least, none of the examined MCDM studies have used the 3P framework of Carayannis and Provan (2008). The new proposed framework has successfully incorporated the 3P framework and shows that besides the measurement of firm innovativeness, it can also be used for the assessment of innovative entrepreneurial ecosystems.

Chapter 4. Proposed Approach

4.1 Overview

The new proposed framework will be appropriate for the assessment of innovative entrepreneurial ecosystems at the macro, meso and micro level. The reasoning behind the creation of this new proposed framework was to develop a framework that could be used for the assessment of the innovative entrepreneurial ecosystems at the macro, meso and micro level with as much consistency between all levels as possible. Due to this fact, the main domains and pillars remain the same throughout all levels. In addition, many and different variables are used that are appropriate for the assessment at each level.

The new proposed framework uses the 3P framework of Carayannis and Provan (2008) which is used for the measurement of firm innovativeness. The 3P framework is incorporated in this thesis in order to create the domains of the new proposed framework and evaluate the immediate, mid-range and long-range results of different innovative entrepreneurial ecosystems.

In addition, the new proposed framework can be connected to the QIH model. The framework developed in this thesis contributes to the evaluation of different stakeholders within the innovative entrepreneurial ecosystems and is connected to the different stakeholders of the QIH model, industry, academia, university and civil society..

According to Figueira et al. (2016) most problems in the real world can be found in a complex environment where logic, uncertainty, inaccurate knowledge and not clear preferences often conflict and have to be taken into consideration simultaneously. The methods of the Multi-Criteria Decision Making can help to face this complexity.

Belton and Stewart (2002) support that *“consideration of different choices or courses of action becomes a multiple criteria decision making (MCDM) problem when there exist a number of such standards which conflict to a substantial extent.”* The authors claim that everyone is well practiced in multicriteria decision making because every decision involves a number of different factors that need to be taken into consideration. Some examples are personal decisions such as the purchase of a new apartment or what to wear every day, etc.

The goal of the Multi-Criteria Decision Making, according to the authors, is to help the decision makers make the best possible decisions by evaluating the available information, all criteria and factors in order to decrease the risk of regrets after the decisions.

In this thesis, the Multi-Criteria Decision Making is used for the problem of assessing innovative entrepreneurial ecosystems at the macro, meso and micro level due to the many benefits it can offer. According to Roy (2016) the goal of a multicriteria approach is to help managers to make “better” decisions, thus, a multicriteria approach can delimit a broad spectrum of points of view liable to structure the decision process with regard to the actors involved.

It can also construct a family of criteria which preserves, for each of them, without any fictitious conversion, the original concrete meaning of the corresponding evaluations. Last but not least, it can facilitate debate on the respective role (weight, veto, aspiration level, rejection level, ...) that each criterion might be called upon to play during the decision aiding process.

Objectivity is a great matter in Multi-Criteria Decision Making and according to Roy (1996) a model is objective only if it constitutes: *“an impartial and unbiased representation of the class of phenomena that it is to reflect within the context of the questions considered, and an impartial and unbiased vehicle for investigation or communication, given the class of phenomena represented and the manner in which they have been taken out of their context.”*

The methods that are used in this thesis are the Non-Weighted model and the TOPSIS method, more details about these methods can be found in Appendix 1. In order to validate the results of the Non-Weighted model with the TOPSIS results, the Spearman's rank correlation coefficient was used and it was found that at all levels strong correlation between these two methods exists.

The NWM was proposed by Huang and Moh (2016) and it is based on the Perron-Frobenius Theorem. It was chosen due to the multiple benefits that it offers. According to Kitsios and Sitaridis (2017) in the NWM no time is spent by the experts for the evaluation of criteria relative importance. There is also independence from subjective experts' judgments. In addition, there is relatively low mathematical complexity and no linear relations assumed.

In this thesis the steps that were followed for the NWM were as described in Kitsios and Sitaridis (2017):

1. Step 1. Construction of the performance matrix with the criteria and the alternatives.
2. Step 2. Calculation of the comparison matrix.
3. Step 3. Calculation of the eigenvectors and eigenvalues.
4. Step 4. Calculation of the ranking.

The Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method was first developed by Hwang and Yoon in 1981. The basic concept of the TOPSIS method, according to Roszkowska (2011) is that it selects the alternative closest to the idea solution and farthest from the negative ideal solution.

According to Latuszynska (2014) in recent years the TOPSIS method has been used widely in different fields such as in human resources management, transport, etc. The TOPSIS method was chosen due to the several advantages that it offers. According to Hung and Cheng (2009) as well as Roszkowska (2011) it is a simple, rational and comprehensible concept. The method has intuitive and clear logic that represent the rationale of human choice. There is ease of computation and good computational efficiency. It has a scalar value that accounts for both the best and worst alternatives ability. In addition, the method allows to measure the relative performance for each alternative in a simple mathematical form whereas there is also possibility for visualization.

In this thesis the steps that were followed for the TOPSIS method were as described in Roszkowska (2011) for a single decision maker:

1. Step 1. Construct the decision matrix and determine the weight of criteria.
2. Step 2. Calculate the normalized decision matrix.
3. Step 3. Calculate the weighted normalized decision matrix.
4. Step 4. Determine the positive ideal and negative ideal solutions.
5. Step 5. Calculate the separation measures from the positive ideal solution and the negative ideal solution.
6. Step 6. Calculate the relative closeness to the positive ideal solution.
7. Step 7. Rank the preference order or select the alternative closest to 1.

4.1.1 Innovative posture, propensity and performance

The structure of the new proposed framework is constituted of three domains, each of one has different pillars, that further have various variables. The new proposed framework's structure is based on the 3P framework of Carayannis and Provan (2008) which has been proposed for measuring firm innovativeness. The authors note that the 3P framework for organizational

innovation is based on the principle that innovation emerges from three critical firm level factors: Posture, Propensity and Performance (see Fig. 4.1).

According to Carayannis and Provan (2008) organizational innovation is a multilayered concept where intangible resources such as knowledge can flow throughout organizations and contribute to new routines, technologies and structures that can have an impact on the future performance of the organizations.

The intangible resources are the ones that provide inputs to the innovation processes of an organization, then its ability to engage in innovation activity is very important, since it will further help to produce the organisational innovation outputs. These outputs are short-horizon outcomes and long-horizon lasting impacts. Therefore, the three firm level factors can be defined as follows:

1. Posture refers to an organisation's position within the greater innovation system of its environment (i.e. region, industry, technological domain). Posture can identify the conditions that exist and can have an impact on a particular firm which has a specific technology and operates in a specific market. There are three dimensions in posture: organisational, technological and market life cycles.
2. Propensity is a firm's ability to capitalize on its posture based on cultural acceptance of innovation. Propensity reflects the intangible assets such as processes, routines, capabilities that exist within a firm. A firm can have cultural or other constraints that can minimize its ability for innovation, despite the fact that it has the necessary resources.

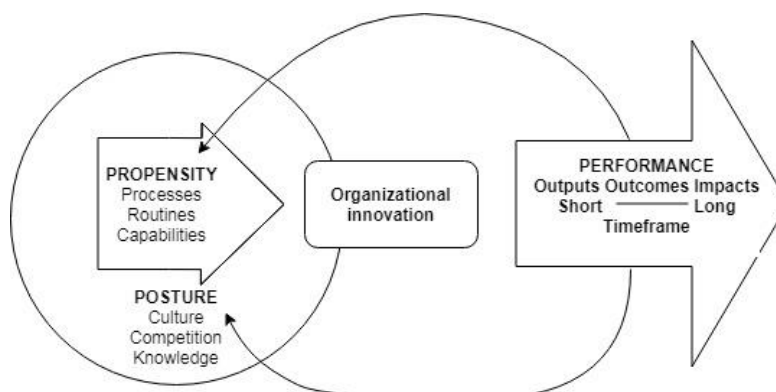


Figure 4.1. The 3P framework. Source: Carayannis and Provan (2008).

3. Performance is the lasting result of innovation. This part of the framework comprises three levels: output, outcome and impact. Outputs show the immediate results of innovation such as new products, patents, etc. Outcomes show the mid-range results of innovation such as revenues from new products. Impacts show the long-range results of both the firm's ability to innovate as well as they are transformed into results for the firm's environment.

Moving forward, as regards to the pillars of the framework, they were selected based both on the domains of Isenberg (2011a) for the entrepreneurship ecosystem, the entrepreneurial ecosystem elements of Stam (2017) and the factor Performance of the 3P framework of Carayannis and Provan (2008). According to Isenberg (2011a) there are six general domains (see Fig. 4.2) that can be used in order to group the entrepreneurship ecosystem's elements. These six general domains are the following:

1. A conducive culture.
2. Enabling policies and leadership.
3. Availability of appropriate finance.
4. Quality human capital.

5. Venture-friendly markets for products.
6. A range of institutional and infrastructural supports.

These general six domains according to Isenberg (2011a) “are strong enough, they are mutually reinforcing, and public leaders do not have to invest quite so much to sustain them. Entrepreneurship programs should be designed to be self-liquidating in order to focus on building sustainability into the environment.”

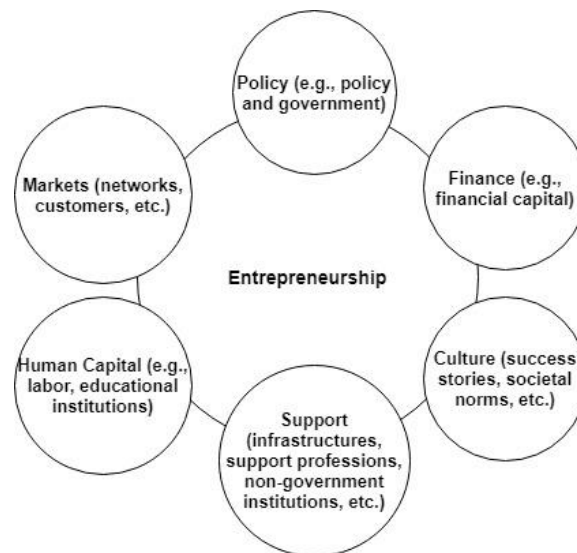


Figure 4.2. Domains of the entrepreneurship ecosystem. Source: Isenberg (2011a).

Stam (2015) proposes a new model for the entrepreneurial ecosystem approach (see Fig. 4.3). This model is constituted by the following four entities:

1. The framework conditions include the social (informal and formal institutions) and the physical conditions which enable or constrain human interaction.

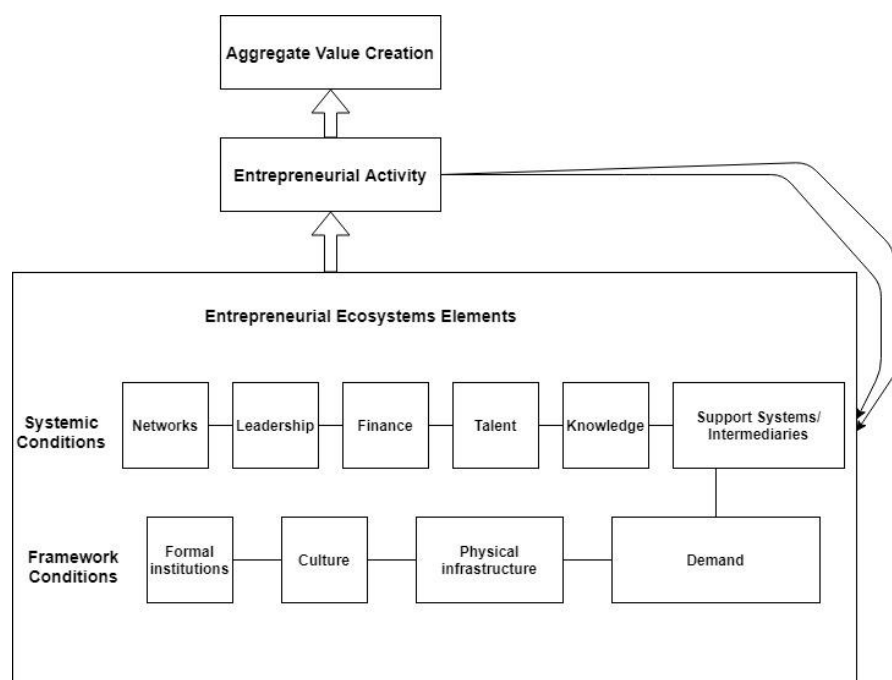


Figure 4.3. Key elements, outputs and outcomes of the entrepreneurial ecosystem. Source: Stam (2015).

2. The systemic conditions are the heart of the ecosystem: networks of entrepreneurs, leadership, finance, talent, knowledge and support services. The presence of these elements and the interaction between them predominantly determine the success of the ecosystem.
3. The outputs which is constituted of the entrepreneurial activity.
4. The outcomes which is constituted of the aggregate value creation.

In addition, Stam (2017) measured the entrepreneurial ecosystem elements with empirical measures (see Table 4.1) and used them to create an entrepreneurial ecosystem index. Mainly, various indicators of high-growth firms as well as the 12 provinces of Netherlands were used. As regards to the entrepreneurship outputs the author used the following elements: ambitious entrepreneurs, high-growth businesses and gazelles.

Table 4.1. Empirical measures of the entrepreneurial ecosystem elements. Source: Stam (2017).

Elements	Description	Empirical indicators
Formal institutions	The rules of the game in society, in particular the quality of government.	Four components: corruption, rule of law, government effectiveness and voice & accountability.
Entrepreneurship culture	The degree to which entrepreneurship is valued in a region.	New firms registered per 1000 inhabitants
Physical infrastructure	Physical infrastructure and the position of a region	Three components: accessibility via road, accessibility via railroad, accessibility via airports (number of passenger flights within 90 minutes' drive)
Demand	Potential market demand	Three components: purchasing power per capita, regional product, total human population
Networks	The connectedness of businesses for new value creation	Percentage of firms in the business population that collaborate for innovation
Leadership	Leadership that provides guidance for and direction of collective action	Leadership is measured with the prevalence of innovation project leaders per 1000 businesses, derived from a database with information on all the innovation projects in the Netherlands that received (Dutch or European) public subsidies in the period 2010-2013. The geographical origin of these project leaders is established by taking the province of the main applicant or principal firm.
Talent	The prevalence of individuals with high levels of human capital	Percentage of higher-educated in the adult population
Finance	The supply and accessibility of finance for new and small firms	Percentage of SMEs that have applied for bank loans and also received this.
New knowledge	Investments in new knowledge	Percentage of gross domestic product invested in R&D (by public and private organizations)

Intermediate services	The supply and accessibility of intermediate business services	Percentage of business service firms in the business population
------------------------------	--	---

More specifically, the pillars Human Capital, Culture, Finance and Policy of the new proposed framework according to Isenberg (2011a) constitute the four out of the six general domains of the entrepreneurial ecosystems and describes them as “*a conducive culture, enabling policies and leadership, availability of appropriate finance, quality human capital.*” Also, Stam (2017) supports that entrepreneurship culture, talent and finance are important elements of the entrepreneurial ecosystems and describes them as follows:

1. Entrepreneurship culture is the degree to which entrepreneurship is valued in a region.
2. Talent is the prevalence of individuals with high levels of human capital.
3. Finance is the supply and accessibility of finance for new and small firms.

As mentioned above, the pillars Outputs, Outcomes and Impacts are based on the factor Performance of the 3P framework of Carayannis and Provan (2008).

Therefore, the structure of the new proposed framework (see Table 4.2), is constituted of domains, pillars and variables. At all levels macro, meso and micro level, the framework has the same domains and pillars whereas each pillar has different variables. The domains and the pillars have been defined as follows:

1. The domain Enablers are composed of the pillars Human Capital and Culture. In the same way with the factor Posture of the 3P framework of Carayannis and Provan (2008), that shapes the firm’s state, the domain Enablers can help in the creation of innovative entrepreneurship within the ecosystem.
2. The domain Capabilities are composed of the pillars Finance and Policy. As the factor Propensity of the 3P framework of Carayannis and Provan (2008), that reflects processes, routines and capabilities, the actors of the domain Enablers can utilize the domain Capabilities to support the development of innovative entrepreneurship within the ecosystem that will further lead to results.
3. The domain Results are constituted of the pillars Outputs, Outcomes and Impacts. In the same way the factor Performance of the 3P framework of Carayannis and Provan (2008) gives the result of innovation through three levels, the domain Results can give the immediate, mid-range and long-range results of innovative entrepreneurship within the ecosystem. More specifically, the pillar Outputs shows the immediate results, the pillar Outcomes shows the mid-range results and the pillar Impact shows the more lasting, long-range results.
4. The pillar Human Capital captures the skills of the actors within the ecosystem through the level and the quality of education as well as the research activity that will allow the production of new knowledge and the enhancement of their skills. According to Isenberg (2011a) Human Capital constitutes one out of the six general domains that can be found in any entrepreneurial ecosystem whereas Stam (2017) also supports that high level of human capital, talent, is necessary in any entrepreneurial ecosystem.
5. The pillar Culture enables the actors within the ecosystem to improve their startup skills, to recognize corruption, opportunities as well as risks in order to engage in innovative entrepreneurship and create new businesses. According to Isenberg (2011a) Culture constitutes another general domain necessary in any entrepreneurial ecosystem, which includes success stories, societal norms, etc.
6. The pillar Finance plays a significant role in entrepreneurial ecosystems and tries to capture the expenditures and the financial services that are available such as R&D and Non-R&D expenditures, ease of access to loans etc. Isenberg (2011a) supports that Finance also constitutes another general domain necessary in any entrepreneurial ecosystem, which focuses

on the availability of financial services. In addition, Stam (2017) supports that Finance is necessary since it shows the supply and accessibility of finance for new and small firms.

7. The pillar Policy focuses on institutional, regulatory and procedural themes that concern the government of each country and region as well as companies since they need to comply to these themes. Isenberg (2011a) claims that Policy is another general domain necessary in any entrepreneurial ecosystem since it provides a range of institutional and infrastructural supports.

8. The pillar Outputs focuses on intellectual property rights, on the innovation of SMEs as well as on Total early-stage Entrepreneurial Activity which are all important innovation indicators. Outputs is the first level of the factor Performance of the 3P framework of Carayannis and Provan (2008) which shows the immediate results of innovation within the innovative entrepreneurial ecosystem.

9. The pillar Outcomes focuses on employment, on exports, as well as on sales which capture the technological competitiveness of a country, a region and a company. Outcomes is the second level of the factor Performance of the 3P framework of Carayannis and Provan (2008) which shows the mid-range results of innovation within the innovative entrepreneurial ecosystem.

10. The pillar Impacts focuses on the competitiveness of a country or a region, as well as on measures of economic activity. Moreover, it captures the overall quality of life of a country's or a region's citizens as well as how satisfied employees are in companies. Impacts is the third level of the factor Performance of the 3P framework of Carayannis and Provan (2008) which shows the mid-range results of innovation within the innovative entrepreneurial ecosystem.

As regards to the variables of the frameworks at all levels, they were chosen carefully in order to capture the essence of each domain and pillar. The main objective was to have as much consistency as possible at all levels. The variables and their data were chosen carefully through different frameworks and surveys that were studied at each level. Due to data availability, when the same variable could not be applied at all levels, a similar variable was chosen. If there was no data availability for the time range in this thesis, which was from 2013 to 2018, or a similar variable could not be found, no variable was used.

For example, in the domain Enablers, in the pillar Human Capital, at the macro level the variable Foreign doctorate students was used. However, due to the fact that there was no available data at the meso and micro level and a similar variable could not be found, this variable was measured only at the macro level.

Another example, in the domain Enablers, in the pillar Human Capital, at the macro and micro level the variable Quality of education system was measured. However, due to the fact that there was no available data at the meso level, a similar variable Early leavers was found and used. In the same way all variables at all levels were processed.

Table 4.2. The proposed framework at macro and meso level.

Domains	Pillar	Macro Level Framework	Meso Level Framework	Micro Level Framework
Enablers (Posture)	Human Capital	Percentage population aged 25-34 with tertiary education	Percentage population aged 30-34 with tertiary education	Employees with tertiary education
		Lifelong learning	Participation rate in education and training	Participation of employees in lifelong learning

		Researchers	Researchers	Human resources in science and technology
		Foreign doctorate students	-	-
		Quality of education system	Early leavers	Quality of education
	Culture	Corruption perception index	Corruption Pillar of EQI Index	Corporate governance
		Opportunity perception	Opportunity perception	Opportunity perception
		Risk acceptance	Risk acceptance	Risk acceptance
		Startup skills	Startup skills	Startup skills
		New business entry density	-	-
Capabilities (Propensity)	Finance	R&D expenditure in the public sector	R&D expenditure in the public sector	R&D expenditures
		R&D expenditure in the business sector	R&D expenditure in the business sector	
		Non-R&D innovation expenditures	Non-R&D innovation expenditures in SMEs	Non-R&D innovation expenditures
		Ease of access to loans	-	Access to finance
		Venture capital expenditures		
	Policy	Government effectiveness	European Quality of Government Index	Organizational growth (as a measure of organizational effectiveness)
		Rule of law Effectiveness of anti-monopoly policy Transparency of government policymaking	Quality Pillar of EQI Index Impartiality Pillar of EQI Index	Access to information about changes in government policies and regulations
		Ease of starting a	-	Ease of starting

		business		a business
		Time to start a business	-	Time to start a business
		-	Total EU Expenditures	-
Results (Performance)	Outputs	PCT patents Trademark applications Design applications	EPO patent applications Trademark applications Design applications	Intellectual property rights (patents, trademarks and design applications)
		SMEs with product or process innovations	SMEs with product or process innovations	Product or process innovations
		SMEs with marketing or organizational innovations	SMEs with marketing or organizational innovations	Marketing or organizational innovations
		SMEs innovating in-house	SMEs innovating in-house	Innovation in-house
		TEA (Total early-stage Entrepreneurial Activity)	-	-
	Outcomes	Employment in knowledge-intensive activities	Employment in medium-high/high-tech manufacturing and knowledge-intensive services	Employees in knowledge-intensive activities
		Employment fast-growing enterprises of innovative sectors	Employment in high-tech sectors	Employees in high-tech activities
		Medium and high-tech product exports	Exports medium and high-tech manufacturing	Exports
		Knowledge-intensive services exports		
		Sales of new-to-market and new-to-firm product innovations	Sales of new-to-market and new-to-firm product innovations	Sales of new-to-market and new-to-firm product innovations

	Impacts	Global Competiveness Index	Regional Competiveness Index	Market share (as a measure of corporate competitiveness)
		GDP per capita	GDP per capita	Turnover per employee
		High-Growth	Real growth rate of regional gross value added Gross fixed capital formation	Net investment
		Unemployment	Unemployment	Employee retention
		Quality of life Index	People at risk of poverty or social exclusion	Employee satisfaction

4.1.2 Quadruple Innovation Helix model

The new proposed framework can be connected to the Quadruple Innovation Helix model. Carayannis and Campbell (2009) define the QIH model (see Fig. 4.4) as follows: “*Quadruple Helix, in this context, means to add to the above stated helices a ‘fourth helix’ that they identify as the “media-based and culture-based public”. This fourth helix associates with ‘media’, ‘creative industries’, ‘culture’, ‘values’, ‘life styles’, ‘art’, and perhaps also the notion of the ‘creative class’ (a term, coined by Florida, 2004). This should emphasize that a broader understanding of knowledge production and innovation application requires that also the public becomes more integrated into advanced innovation systems.*”

Furthermore, Carayannis and Campbell (2009) highlight the fact that the QIH model “*refers to structures and processes of the gloCal knowledge economy and society*” and also according to Carayannis and Campbell (2011) in the context of this model creative industries can be a part of the economy.

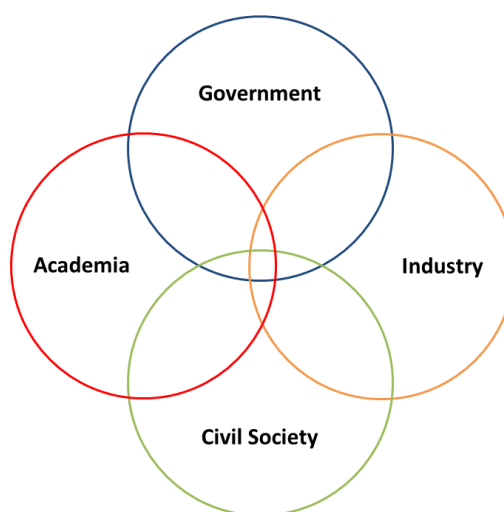


Figure 4.4. Quadruple Innovation Helix model. Source: Carayannis and Campbell (2009).

Moreover, according to Carayannis and Rakhmatullin (2014) “*Quadruple Helix models place a stronger focus on cooperation in innovation and, in particular, the dynamically intertwined processes of co-opetition, co-evolution and co-specialization within and across regional and sectoral innovation ecosystems (Carayannis and Campbell 2009, 2010, 2012) that could serve as the foundation for diverse smart specialization strategies (and introduce a move towards systemic and user-centric innovation structures).*” The authors further explain that in the heart of the QIH model the innovation users can be found which develop innovations that are suitable for civil society, they own and they are responsible for evolving the innovation processes.

The QIH model can support the characteristics that exist in the innovative entrepreneurship ecosystems such as the dynamics and co-evolution (Phillips and Ritala, 2019). In addition, Walrave et al. (2018) claim that ““*ecosystems co-evolve in alignment with their socio-technical environment*”. The QIH model allows and places a strong emphasis on the co-evolution processes within the innovative entrepreneurial ecosystems.

Furthermore, Thomas and Autio (2020) support that in ecosystems, there is participant heterogeneity which include different participants that can come from different industries and sectors and take over various roles. The QIH model also supports participant heterogeneity since each helix has more than one actors, each of one has different roles. For example, the helix Academia is constituted of universities, schools, etc, each of this institution has different roles. In the new proposed framework, different actors exist across each domain with their pillar that have different roles, such as in the pillar Policy where actors are responsible for the creation of new policies.

In addition, Thomas and Autio (2020) claim that ecosystem outputs can be products or services as well as knowledge production. The QIH model also facilitates the creation of new outputs through each helix. For example, the helix Government focuses on the creation and implementation of new policies, strategies, etc. In the new proposed framework, each domain with its pillars produce different outputs. For example, the domain Capabilities with the pillar Finance focuses on the financial outputs of the innovative entrepreneurial ecosystems.

Participant interdependence and non-contractual governance, are two more characteristics of ecosystems, according to Thomas and Autio (2020). Participant interdependence can be technological, economic or cognitive whereas the non-contractual governance is a co-alignment structure that allows participants to interact without formal contracts.

In the QIH model both the helices and the innovation users that exist in its heart interact with each other without formal contracts and depend to each other in order to perform the intertwined processes of co-opetition, co-evolution and co-specialization within and across the ecosystems. For example, the actors in the helix Industry can cooperate with the actors in the helix Academia in order to produce technological outputs that can be further used in the industry.

Moreover, the same principle applies in the new proposed framework, where all actors can also interact with each other without formal contracts and depend to each other in order to perform various tasks. For example, the actors in the pillar Human Capital can produce new knowledge which can further lead to specific results in the pillar Impacts.

Consequently, the new proposed framework can be connected to the QIH model. According to Carayannis and Grigoroudis (2016) the helix “*Education System — refers to academia, universities, higher education systems, and schools (human capital).*” In the new proposed framework the Enablers which are constituted of Human Capital and Culture can be connected to the helix of Academia. The actors through a common culture which they share, they can produce new knowledge by using their skills, education, training and research whereas also this knowledge can be transferred and further lead to an impact.

The authors support that the helix “*Economic System — consists of industry/industries, firms, services, and banks (economic capital)*” and the helix “*Political System — formulates the*

direction in which the state/country is heading in the present and future, as well as the laws (political and legal capital)." In the new proposed framework the Capabilities which are constituted of Finance and Policy can be connected to the Government and the Industry helices since they include the appropriate resources that can be combined in order to capture and create value in the ecosystem.

The authors also claim that the helix *"Civil Society — media based-culture integrates and combines two forms of capital: culture-based public — tradition, values etc. (social capital) and media-based public — television, internet, newspapers (capital of information)."* In the new proposed framework the Enablers which are constituted of Human Capital and Culture can also be connected to the helix Civil Society. This helix refers to *"media-based and culture-based public"*, according to Carayannis and Campbell (2012), where all entities collaborate and participate to new ways of thinking by trying to find solutions to various problems that affect society.

In addition, Civil Society is influenced by culture and values, there are non-profits organizations and citizens' initiatives that can face social challenges, as well as there are platforms through which technology enable the exchange of ideas and open data.

Finally, the domain Results of the new proposed framework which are constituted of Outputs, Outcomes and Impacts can be connected to all the helices of the QIH model, since they capture the immediate, mid-range and long-range results of innovation and entrepreneurship within the ecosystem that will have an impact on all helices. The pillar Outputs shows the immediate results, the pillar Outcomes shows the mid-range results and the pillar Impact shows the more lasting, long-range results.

4.2 Macro-level framework

At the macro level, quantitative data were used in order to evaluate national entrepreneurial ecosystems. Moreover, secondary data from different sources were collected and used where the new proposed framework at this level is constituted of 38 indicators.

Although, the framework at the macro level was implemented for 28 European countries as mentioned above, in this thesis, the results for 2 countries will be presented, which are the following: 1) Greece and 2) Sweden whereas the results for the remaining countries can be found in Appendix 3. The EU-28 countries are the following:

1. Belgium
2. Bulgaria
3. Czech Republic
4. Denmark
5. Germany
6. Estonia
7. Ireland
8. Greece
9. Spain
10. France
11. Croatia
12. Italy
13. Cyprus
14. Latvia
15. Lithuania
16. Luxembourg
17. Hungary
18. Malta
19. Netherlands
20. Austria

21. Poland
22. Portugal
23. Romania
24. Slovenia
25. Slovakia
26. Finland
27. Sweden
28. United Kingdom (at the time that this study took place, UK was part of the European Union)

4.2.1 Dimensions and indicators

For the dimensions and the indicators of the new proposed framework, some of the most widely known and used frameworks at the macro level were studied. These frameworks are the European Innovation Scoreboard (EIS), the Global Innovation Index (GII), the World Economic Forum (WEF), the Eurostat, the World Bank, the Numbeo, the Transparency International and the Global Entrepreneurship Index (GEI).

Some of the variables of these frameworks as well as their data have been used in the new proposed framework (see Table 4.3). Furthermore, the existing datasets of these frameworks and their websites were visited in order to collect and download their data.

The criteria based on which these frameworks were chosen, are the facts that these frameworks are the most widely used frameworks for the assessment of innovation and entrepreneurship ecosystems at the macro level.

Moreover, they provide full databases with minimum gaps, whereas some of the data of these specific frameworks are originally produced through primary surveys that are conducted by reliable organizations such as the European Commission, the World Economic Forum etc. This fact can ensure data validity, whereas they also cover a wide time range and at the macro level in this thesis the time range was from 2013 to 2018. As regards to the variables that were used, the main objective was to ensure consistency in all levels, macro, meso and micro.

Table 4.3. Macro level Variables.

INDICATOR	DESCRIPTION	MEASUREMENT UNTIS	SOURCE
Percentage population aged 25-34 with tertiary education	<p>Definition Numerator: Number of persons in age class with some form of post-secondary education</p> <p>Definition Denominator: Population between and including 25 and 34 years</p> <p>This is a general indicator of the supply of advanced skills. It is not limited to science and technical fields, because the adoption of innovations in many</p>	Percentage of population aged 25-34	European Innovation Scoreboard

	<p>areas, in particular in the service sectors, depends on a wide range of skills. The indicator focuses on a relatively young age cohort of the population, aged 25 to 34 and will therefore easily and quickly reflect changes in educational policies leading to more tertiary graduates</p>		
Lifelong learning	<p>Definition Numerator: The target population for lifelong learning statistics refers to all persons in private households aged between 25 and 64 years. The information collected relates to all education or training whether or not relevant to the respondent's current or possible future job. Data are collected through the EU labour force survey (LFS)</p> <p>Definition Denominator: Total population of the same age group, excluding those who did not answer the question concerning participation in (formal and non-formal) education and training</p> <p>Lifelong learning encompasses all purposeful learning activity, whether formal, non-formal or informal, undertaken on an ongoing basis with the aim of improving knowledge, skills and competence. The intention or aim to</p>	Percentage of population aged 25-64 years	European Innovation Scoreboard

	learn is the critical point that distinguishes these activities from non-learning activities, such as cultural or sporting activities		
Researchers	<p>Researchers per million population, full-time equivalent. Researchers in R&D are professionals engaged in the conception or creation of new knowledge, products, processes, methods, or systems and in the management of the projects concerned.</p> <p>Postgraduate PhD students (ISCED97 level 6) engaged in R&D are included</p>	Full time equivalent per million population	Global Innovation Index
Foreign doctorate students	<p>Definition Numerator: Number of doctorate students from foreign countries</p> <p>Definition Denominator: Total number of doctorate students</p> <p>The indicator is a measure of the supply of new second-stage tertiary graduates in all fields of training (ISCED 8). For most countries, ISCED 8 captures PhD graduates</p>	Percentage of total number of doctorate students	European Innovation Scoreboard
Quality of education system	In your country, how well does the education system meet the needs of a competitive economy?	Score based on the methodology of the Executive Opinion Survey [1 = not well at all; 7 = extremely well]	World Economic Forum
Corruption perception index	The index, which ranks 180 countries and territories by their perceived levels of public sector corruption according	Score from 0 to 100	Transparency International

	to experts and business people, uses a scale of 0 to 100, where 0 is highly corrupt and 100 is very clean		
Opportunity perception	This index refers to the entrepreneurial opportunity perception potential of the population and weights this against the freedom of the country and property rights. Calculation based on the two variables: Opportunity Recognition: The percentage of the 18-64 aged population recognizing good conditions to start business next 6 months in area he/she lives and Freedom (Economic Freedom * Property Rights)	Score (based on the GEI methodology – minimum value 0 maximum value 1)	Global Entrepreneurship Index
Risk acceptance	Risk Acceptance captures the inhibiting effect of fear of failure of the population on entrepreneurial action combined with a measure of the country's risk. Calculation based on the two variables: 1) Risk Perception: The percentage of the 18-64 aged population stating that the fear of failure would not prevent starting a business and 2) Country Risk: The country risk classifications are meant to reflect country risk. Under the Participants' system, country risk is composed of transfer and convertibility risk (i.e. the risk a government imposes capital or exchange	Score (based on the GEI methodology – minimum value 0 maximum value 1)	Global Entrepreneurship Index

	controls that prevent an entity from converting local currency into foreign currency and/or transferring funds to creditors located outside the country) and cases of force majeure (e.g. war, expropriation, revolution, civil disturbance, floods, earthquakes)		
Startup skills	Startup skills captures the perception of startup skills in the population and weights this aspect with the quality of education. Calculation based on the two variables: Skill Perception: The percentage of the 18-64 aged population claiming to possess the required knowledge/skills to start business and Education (Tertiary Education * Quality of Education)	Score (based on the GEI methodology – minimum value 0 maximum value 1)	Global Entrepreneurship Index
New business entry density	The number of newly registered firms with limited liability per 1,000 working-age people (ages 15-64) per calendar year	Number of newly registered firms with limited liability per 1,000 working-age people (ages 15-64)	World Bank Doing Business
R&D expenditure in the public sector	Definition Numerator: All R&D expenditures in the government sector (GOVERD) and the higher education sector (HERD) Definition Denominator: Gross Domestic Product R&D expenditure represents one of the major drivers of economic growth in a	Percentage of GDP	European Innovation Scoreboard

	<p>knowledge based economy. As such, trends in the R&D expenditure indicator provide key indications of the future competitiveness and wealth of the EU. Research and development spending is essential for making the transition to a knowledge-based economy as well as for improving production technologies and stimulating growth</p>		
R&D expenditure in the business sector	<p>Definition Numerator: All R&D expenditures in the business sector (BERD)</p> <p>Definition Denominator: Gross Domestic Product</p> <p>The indicator captures the formal creation of new knowledge within firms. It is particularly important in the science-based sectors (pharmaceuticals, chemicals and some areas of electronics) where most new knowledge is created in or near R&D laboratories</p>	Percentage of GDP	European Innovation Scoreboard
Non-R&D innovation expenditures	<p>Definition Numerator: Sum of total innovation expenditure for enterprises, excluding intramural and extramural R&D expenditures</p> <p>Definition Denominator: Total turnover for all enterprises</p> <p>This indicator measures non-R&D innovation expenditure as a percentage of total</p>	Percentage of turnover	European Innovation Scoreboard

	turnover. Several of the components of innovation expenditure, such as investment in equipment and machinery and the acquisition of patents and licenses, measure the diffusion of new production technology and ideas		
Ease of access to loans	In your country, how easy is it for businesses to obtain a bank loan?	Score based on the methodology of the Executive Opinion Survey [1 = extremely difficult; 7 = extremely easy]	World Economic Forum
Venture capital expenditures	<p>Definition Numerator: Venture capital expenditures is defined as private equity being raised for investment in companies. Management buyouts, management buy-ins and venture purchase of quoted shares are excluded. Venture capital includes early stage (seed + startup) and expansion and replacement capital</p> <p>Definition Denominator: Gross Domestic Product</p> <p>The amount of venture capital is a proxy for the relative dynamism of new business creation. In particular for enterprises using or developing new (risky) technologies, venture capital is often the only available means of financing their (expanding) business</p>	Percentage of GDP	European Innovation Scoreboard
Government effectiveness	Index that reflects perceptions of the quality of public services, the quality of	Score based on the Worldwide Governance Indicators methodology (0-lowest	Global Innovation Index

	the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation and the credibility of the government's commitment to such policies	score to 100-highest score)	
Rule of law	Index that reflects perceptions of the extent to which agents have confidence in and abide by the rules of society and in particular the quality of contract enforcement, property rights, the police and the courts, as well as the likelihood of crime and violence	Score based on the Worldwide Governance Indicators methodology (0-lowest score to 100-highest score)	Global Innovation Index
Effectiveness of anti-monopoly policy	In your country, how effective are anti-monopoly policies at ensuring fair competition?	Score based on the methodology of the Executive Opinion Survey [1 = not effective at all; 7 = extremely effective]	World Economic Forum
Transparency of government policymaking	In your country, how easy is it for companies to obtain information about changes in government policies and regulations affecting their activities?	Score based on the methodology of the Executive Opinion Survey [1 = extremely difficult; 7 = extremely easy]	World Economic Forum
Ease of starting a business	The ranking of economies on the ease of starting a business is determined by sorting their distance to frontier scores for starting a business. These scores are the simple average of the distance to frontier scores for each of the component indicators. Doing Business records all procedures officially required, or commonly done in	Score based on the Word Bank Doing Business (0-lowest score to 100-highest score)	Global Innovation Index

	<p>practice, for an entrepreneur to start up and formally operate an industrial or commercial business, as well as the time and cost to complete these procedures and the paid-in minimum capital requirement. These procedures include obtaining all necessary licenses and permits and completing any required notifications, verifications, or inscriptions for the company and employees with relevant authorities. Data are collected from limited liability companies based in the largest business cities. For 11 economies, the data are also collected for the second-largest business city. The distance to frontier score shows the distance of an economy to the ‘frontier’, which is derived from the most efficient practice or highest score achieved on each indicator</p>		
Time to start a business days	Number of days required to start a business	Number	World Economic Forum
PCT patents	<p>Definition Numerator: Number of patent applications filed under the PCT, at international phase, designating the European Patent Office (EPO). Patent counts are based on the priority date, the inventor’s country of residence and fractional counts</p>	Number of PCT patent applications per billion GDP (in PPS)	European Innovation Scoreboard

	<p>Definition Denominator: Gross Domestic Product in Purchasing Power Standard</p> <p>The capacity of firms to develop new products will determine their competitive advantage. One measure of the rate of new product innovation is the number of patents. This indicator measures the number of PCT patent applications</p>		
Trademark applications	<p>Definition Numerator: Number of trademark applications applied for at EUIPO plus number of trademark applications applied for at WIPO (“yearly Madrid applications by origin”)</p> <p>Definition Denominator: Gross Domestic Product in Purchasing Power Standard</p> <p>Trademarks are an important innovation indicator, especially for the service sector. The Community trademark gives its proprietor a uniform right applicable in all Member States of the European Union through a single procedure which simplifies trademark policies at European level. It fulfils the three essential functions of a trademark: it identifies the origin of goods and services, guarantees</p>	Number of Trademark applications per billion GDP (in PPS)	European Innovation Scoreboard

	consistent quality through evidence of the company's commitment vis-à-vis the consumer and it is a form of communication, a basis for publicity and advertising		
Design applications	<p>Definition Numerator: Number of individual designs applied for at EUIPO</p> <p>Definition Denominator: Gross Domestic Product in Purchasing Power Standard</p> <p>A design is the outward appearance of a product or part of it resulting from the lines, contours, colours, shape, texture, materials and/or its ornamentation. A product can be any industrial or handicraft item including packaging, graphic symbols and typographic typefaces but excluding computer programmes. It also includes products that are composed of multiple components, which may be disassembled and reassembled. Community design protection is directly enforceable in each Member State and it provides both the option of an unregistered and a registered Community design right for one area encompassing all Member States</p>	Number of Design applications per billion GDP (in PPS)	European Innovation Scoreboard
SMEs with product or	Definition Numerator: Number of Small and	Percentage of SMEs	European Innovation

process innovations	<p>medium-sized enterprises (SMEs) who introduced at least one product innovation or process innovation either new to the enterprise or new to their market. A product innovation is the market introduction of a new or significantly improved good or service with respect to its capabilities, user friendliness, components or sub-systems. A process innovation is the implementation of a new or significantly improved production process, distribution method, or supporting activity</p> <p>Definition Denominator: Total number of Small and medium-sized enterprises</p> <p>Technological innovation, as measured by the introduction of new products (goods or services) and processes, is a key ingredient to innovation in manufacturing activities. Higher shares of technological innovators should reflect a higher level of innovation activities</p>		Scoreboard
SMEs with marketing or organisational innovations	<p>Definition Numerator: Number of Small and medium-sized enterprises (SMEs) who introduced at least one new organisational innovation or marketing innovation.</p>	Percentage of SMEs	European Innovation Scoreboard

	<p>An organisational innovation is a new organisational method in an enterprise's business practices (including knowledge management), workplace organisation or external relations that has not been previously used by the enterprise. A marketing innovation is the implementation of a new marketing concept or strategy that differs significantly from an enterprise's existing marketing methods and which has not been used before</p> <p>Definition Denominator: Total number of Small and medium-sized enterprises</p> <p>Many firms, in particular in the services sectors, innovate through other non-technological forms of innovation. Examples of these are marketing and organisational innovations. This indicator captures the extent to which SMEs innovate through non-technological innovation</p>		
SMEs innovating in-house	<p>Definition Numerator: Number of Small and medium sized enterprises (SMEs) with in-house innovation activities. In-house innovating enterprises are defined as enterprises which have introduced</p>	Percentage of SMEs	European Innovation Scoreboard

	<p>product or process innovations either themselves or in co-operation with other enterprises or organisations</p> <p>Definition Denominator: Total number of Small and medium-sized enterprises</p> <p>This indicator measures the degree to which SMEs, that have introduced any new or significantly improved products or production processes, have innovated in-house. The indicator is limited to SMEs, because almost all large firms innovate and because countries with an industrial structure weighted towards larger firms tend to do better</p>		
TEA	TEA (Total early-stage Entrepreneurial Activity) is the percentage of 18-64 population who are either a nascent entrepreneur or owner-manager of a new business	Percentage of 18-64 population	Word Bank
Employment in knowledge-intensive activities	<p>Definition Numerator: Number of employed persons in knowledge-intensive activities in business industries. Knowledge intensive activities are defined, based on EU Labour Force Survey data, as all NACE Rev.2 industries at 2-digit level where at least 33% of employment has a higher education degree (ISCED 5-8)</p>	Percentage of total employment	European Innovation Scoreboard

	<p>Definition</p> <p>Denominator: Total employment</p> <p>Knowledge-intensive activities provide services directly to consumers, such as telecommunications and provide inputs to the innovative activities of other firms in all sectors of the economy</p>		
Employment fast-growing enterprises of innovative sectors	<p>Definition Numerator: Number of employees in high growth enterprises in 50% 'most innovative' industries</p> <p>Definition</p> <p>Denominator: Total employment for enterprises with 10 or more employees</p> <p>This indicator provides an indication of the dynamism of fast-growing firms in innovative sectors as compared to all fast-growing business activities. It captures the capacity of a country to rapidly transform its economy to respond to new needs and to take advantage of emerging demand</p>	Percentage of total employment	European Innovation Scoreboard
Medium and high-tech product exports	<p>Definition Numerator: Value of medium and high-tech exports, in national currency and current prices, including exports of the following SITC Rev.3 products: 266, 267, 512, 513, 525, 533, 54, 553, 554, 562, 57, 58, 591, 593, 597, 598, 629, 653, 671, 672, 679, 71, 72, 731, 733, 737, 74, 751, 752,</p>	Percentage of total product exports	European Innovation Scoreboard

	<p>759, 76, 77, 78, 79, 812, 87, 88 and 891</p> <p>Definition Denominator: Value of total product exports</p> <p>The indicator measures the technological competitiveness of the EU, i.e. the ability to commercialise the results of research and development (R&D) and innovation in international markets. It also reflects product specialisation by country. Creating, exploiting and commercialising new technologies are vital for the competitiveness of a country in the modern economy. Medium and high-technology products are key drivers for economic growth, productivity and welfare and are generally a source of high value added and well paid employment</p>		
Knowledge-intensive services exports	<p>Definition Numerator: Exports of knowledge-intensive services is defined as the sum of credits in EBOPS 2010 (Extended Balance of Payments Services Classification) items SC1, SC2, SC3A, SF, SG, SH, SI, SJ and SK1</p> <p>Definition Numerator: Total value of services exports</p> <p>The indicator measures the competitiveness of the knowledge-intensive services sector.</p>	Percentage of total services exports	European Innovation Scoreboard

	<p>Competitiveness-enhancing measures and innovation strategies can be mutually reinforcing for the growth of employment, export shares and turnover at the firm level. The indicator reflects the ability of an economy, notably resulting from innovation, to export services with high levels of value added and successfully take part in knowledge-intensive global value chains</p>		
<p>Sales of new-to-market and new-to-firm product innovations</p>	<p>Definition Numerator: Sum of total turnover of new or significantly improved products, either new-to-the-firm or new-to the- market, for all enterprises</p> <p>Definition Denominator: Total turnover for all enterprises</p> <p>This indicator measures the turnover of new or significantly improved products and includes both products which are only new to the firm and products which are also new to the market. The indicator thus captures both the creation of state-of-the-art technologies (new-to-market products) and the diffusion of these technologies (new-to-firm products)</p>	Percentage of turnover	European Innovation Scoreboard
<p>Global Competitiveness Index</p>	<p>The GCI combines 114 indicators that capture concepts that matter for productivity and long term prosperity</p>	Score based on the methodology of WEF (0-lowest score to 100-highest score)	World Economic Forum

GDP per capita	Gross domestic product (GDP) is a measure for the economic activity. It refers to the value of the total output of goods and services produced by an economy, less intermediate consumption, plus net taxes on products and imports. GDP per capita is calculated as the ratio of GDP to the average population in a specific year	Euro per inhabitant	Eurostat
High-Growth	The High Growth pillar is a combined measure of: (1) the percentage of high-growth businesses that intend to employ at least ten people and plan to grow more than 50 percent in five years, (2) the availability of venture capital and (3) business strategy sophistication	Score (based on the GEI methodology – minimum value 0 maximum value 1)	Global Entrepreneurship Index
Unemployment	The unemployment rate is the number of persons who are unemployed as a percent of the total number of employed and unemployed persons (i.e., the labour force)	Percentage of labor force	World Bank
Quality of life Index	Quality of Life Index (higher is better) is an estimation of overall quality of life by using an empirical formula which takes into account purchasing power index (higher is better), pollution index (lower is better), house price to income ratio (lower is better), cost of living index (lower is better), safety index	Score from 0 which is the worst to above 180, 190, 200 which are the best	NUMBEO

	(higher is better), health care index (higher is better), traffic commute time index (lower is better) and climate index (higher is better)		
--	---	--	--

At the macro level the pillar Human Capital has five variables. The variable percentage population aged 25-34 with tertiary education is used which is also measured in EIS and in the study of Weresa (2020). The authors used this variable in the context of human resources as an empirical indicator for measuring the innovation infrastructure of a nation.

Lifelong learning is used which is also measured in EIS and in the study of Badescu and Saisana (2008). The authors analyzed the patterns of participation of lifelong learning in European countries and claimed that national strategies should be developed for the promotion of lifelong learning.

Researchers are used as a variable which is also measured in GII and Eurostat. Moreover, this variable is used in the study of Chowdhury et al. (2016). The authors conducted two studies where they measured the impact of research in UK and they included the total number of researchers as a measure.

The variable foreign doctorate students is used which is also measured in EIS. In addition, Hasgall et al. (2019) claimed that the proportion of foreign doctorate students are among the main indicators used by institutions for the measurement of the quality of doctoral education.

Also, the quality of education system is measured which is also measured in WEF as well as in the study of Newman et al. (2016). The authors used this variable to explore its relationship to the education outcomes and the results revealed that the better the quality of the education system, the better education outcomes can occur.

At the macro level the pillar Culture uses the variable Corruption perception index as a measure of transparency. Ceresia and Mendola (2019) claimed that corruption has a connection to entrepreneurial behaviours and it can be measured both at an individual as well as at a national level. They mentioned that although many global organizations have used different indicators for measuring corruption at the national level, among the most used index in the literature, is the Corruption Perception Index of the Transparency International.

The variable opportunity perception shows how population recognizes good conditions in order to start a new business. The variable startup skills shows the skills of the population to start a new business. The variable risk acceptance shows how population perceives the risk of failure regarding entrepreneurial actions. These variables are also measured in GEI. In addition, the number of newly-registered firms is used which is also measured in World Bank and is used only at the macro level since there are no data at the meso level.

The variable opportunity perception is also used in the study of Stuetzer et al. (2014) who used this variable as a measure of indirect effect of regional characteristics on individual entrepreneurship.

Moreover, the variable startup skills is also measured in the study of Castaño-Martínez et al. (2015) where the authors suggested policies to promote entrepreneurial activity and economic performance, using variables as measures from the GEM framework.

Risk acceptance, is also examined in the study of Caliendo and Kritikos (2011) who supported that entrepreneurs are considered generally to be people that have great risk tolerance (as cited in Röhl 2016). Risks are perceived less serious and more manageable, according to Röhl (2016), from people who want to be entrepreneurs and can connect both their autonomy and profit desires with their high level of professional skills.

Suddle et al. (2007) also measured the number of newly-registered firms in their study. The authors developed a new measure of entrepreneurial culture and investigated its relationship with the rate of nascent entrepreneurship as defined in the GEM framework on a sample of 34 countries.

The pillar Finance tries to capture the expenditures and the financial services available within a country. The pillar Finance focuses on R&D expenditures both in public and business sector and on Non-R&D expenditures. These variables are also measured in EIS. In addition, the pillar focuses on how easy is for population to have access to loans which is also measured in WEF. Moreover, the pillar focuses on venture capital expenditures which are also measured in EIS, only at the macro level since there are no data at the meso level.

As regards to R&D innovation expenditures in public and business sector, these variables are also used in the study of Conte et al. (2009) where they are considered among the core R&D innovation indicators. The authors measured the innovation performance of EU member states and estimated the efficiency of R&D spending.

Moreover, in the study of Huang et al. (2010) the Non-R&D innovation expenditures are also measured as a variable that can show the budget that one firm spends in innovation activities that does not concern R&D.

Ease of access to loans is measured which is a variable that is also used in the study of Chant (2008) who analyzed the performance of the Canadian banks as regards to both bank lending and entrepreneurial finance.

Bonini and Capizzi (2019) reviewed the role of venture capital within the entrepreneurial ecosystem finance as regards to its challenges and market opportunities compared to the alternative sources of financing. The authors found that although there are other alternative sources of financing they are not yet able to constitute the venture capital system out of date.

The pillar Policy focuses on institutional and regulatory themes. At the macro level, the variable government effectiveness is measured which is also used in GII and in the study of Friedman (2011). The authors used this variable along with other six World Governance Indicators and five GEM variables in order to examine the relationship of government effectiveness and entrepreneurship.

Then, the variables effectiveness of anti-monopoly policy and transparency of government policymaking are measured which is also measured in WEF. The variable rule of law which shows how citizens have confidence in the rule of law is measured which is also used in GII.

Autio et al. (2018b) in their study used the variables effectiveness of anti-monopoly policy and rule of law among other variables, to measure the formal institutions, regulations and taxation. In addition, Relly and Sabharwal (2009) used the variable transparency of government policymaking to examine different indicators in literature that affected the perceptions of this variable at a national level.

Moreover, the pillar Policy focuses on procedural themes such as how easy is to start a business which is also measured in GII. Also, how many days it takes to start a business which is also measured in WEF and in the study of Carane (2018) who used these variables to measure the effect of ease of doing business in firm creation.

The pillar Outputs focuses on PCT patents, trademark and design applications. The pillar also focuses on SMEs with product or process innovations, with marketing or organisational innovations and innovating in-house. These variables capture innovations, non-technological innovations of SMEs as well as if SMEs have innovated in-house. All these variable are also measured in EIS.

Furthermore, the variable Total early-stage Entrepreneurial Activity (TEA) is measured only at the macro level since there are no data at the meso level. This variable is also measured in

World Bank and in the study of Bosma et al. (2005) who measured the TEA activity across 16 EU countries.

As regards to PCT patents, Vértesy (2017) also used this variable to measure technological innovation. In addition, Dzienis et al. (2019) used the variables trademark and design applications to present the effects of innovation activity in Poland.

The variables SMEs with product or process innovations and SMEs with marketing or organisational innovations, were also used in the study of Ukpabio et al. (2017). The authors analyzed the effect of innovation performance of manufacturing SMEs in Nigeria. The variable SMEs innovating in-house was also used in the study of Dzienis et al. (2019) to show that Poland has a low innovation performance.

Moving forward, the pillar Outcomes focuses on the employment in knowledge-intensive activities and also on the employment in fast-growing enterprises of innovative sectors which both play an important role to a country's economy. These variables are also measured in EIS.

Vértesy (2017) used the variable employment in knowledge-intensive activities to measure the supply feeds into the economic structure as well as the employment in fast-growing enterprises of innovative sectors to show the dynamism of fast-growing firms compared to all fast-growing business activities.

Moreover, the pillar Outcomes focuses on exports of medium and high-tech product and knowledge-intensive services which captures the technological competitiveness of EU. Last but not least, the pillar Outcomes focuses on sales of new-to-market and new-to-firm product innovations which measure the turnover of new or significantly improved products. These variables are also measured in EIS.

As regards to exports of medium and high-tech product and knowledge-intensive services also Vértesy (2017) used these variables in order to measure the international competitiveness in knowledge-intensive sectors.

The variable sales of new-to-market and new-to-firm product innovations, was also measured in the study of Dzienis et al. (2019) who used this variable to further present the effects of innovation activity in Poland.

The pillar Impacts focuses on the global competitiveness index which measures the competitiveness of a country and is also measured in WEF. The pillar also focuses on GDP per capita which is a measure of economic activity and on unemployment which can have a negative impact on a country. These variables are also measured in Eurostat and in World Bank.

The global competitiveness index is also used in the study of Herman (2018) where innovation and entrepreneurship competitiveness were examined. As regards to GDP per capita and unemployment, they are also measured in the study of OECD (2017) where employment and skills strategies in Slovenia were examined.

Also, the quality of life index was measured which captures the overall quality of life of a county's citizens. According to Auerswald (2015) this variable is a factor that has great importance for entrepreneurs since it can affect the place they will live. This variable is also measured in the Numbeo database.

Finally, the variable rate of high-growth enterprises was measured which is also measured in GEI. This variable is also measured in the study of Hölzl (2016) where high-growth firms are studied in depth in order to gain better understanding of them across EU member states.

4.2.2 Combining 3P and QIH models

The new proposed framework can be connected to the QIH model. Based on the definitions of the variables at the macro level and the domains as well as the pillars in which they belong, the variables were assigned to the Quadruple Innovation helices, civil society, industry, university and government (see Table 4.4). Each variable can correspond to more than one helices.

For example, the variable Corruption perception index measures the degree to which the public sector is corrupted according to experts and business people, it is in the domain posture therefore this variable directly affects the helices government and civil society.

Table 4.4. The QIH model at the macro level.

QIH/ 3P	Posture	Propensity	Output	Outcome	Impact
Government	Corruption perception index	Government effectiveness	PCT patents	Medium and high-tech product exports	GDP per capita
		Rule of law	Trademark applications		Unemployment
		Ease of starting a business	Design applications	Knowledge-intensive services exports	Quality of life Index
		Time to start a business			Global Competitiveness Index
		R&D expenditure in the public sector			
		Effectiveness of anti-monopoly policy			
		Transparency of government policymaking			
Industry	Lifelong learning	Ease of starting a business	PCT patents	Employment in knowledge-intensive activities	Quality of life Index
	Researchers	Time to start a business	Trademark applications		High-Growth
	Opportunity Perception	Ease of access to loans	Design applications	Employment fast-growing enterprises of innovative sectors	Global Competitiveness Index
	Risk Acceptance	R&D expenditure in the business sector	TEA		
	New business entry density		SMEs with product or process innovations		
	Startup Skills			Medium and high-tech	

		Non-R&D innovation expenditures Venture capital expenditures Effectiveness of anti-monopoly policy Transparency of government policymaking	SMEs with marketing or organisational innovations SMEs innovating in-house	product exports Knowledge-intensive services exports Sales of new-to-market and new-to-firm product innovations	
University	Population with tertiary education Quality of education system Foreign doctorate students Researchers Startup Skills	R&D expenditure in the public sector	PCT patents	Employment in knowledge-intensive activities Employment fast-growing enterprises of innovative sectors	Unemployment Quality of life Index Global Competitiveness Index
Civil society	Population with tertiary education Lifelong learning Opportunity Perception Risk Acceptance Corruption perception index	Rule of law	TEA	Employment in knowledge-intensive activities Employment fast-growing enterprises of innovative sectors	GDP per capita Unemployment Quality of life Index Global Competitiveness Index

4.3 Meso-level framework

At the meso level, quantitative data were used in order to evaluate regional entrepreneurial ecosystems. Moreover, secondary data were used and collected for 212 European regions (see Table 4.5) whereas the new proposed framework at this level is constituted of 31 indicators.

The framework at the meso level was implemented for 212 regions of the EU-28 countries that were studied at the macro level, however in this thesis, the results for 2 regions will be presented which are the following: 1) for Greece the region Crete and 2) for Sweden the region Stockholm, whereas the results for the remaining regions can be found in Appendix 3.

Table 4.5. NUTS 1 and NUTS 2 Regions.

COUNTRY	NUTS 1	NUTS 2
Belgium	Région de Bruxelles-Capitale / Brussels Hoofdstedelijk Gewest Vlaams Gewest Région Wallonne	-
Bulgaria	Severna i iztochna Bulgaria Yugozapadna i yuzhna tsentralna Bulgaria	-
Czech Republic	-	Praha Strední Čechy Jihozápad Severozápad Severovýchod Jihovýchod Strední Morava Moravskoslezsko
Denmark	-	Hovedstaden Sjælland Syddanmark Midtjylland Nordjylland
Germany	Berlin Brandenburg Bremen Hamburg Mecklenburg-Vorpommern Saarland Sachsen-Anhalt Schleswig-Holstein Thüringen	Stuttgart Karlsruhe Freiburg Tübingen Oberbayern Niederbayern Oberpfalz Oberfranken Mittelfranken Unterfranken Schwaben Berlin Brandenburg Bremen Hamburg Darmstadt Gießen Kassel Mecklenburg-Vorpommern Braunschweig Hannover Lüneburg Weser-Ems Düsseldorf Köln Münster Detmold

		Arnsberg Koblenz Trier Rheinhessen-Pfalz Saarland Dresden Chemnitz Leipzig Sachsen-Anhalt Schleswig-Holstein Thüringen
Ireland	-	Border, Midland and Western Southern and Eastern
Greece	-	Anatoliki Makedonia, Thraki Kentriki Makedonia Dytiki Makedonia Ipeiros Thessalia Ionia Nisia Dytiki Ellada Sterea Ellada Peloponnisos Attiki Voreio Aigaio Notio Aigaio Kriti
Spain	Comunidad de Madrid Canarias	Galicia Principado de Asturias Cantabria País Vasco Comunidad Foral de Navarra La Rioja Aragón Comunidad de Madrid Castilla y León Castilla-la Mancha Extremadura Cataluña Comunidad Valenciana Illes Balears Andalucía Región de Murcia Ciudad Autónoma de Ceuta Ciudad Autónoma de Melilla Canarias
Croatia	-	Jadranska Hrvatska Kontinentalna Hrvatska
France	Île de France Bassin Parisien Nord - Pas-de-Calais Est Ouest Sud-Ouest Centre-Est	-

	Méditerranée French overseas departments	
Italy	-	Piemonte Valle d'Aosta/Vallée d'Aoste Liguria Lombardia Provincia Autonoma Bolzano/Bozen Provincia Autonoma Trento Veneto Friuli-Venezia Giulia Emilia-Romagna Toscana Umbria Marche Lazio Abruzzo Molise Campania Puglia Basilicata Calabria Sicilia Sardegna
Hungary	Közép-Magyarország	Közép-Magyarország Közép-Dunántúl Nyugat-Dunántúl Dél-Dunántúl Észak-Magyarország Észak-Alföld Dél-Alföld
Netherlands	-	Groningen Friesland Drenthe Overijssel Gelderland Flevoland Utrecht Noord-Holland Zuid-Holland Zeeland Noord-Brabant Limburg
Austria	Ostösterreich Südösterreich Westösterreich	
Poland	-	Lódzkie Mazowieckie Malopolskie Slaskie Lubelskie Podkarpackie Swietokrzyskie Podlaskie

		Wielkopolskie Zachodniopomorskie Lubuskie Dolnoslaskie Opolskie Kujawsko-Pomorskie Warminsko-Mazurskie Pomorskie
Portugal	Região Autónoma dos Açores Região Autónoma da Madeira	Norte Algarve Centro Lisboa Alentejo Região Autónoma dos Açores Região Autónoma da Madeira
Romania	-	Nord-Vest Centru Nord-Est Sud-Est Sud - Muntenia Bucuresti - Ilfov Sud-Vest Oltenia Vest
Slovenia	-	Vzhodna Slovenija Zahodna Slovenija
Slovakia	-	Bratislavský kraj Západné Slovensko Stredné Slovensko Východné Slovensko
Finland	Åland	Helsinki-Uusimaa Etelä-Suomi Länsi-Suomi Pohjois- ja Itä-Suomi Åland
Sweden	-	Stockholm Östra Mellansverige Småland med öarna Sydsverige Västsverige Norra Mellansverige Mellersta Norrland Övre Norrland
United Kingdom	North East North West Yorkshire and The Humber East Midlands West Midlands East of England London South East South West Wales Scotland Northern Ireland	-

Estonia	Eesti	Eesti
Cyprus	Kypros	Kypros
Latvia	Latvija	Latvija
Lithuania	Lietuva	Lietuva
Luxembourg	Luxembourg	Luxembourg
Malta	Malta	Malta

4.3.1 Dimensions and indicators

For the dimensions and the indicators of the new proposed framework, some of the most widely known and used frameworks at the meso level were studied. These frameworks are the Regional Innovation Index (RIS), the Global Entrepreneurship Index, the Eurostat, the European Structural & Investment Funds and the Quality of Government Institute.

Some of the variables of these frameworks as well as their data have been used in the new proposed framework (see Table 4.6). Furthermore, the existing datasets of these frameworks were identified and their websites were visited in order to collect and download their data.

The criteria based on which these frameworks were chosen, are the same as the criteria at the macro level. At the meso level, in this thesis the time range was from 2013 to 2018. As regards to the variables that were used, again the main objective was to ensure consistency in all levels, macro, meso and micro.

Table 4.6. Meso level variables.

INDICATOR	DESCRIPTION	MEASUREMENT UNTIS	SOURCE
Percentage population aged 30-34 with tertiary education	<p>Definition Numerator: Number of persons in age class with some form of post-secondary education</p> <p>Definition Denominator: Total population between 30 and 34 years</p> <p>This is a general indicator of the supply of advanced skills. It is not limited to science and technical fields, because the adoption of innovations in many areas, in particular in the service sectors, depends on a wide range of skills. The indicator focuses on a narrow share of the population aged 30 to 34 and will relatively quickly reflect changes in educational policies leading to more tertiary graduates</p>	Percentage of population aged 30-34	RIS

Participation rate in education and training	Participation in education and training (last 4 weeks) by NUTS 2 regions is a measure of lifelong learning. The participation rate in education and training covers participation in formal and non-formal education and training. The reference period for the participation in education and training is the four weeks prior to the interview. Participation rates in education and training for various age groups and by different breakdowns are presented	Percentage of population aged 25-64 years	Eurostat
Researchers	Researchers (all sectors by NUTS 2 regions % of total employment-numerator in full-time equivalent (FTE)) are professionals engaged in the conception or creation of new knowledge, products, processes, methods and systems and also in the management of the projects concerned. The measure shown in this table is researchers in full time equivalents divided by the total annual average employed population. Please note that the calculation of the measure in this table has changed from being based on head count to full time equivalents from January 2010. The measure based on head count is still accessible through Eurostat public data bases, table: Total R&D personnel and researchers by sectors of performance, region and sex	Percentage of total employment	Eurostat
Early leavers	Early leavers from education and training denotes the percentage of the population aged 18 to 24 having attained at most	Percentage of population aged 18-24	Eurostat

	lower secondary education and not being involved in further education or training. The numerator of the indicator refers to persons aged 18 to 24 who meet the following two conditions: (a) the highest level of education or training they have completed is ISCED 2011 level 0, 1 or 2 (ISCED 1997: 0, 1, 2 or 3C short) and (b) they have not received any education or training (i.e. neither formal nor non-formal) in the four weeks preceding the survey		
Corruption Pillar of EQI Index	<p>The Corruption Pillar of the EQI measures the respondents' perception of the extent to which corruption is present in their public services, along with a general question of how often they believe that 'others in their area' use corruption to obtain public services. The Corruption Pillar of the EQI measures the following variables:</p> <p>a. perceptions</p> <ol style="list-style-type: none"> 1. corruption in education 2. corruption in health care 3. corruption in law enforcement 4. need corruption 5. greed corruption 6. elections clean from corruption <p>b. experiences</p> <ol style="list-style-type: none"> 1. asked to pay a bribe for public service 2. paid a bribe for public service 	Score of the Corruption Pillar of EQI Index (0-100)	The Quality of Government Institute
Opportunity Perception	See definitions at macro level	Score (based on the GEI methodology –	Global Entrepreneursh

Risk acceptance		minimum value 0 maximum value 1)	ip Index
Startup skills			
R&D expenditure in the public sector	<p>Definition Numerator: All R&D expenditures in the government sector (GOVERD) and the higher education sector (HERD)</p> <p>Definition Denominator: Regional GDP</p> <p>R&D expenditure represents one of the major drivers of economic growth in a knowledge-based economy. As such, trends in the R&D expenditure indicator provide key indications of the future competitiveness and wealth of a region. Research and development spending is essential for making the transition to a knowledge-based economy as well as for improving production technologies and stimulating growth</p>	Percentage of Regional GDP	RIS
R&D expenditure in the business sector	<p>Definition Numerator: All R&D expenditures in the business sector (BERD)</p> <p>Definition Denominator: Regional Gross Domestic Product</p> <p>The indicator captures the formal creation of new knowledge within firms. It is particularly important in the science-based sector (pharmaceuticals, chemicals and some areas of electronics), where most new knowledge is created in or near R&D laboratories</p>	Percentage of Regional GDP	RIS
Non-R&D innovation expenditures in SMEs	<p>Definition Numerator: Sum of total innovation expenditure for SMEs, excluding intramural and</p>	Percentage of total turnover for SMEs	RIS

	<p>extramural R&D expenditures</p> <p>Definition Denominator: Total turnover for SMEs</p> <p>This indicator measures non-R&D innovation expenditure as percentage of total turnover. Several of the components of innovation expenditure, such as investment in equipment and machinery and the acquisition of patents and licenses, measure the diffusion of new production technology and ideas</p>		
European Quality of Government Index	<p>The European Quality of Government Index (EQI) is the result novel survey data on corruption and governance at the regional level within the EU, conducted in first in 2010 and then again in 2013. The data focus on both perceptions and experiences with public sector corruption, along with the extent to which citizens believe various public sector services are impartially allocated and of good quality. The EQI is constructed by the following elements: 1) Regional survey with three indicators Quality, Impartiality and Corruption and 2) World Governance Indicators of World Bank</p>	Score of the European Quality of Government Index (0-100)	The Quality of Government Institute
Quality Pillar of EQI Index	<p>The Quality Pillar of the EQI data measures the quality of the services. The Quality Pillar of the EQI measures the following variables: 1) quality of education, 2) quality of health care and 3) quality of law enforcement</p>	Score of the Quality Pillar of EQI Index (0-100)	The Quality of Government Institute

Impartiality Pillar of EQI Index	<p>The Impartiality Pillar of the EQI data captures the extent to which public services are delivered impartially in the regions of Europe. The Impartiality Pillar of the EQI measures the following variables: 1) some get special advantages in education, 2) some get special advantages in health care, 3) some get special advantages in law enforcement, 4) all treated equally in education, 5) all treated equally in health care, 6) all treated equally in law enforcement and 7) all treated equally by tax authorities</p>	Score of the Impartiality Pillar of EQI Index (0-100)	The Quality of Government Institute
Total EU expenditures	<p>The EU budget in member state is used for six main categories of expenditure:</p> <p>Growth (aimed at enhancing competitiveness for growth and jobs and economic, social and territorial cohesion)</p> <p>Natural resources (covering the common agricultural and common fisheries policies and rural and environmental measures)</p> <p>Security and citizenship (covering justice, border protection, immigration and asylum, public health, consumer protection and culture)</p> <p>Foreign policy (including development assistance or humanitarian aid outside the EU)</p> <p>Administration (covering all the European institutions, pensions and European schools)</p> <p>Compensations (temporary payments to Croatia)</p>	Total EU expenditures in million euro of GDP	European Structural & Investment Funds

EPO patent applications	<p>Definition Numerator: Number of patents applied for at the European Patent Office (EPO), by year of filing. The regional distribution of the patent applications is assigned according to the address of the inventor</p> <p>Definition Denominator: Gross Domestic Product in Purchasing Power Standard The capacity of firms to develop new products determines their competitive advantage. One indicator of the rate of new product innovation is the number of patents. This indicator measures the number of patent applications at the European Patent Office</p>	Percentage of per billion GDP	RIS
Trademark applications	<p>European Union Trademarks refer to trade mark protections throughout the European Union, which covers 28 countries. The European Union Intellectual Property Office (EUIPO) is the official office of the European Union for the registration of European Union Trademarks and Designs.</p> <p>A European Union Trade mark is an exclusive right that protects distinctive signs, valid across the EU, registered directly with EUIPO in Alicante in accordance with the conditions specified in the EUTM Regulations</p>	Percentage of per billion GDP	Eurostat
Design applications	Community Designs refer to design protections throughout the European Union. The Office for Harmonization in the Internal Market (EUIPO) is the official office of the	Percentage of per billion GDP	Eurostat

	<p>European Union for the registration of Community Trademarks and Designs.</p> <p>A registered Community design (RCD) is an exclusive right that covers the outward appearance of a product or part of it. The fact that the right is registered confers on the design great certainty should infringement occur. An RCD initially has a life of five years from the filing date and can be renewed in blocks of five years up to a maximum of 25 years. Applicants may market a design for up to 12 months before filing for an RCD without destroying its novelty</p>		
SMEs with product or process innovations	<p>Definition Numerator: Number of SMEs that introduced a new product or a new process to one of their markets</p> <p>Definition Denominator: Total number of SMEs</p> <p>Technological innovation as measured by the introduction of new products (goods or services) and processes is key to innovation in manufacturing activities. Higher shares of technological innovators should reflect a higher level of innovation activities</p>	Percentage of total number of SMEs	RIS
SMEs with marketing or organisational innovations	<p>Definition Numerator: Number of SMEs that introduced a new marketing innovation and/or organisational innovation to one of their markets</p> <p>Definition Denominator: Total number of SMEs</p>	Percentage of total number of SMEs	RIS

	Many firms, in particular in the service sectors, innovate through non-technological forms of innovation. Examples of these are organisational innovations. This indicator tries to capture the extent to which SMEs innovate through non-technological innovation		
SMEs innovating in-house	<p>Definition Numerator: Number of SMEs with in-house innovation activities. Innovative firms with in-house innovation activities have introduced a new product or new process either in-house or in combination with other firms. The indicator does not include new products or processes developed by other firms</p> <p>Definition Denominator: Total number of SMEs</p> <p>This indicator measures the degree to which SMEs that have introduced any new or significantly improved products or production processes have innovated in-house. The indicator is limited to SMEs, because almost all large firms innovate</p>	Percentage of total number of SMEs	RIS
Employment in medium-high/high-tech manufacturing and knowledge-intensive services	<p>Definition Numerator: Number of employed persons in the medium-high and high-tech manufacturing sectors include Chemicals (NACE24), Machinery (NACE29), Office equipment (NACE30), Electrical equipment (NACE31), Telecommunications and related equipment (NACE32), Precision instruments (NACE33), Automobiles (NACE34)</p>	Percentage of total workforce	RIS

	<p>and Aerospace and other transport (NACE35). Number of employed persons in the knowledge-intensive services sectors include Water transport (NACE 61), Air transport (NACE 62), Post and telecommunications (NACE64), Financial intermediation (NACE 65), Insurance and pension funding (NACE 66), Activities auxiliary to financial intermediation (NACE 67), Real estate activities (NACE 70), Renting of machinery and equipment (NACE 71), Computer and related activities (NACE72), Research and development (NACE73), and Other business activities (NACE 74)</p> <p>Definition Denominator: Total workforce including all manufacturing and service sectors</p> <p>The share of employment in high-technology manufacturing sectors is an indicator of the manufacturing economy that is based on continual innovation through creative, inventive activity. The use of total employment gives a better indicator than using the share of manufacturing employment alone, since the latter will be affected by the relative decline of manufacturing in some countries. Knowledge-intensive services can be provided directly to consumers, such as telecommunications and provide inputs to the innovative activities of</p>		
--	--	--	--

	other firms in all sectors of the economy. The latter can increase productivity throughout the economy and support the diffusion of a range of innovations, in particular those based on ICT		
Employment in high-tech sectors	Employment in high-tech sectors by NUTS 2 regions % of total employment. Data come from EU Labour force survey (LFS). Employed people are defined as persons aged 15 years and over who during the reference week performed work, even for just one hour a week, for pay, profit or family gain or were not at work but had a job or business from which they were temporarily absent because of, e.g., illness, holidays, industrial dispute and education and training. In high-tech statistics the population excludes anyone below the age of 15 or over the age of 74. In high-tech statistics the population excludes anyone below the age of 15 or over the age of 74	Percentage of total employment	Eurostat
Exports medium and high-tech manufacturing	Definition Numerator: Sum of exports in Chemicals and chemical products (NACE Rev. 1.1 category 24), Machinery and equipment (NACE Rev. 1.1 category 29), Office machinery and computers (NACE Rev. 1.1 category 30), Electrical machinery and apparatus (NACE Rev. 1.1 category 31), Radio, television and communication equipment (NACE Rev. 1.1 category 32), Medical, precision and optical instruments	Percentage of total exports	RIS

	<p>(NACE Rev. 1.1 category 3), Motor vehicles, trailers and semi-trailers and Other transport equipment (NACE Rev. 1.1 category 34)</p> <p>Definition Denominator: Total manufacturing exports</p> <p>The indicator measures the technological competitiveness of a region, i.e. its ability to commercialise the results of research and development (R&D) and innovation in the international markets. It also reflects product specialisation. Creating, exploiting and commercialising new technologies are vital for the competitiveness of a region in the modern economy. Medium and high-technology products are key drivers of economic growth, productivity and welfare and are generally a source of high value added and well-paid employment</p>		
Sales of new-to-market and new-to-firm product innovations	<p>Definition Numerator: Sum of total turnover of new or significantly improved products for SMEs</p> <p>Definition Denominator: Total turnover for SMEs</p> <p>This indicator measures the turnover of new or significantly improved products and includes both products which are only new to the firm and products which are also new to the market. The indicator thus captures both the creation of state-</p>	Percentage of total turnover for SMEs	RIS

	of-the-art technologies (new to market products) and the diffusion of these technologies (new to firm products)		
Regional Competitiveness Index	The Regional Competitiveness Index (RCI) has been measuring the major factors of competitiveness over the past ten years for all the NUTS-2 level regions across the European Union. The Index measures with more than 70 comparable indicators the ability of a region to offer an attractive and sustainable environment for firms and residents to live and work	Score (0-1)	Eurostat
GDP per capita	GDP (Gross Domestic Product) by NUTS 2 regions is an indicator for a nation's economic situation. It reflects the total value of all goods and services produced less the value of goods and services used for intermediate consumption in their production. Expressing GDP in PPS (purchasing power standards) eliminates differences in price levels between countries and calculations on a per head basis allows for the comparison of economies significantly different in absolute size	Euro per inhabitant	Eurostat
Gross fixed capital formation	Gross fixed capital formation for total - all NACE activities by NUTS 2 regions, abbreviated as GFCF, consists of resident producers' investments, deducting disposals, in fixed assets during a given period. It also includes certain additions to the value of non-produced assets realized by	Million euro of GDP	Eurostat

	producers or institutional units. Fixed assets are tangible or intangible assets produced as outputs from production processes that are used repeatedly, or continuously, for more than one year		
Real growth rate of regional gross value added	GVA (gross value added) for total - all NACE activities by NUTS 2 regions is an indicator of the economic activity of a country or a region. It reflects the total value of all goods and services produced less the value of goods and services used for intermediate consumption in their production	Million euro of GDP	Eurostat
Unemployment	Unemployment rates by sex, age and NUTS 2 regions (%). An unemployed person is someone aged 15 to 74 years who is without work, but who has actively sought employment in the last four weeks and is available to begin work within the next two weeks. The unemployment rate is the number of unemployed persons expressed as a percentage of the total labour force	Percentage of total labour force	Eurostat
People at risk of poverty or social exclusion	People at risk of poverty or social exclusion % of total population. Persons who are at risk of poverty or severely materially deprived or living in households with very low work intensity in NUTS 2 regions. Persons are only counted once even if they are present in several sub-indicators. At risk-of-poverty are persons with an equalized disposable income below the risk-of-poverty	Percentage of total population	Eurostat

	<p>threshold, which is set at 60 % of the national median equalized disposable income (after social transfers). Material deprivation covers indicators relating to economic strain and durables. Severely materially deprived persons have living conditions severely constrained by a lack of resources, they experience at least 4 out of 9 following deprivations items: cannot afford</p> <ul style="list-style-type: none"> i) to pay rent or utility bills, ii) keep home adequately warm, iii) face unexpected expenses, iv) eat meat, fish or a protein equivalent every second day, v) a week holiday away from home, vi) a car, vii) a washing machine, viii) a colour TV, or ix) a telephone. <p>People living in households with very low work intensity are those aged 0-59 living in households where the adults (aged 18-59) work less than 20% of their total work potential during the past year</p>		
--	--	--	--

At the meso level, the variables of the pillar Human Capital, such as percentage population aged 30-34 with tertiary education, participation rate in education and training and researchers have been defined exactly as they were defined at the macro level.

The variable foreign doctorate students can be measured only at the macro level since there are no available data at the meso level. Instead, at the meso level the variable early leavers is measured as a similar variable. According to the study of González-Rodríguez et al. (2019) the factors that influence early school leaving are academic factors related to education that can affect one to leave school. Moreover, according to European Commission/EACEA/Eurydice/Cedefop (2014) besides the socio-economic factors there are other factors related to education that can affect someone to leave school early.

At the meso level, the variables of the pillar Culture, opportunity perception, startup skills and risk acceptance have been defined exactly as they were defined at the macro level. The variable Corruption of the European Quality of Government Index (EQI) of Charron (2014,

2015, 2018) is measured which captures the perceptions and experiences of the extent to which corruption is present in regional public services.

The variables of the pillar Finance, R&D expenditures in the public sector, R&D expenditures in the business sector and Non-R&D innovation expenditures in SMEs have been defined exactly as they were defined at the macro level. The variables ease of access to loans and venture capital expenditures can be only measured at the macro level since there are no available data at the meso level.

The pillar Policy measures the variable European Quality of Government Index (EQI) of Charron (2014, 2015, 2018) that captures both perceptions and experiences with public sector corruption, along with the extent to which citizens believe various public sector services are impartially allocated and of good quality.

Moreover, the variables Quality and Impartiality of the EQI pillar of Charron (2014, 2015, 2018) are measured since they capture the quality and the extent to which public services are delivered impartially in the regions of Europe respectively.

The variables ease of starting a business and time to start a business can be measured only at the macro level since there are no available data at the meso level, however the total EU expenditures are measured. This variable is also measured in the European Structural & Investment Funds, these expenditures are part of a region's policy and basically they are the EU budgets for growth, natural resources, security and citizenship, foreign policy, administration, as well as compensations.

Furthermore, the variables of the pillar Outputs, EPO patent applications, trademark applications, design applications, SMEs with product or process innovations, SMEs with marketing or organizational innovations and SMEs innovating in-house have been defined exactly as they were defined at the macro level. The variable TEA can be only measured at the macro level due to the fact that there are no available data at the meso level.

Moving forward, the pillar Outcomes focuses on the employment in medium-high/high-tech manufacturing and knowledge-intensive services and on the employment in high-tech sectors which both play an important role to a region's economy. These variables are also measured both in RIS.

The pillar Outcomes focuses on exports of medium and high-tech manufacturing and on sales of new-to-market and new-to-firm product innovations which capture the competitiveness of the knowledge-intensive services sector and the turnover of new or significantly improved products respectively. These variables are also measured both in RIS.

The pillar Impacts focuses on the regional competitiveness index which measures the competitiveness of a region and is also measured in Eurostat. Snieška and Bruneckienė (2009) used the regional competitiveness index to measure the competitiveness of Lithuanian regions. The pillar also focuses on GDP per capita which is a measure for economic activity and on unemployment which can have a negative impact on a region. These variables are also measured in Eurostat and in World Bank.

In addition, the variable rate of high-growth enterprises can be only measured at the macro level due to the fact that there are no available data at the meso level. Instead, two similar variables are measured at the meso level. These are the real growth rate of regional gross value added (GVA) and the gross fixed capital formation. These variables are measured as indicators of economic activity of a region that contribute to its growth and they are also measured in Eurostat.

As regards to GVA, Zymek and Jones (2020) used this variable in their study to examine the differences of the UK regions in productivity. As regards to the gross fixed capital formation, this variable is also used in the study of the Statistics Department of the African Development Bank (2018) which provides a manual for the measurement of all GDP forms in African countries.

Finally, the variable quality of life index can be only measured at the macro level since there are no available data at the meso level. Instead, a similar variable is measured at the meso level. This variable is people at risk of poverty or social exclusion which is also measured in Eurostat. According to Eurostat (2019) “poverty can be examined as a dimension in relation to the quality of life, the share of the population at risk of poverty is a relative and objective indicator.”

4.3.2 Combing 3P and QIH models

Again based on the definitions of the variables at the meso level, the variables were assigned to the Quadruple Innovation helices, civil society, industry, university and government (see Table 4.7). Each variable can correspond to more than one helices. For example, the variable Researchers measures the professional researches as a percentage of total employment, it is in the domain posture therefore this variable directly affects the helix university.

Table 4.7. The QIH model at the meso level.

QIH/ 3P	Posture	Propensity	Output	Outcome	Impact
Government	Corruption Pillar of EQI Index	R&D expenditure in the public sector	EPO patent applications	Exports medium and high-tech manufacturing	Unemployment
		European Quality of Government Index	Trademark applications		GDP per capita
		Quality Pillar of EQI Index	Design applications		Real growth rate of regional gross value added
		Impartiality Pillar of EQI Index			People at risk of poverty or social exclusion
		Total EU expenditures			Regional Competitiveness Index
Industry	Participation rate in education and training	R&D expenditure in the business sector	EPO patent applications	Employment in medium-high/high-tech manufacturing and knowledge-intensive services	Gross fixed capital formation
	Researchers	Non-R&D innovation expenditures in SMEs	Trademark applications		Real growth rate of regional gross value added
	Opportunity Perception		Design applications		
	Startup Skills	Total EU expenditures	SMEs with product or process innovations	Employment in high-tech sectors	Regional Competitiveness Index
	Risk Acceptance		SMEs with marketing or organisational	Sales of new-to-market and new-to-firm product	

			innovations SMEs innovating in- house	innovations Exports medium and high-tech manufacturing	
University	Population with tertiary education Researchers Startup Skills Early leavers	R&D expenditure in the public sector Total EU expenditures	EPO patent applications	Employment in medium- high/high-tech manufacturing and knowledge- intensive services Employment in high-tech sectors	Unemployment Regional Competiveness Index
Civil society	Population with tertiary education Participation rate in education and training Opportunity Perception Corruption Pillar of EQI Index Risk Acceptance	Quality Pillar of EQI Index Impartiality Pillar of EQI Index Total EU expenditures	EPO patent applications	Employment in medium- high/high-tech manufacturing and knowledge- intensive services Employment in high-tech sectors	Unemployment GDP per capita Real growth rate of regional gross value added People at risk of poverty or social exclusion Regional Competiveness Index

4.4 Micro level framework

At the micro level, the Agrofood industry at the region of Crete was studied and both quantitative as well as qualitative research was conducted. For the quantitative research, a questionnaire was created based on the pillars of the new proposed framework. For the qualitative research, three case studies were conducted in companies that operate in the Cretan Agrofood industry.

4.4.1 Dimensions and indicators

For the creation of the framework at the micro level, primary research was conducted in companies that operate in the Cretan Agrofood industry. The research was conducted with the use of a questionnaire in the year 2020. Based on the framework that has been presented at both macro and meso levels, 28 different variables that correspond to 28 questions have been created and defined at the micro level (see Table 4.8).

These variables can be also documented by different surveys and frameworks such as the Community Innovation Survey, the European Innovation Scoreboard (EIS), the Global Innovation Index (GII), the World Economic Forum (WEF), the Eurostat, the World Bank and the Global Entrepreneurship Index (GEI). These surveys and frameworks were studied in order to understand what and how they measure, which variables and which scales they use. Moreover, sources such as Investopedia and Wikipedia were studied, to find the definitions on economic variables such as net investment.

The criteria based on which these frameworks were studied at the micro level, are similar to the criteria presented at both macro and meso levels, whereas the main objective was to ensure consistency in all levels macro, meso and micro.

Table 4.8. Micro level variables.

INDICATOR	DESCRIPTION	MEASUREMENT UNTIS
Employees with tertiary education	What is the approximate total percentage of employees (permanent, seasonal, etc.) who have a higher education degree in the last year?	0% 1% less than 5% 5% less than 10% 10% less than 25% 25% less than 50% 50% less than 75% 75% or more
Participation of employees in lifelong learning	What is the approximate average of the total percentage of employees (permanent, seasonal, etc.) attending educational programs (seminars, lifelong learning programs, etc.) in the last year?	0% 1% less than 5% 5% less than 10% 10% less than 25% 25% less than 50% 50% less than 75% 75% or more
Human resources in science and technology	What is the approximate percentage of employees (permanent, seasonal, etc.) who have a basic degree in science (eg mathematics, physics, polytechnics, etc.) in the last year?	0% 1% less than 5% 5% less than 10% 10% less than 25% 25% less than 50% 50% less than 75% 75% or more
Quality education system	How well do you think employees in the education system (high school, lyceum, university) are prepared to meet job requirements?	Not at all A little Moderate Enough A lot
Corporate governance	How effective is the corporate governance of the company (eg transparency of management actions towards all, participation of many in decision making, management control by third parties, risk management, etc.)?	Not at all effective A little effective Moderate effective Enough effective A lot effective
Opportunity Perception	How well do you think the company is taking advantage of potential business opportunities?	Not at all A little Moderate Enough A lot

Risk acceptance	Do you consider that the company takes business risk in its various activities?	Not at all A little Moderate Enough A lot
Startup skills	To what extent do you consider that the new employees in the region of Crete possess the required skills for the creation of a new business?	Not at all A little Moderate Enough A lot
R&D expenditures	What percentage of the company's turnover is used for Research and Development expenses (eg development of new products and services) in the last year?	0% 1% less than 5% 5% less than 10% 10% less than 25% 25% less than 50% 50% less than 75% 75% or more
Non-R&D innovation expenditures	What percentage of the company's turnover is used for expenses that do not relate to Research and Development (eg investment in equipment, machinery or obtaining patents and licenses) in the last year?	0% 1% less than 5% 5% less than 10% 10% less than 25% 25% less than 50% 50% less than 75% 75% or more
Access to finance (Ease of access to loans)	How satisfactory do you consider your company's access to finance (eg bank loans, business equity, other capital)?	Not at all satisfactory A little satisfactory Moderate satisfactory Enough satisfactory A lot satisfactory
Organizational growth (as a measure of organizational effectiveness)	How would you evaluate the effectiveness of the organization that exists in the company?	Not at all effective A little effective Moderate effective Enough effective A lot effective
Access to information about changes in government policies and regulations (Transparency of government policymaking)	How satisfactory do you consider access to information on changes in government policies and regulations (eg legislation, anti-monopoly policies to ensure fair competition, programs) that affect your activities?	Not at all satisfactory A little satisfactory Moderate satisfactory Enough satisfactory A lot satisfactory
Ease of starting a business	In general, how easy do you think it is to complete all the procedures for starting a business in your country?	Not at all A little Moderate Enough A lot
Time to start a business	In general, how satisfactory do you consider the time required starting a business?	Not at all satisfactory A little satisfactory Moderate satisfactory Enough satisfactory A lot satisfactory

Intellectual property rights (patent, trademark and design applications)	What is the total number of patents or trademarks or industrial designs that the company has applied for in the last three years?	0 1-5 5-10 10-25 25 or more
Product or process innovations	What is the number of product innovations (eg new products or services) or processes (eg new modes of production, new modes of delivery or distribution, new maintenance procedures) that the company has introduced in the last three years?	0 1-5 5-10 10-25 25 or more
Marketing or organizational innovations	What is the number of organizational innovations (eg new ways of supply chain management, new ways of organizing and making decisions, new external strategic partnerships) or marketing innovations (eg new design or packaging, new ways of advertising and product promotion, new sales channels, new pricing modes) that the company has introduced in the last three years?	0 1-5 5-10 10-25 25 or more
Innovation in-house	What percentage of the previous innovations does the company develop internally without any external cooperation in the last three years?	0% 1% less than 5% 5% less than 10% 10% less than 25% 25% less than 50% 50% less than 75% 75% or more
Employees in knowledge-intensive activities	What percentage of jobs in the company is related to activities that require a higher education degree (knowledge-intensive activities)?	0% 1% less than 5% 5% less than 10% 10% less than 25% 25% less than 50% 50% less than 75% 75% or more
Employees in high-tech activities	What percentage of jobs in the business is related to activities that require high-tech activities?	0% 1% less than 5% 5% less than 10% 10% less than 25% 25% less than 50% 50% less than 75% 75% or more
Exports	What is the percentage of production (in quantity) exported in the last year?	0% 1% less than 5% 5% less than 10% 10% less than 25% 25% less than 50% 50% less than 75% 75% or more
Sales of new-to-market and new-to-	What is the percentage of sales that come from new or significantly	0% 1% less than 5%

firm product innovations	improved products that are new either for the business or for the market in the last year?	5% less than 10% 10% less than 25% 25% less than 50% 50% less than 75% 75% or more
Market share (as a measure of corporate competitiveness)	What is the approximate percentage of the company's market share in the last year?	0% 1% less than 5% 5% less than 10% 10% less than 25% 25% less than 50% 50% less than 75% 75% or more
Turnover per employee	-	The variable Turnover per employee was calculated by dividing the company's annual turnover in the last year with the company's total number of employees
Net investment	What are the net investments (investments minus depreciation) as a percentage of the company's turnover in the last year?	0% 1% less than 5% 5% less than 10% 10% less than 25% 25% less than 50% 50% less than 75% 75% or more
Employee retention	What is the percentage of staff retention this year (ie the percentage of employees of the previous year who are still working this year)?	0% - 10% 10% - 20% 20% - 40% 40% - 60% 60% - 80% 80% - 90% 90% - 100%
Employee satisfaction	How satisfied do you think the employees of the company are in the last year?	Not at all A little Moderate Enough A lot

At the micro level, the pillar Human Capital has the following variables, employees with tertiary education which is also measured in CIS and in the Annual Report of European SMEs of the European Commission (2017). Then, the variable participation of employees in lifelong learning is used which is also measured in EIS. Moreover, this variable is measured in the study of Ahlgren and Engel (2011) where the relationship between SMEs and employees participation was explored as regards to formal education in two UK countries, England and Scotland.

Human resources in science and technology is measured which is also measured in Eurostat and in the study of Berrone et al. (2014). The authors explored the determinants of the performance in microenterprises and found that human capital when proxied by educational level and degree of dedication, has a positive impact on the performance of micro enterprises.

The quality of the education system is used which is also measured in WEF and in the study of Ganaei et al. (2011). The authors studied the impact of entrepreneurs' education on the quality of doing business in SMEs located in Pakistan and found that there is a positive

relationship between them, meaning that the better education an entrepreneur has received the better the quality of their business will be.

Culture at the micro level focuses on the corporate governance of a company which is also measured in the study of Branko and Nicola (2014) where they measured the quality of corporate governance in the banking sector of Bosnia and Herzegovina.

Also, the variables opportunity perception, startup skills and risk acceptance were used and they are also measured in GEI. The variable opportunity perception shows the perception of the company's owner regarding to if the company is taking advantage of potential business opportunities. The variable startup skills shows to what extent the company's owner considers that new employees in the region of Crete possess the required skills for the creation of a new business. The variable risk acceptance shows if the company takes business risk in its various activities.

The study of European Commission (2012a) also used these variables when exploring the effects and impact of entrepreneurship education programs in EU higher institutions. The results revealed that alumni that have participated in entrepreneurship programmes prefer to be self-employed due to the fact that they identified good business opportunities. In addition, they had the skills and know-how to run a business based on the higher education they have received. They also had higher risk propensity which is the tendency of an individual to take risks.

The pillar Finance tries to capture the expenditures and the financial services available to companies. The pillar Finance focuses on R&D expenditures which are also measured in EIS and in the study of Di Cintio et al. (2017) where R&D expenditures were explored on a sample of Italian SMEs in the manufacturing industry.

The variable Non-R&D expenditures is used which is also measured in EIS and in the study of Zheng et al. (2012) where this variable was analyzed and showed how this is a necessary approach for the Chinese SMEs.

Also, the pillar Finance focuses on how easy is for population to have access to loans which is also measured in WEF and in the study of OECD (2012) that measured the entrepreneurial finance based on a European SMEs survey.

The pillar Policy focuses on institutional and regulatory themes that concern the government of each country and region which implements policies that all companies should comply to as well as on procedural themes. The organizational growth is measured as a part of the organizational effectiveness and it is also explored in the study of Janićijević and Bogićević Milikić (2010) where they explored if the corporate governance structures of three Serbian medium sized companies can influence their organizational growth.

The variable access to information about changes in government policies and regulations is used which is also measured in the Executive Opinion Survey of the WEF. In addition, this variable is used in the study of OECD (1999) for the regulatory reform of smaller firms where it is discussed that access to information infrastructure can have an impact on how SMEs perform.

The variables how easy is to start a business is used which is also measured in GII and in the World Bank Doing Business. Moreover, the variable how many days it takes to start a business is used which is also measured in WEF. These two variables are also discussed in the study of Fadel and Qazi (2015) for the improvement of the business regulatory environment for entrepreneurs and SMEs in Qatar.

The pillar Outputs focuses on the intellectual property rights such as PCT patents, trademark and design applications which are important innovation indicators and are measured also in EIS and in the study of Sukarmijan and Sapong (2014) where the importance of intellectual property rights for SMEs was analyzed.

The pillar Outputs also focuses on SMEs with product or process innovations, with marketing or organisational innovations and innovating in-house. This pillar captures the innovations, the non-technological innovations of SMEs as well as if they have innovated in-house which are also measured in EIS.

The variable SMEs with product innovations is used which is also analyzed in the study of Karlsson and Olsson (1998) where product innovations are explored as regards to their role in small and large enterprises.

The variable SMEs with process innovations is used which is also explored in the study of Máñez et al. (2011) and the effect that these innovations can have in SMEs productivity.

The variable SMEs with marketing or organisational innovations is also measured in the study of Ajayi and Morton (2015) where the roles of marketing and organizational innovations were explored in SMEs located in South-Western Nigeria.

The variable SMEs innovating in-house is used which is also highlighted as a key area to be considered in policies as regards to innovation according to the study promoting innovation in established SMEs of OECD (2018a).

The pillar Outcomes focuses on the employment in knowledge-intensive activities and on the employment in high-tech activities which these variables are also measured both in EIS. Moreover, the pillar Outcomes focuses on exports and on sales of new-to-market and new-to-firm product innovations which measure the turnover of new or significantly improved products. These variables are also measured both in EIS.

The variables employment in knowledge-intensive activities and employment in high-tech activities as well as exports are used which are also measured in the Annual report on European SMEs of the European Commission (2019).

The variable sales of new-to-market and new-to-firm product innovations is also measured in the study of Joueid and Coenders (2018) where they found that marketing innovation can increase the share of new-to-market and new-to-firm product innovations.

The pillar Impacts focuses on the company's elements such as market share which is also measured in the study of Hu and Schive (1996) where the authors explored the determinants of the market share for SMEs that operate in the manufacturing sector.

Moreover, the variable turnover per employee is used which is also measured in the study of Abdulquadri et al. (2015) where the impact of employee turnover was explored in SMEs construction firms in Nigeria.

The variable net investment is used which is also measured in the study of Hsiao and Li (2012) who analyzed the investment proxies in an attempt to find which measures are more appropriate for investment and the differences in their performance.

The variable employee retention is used which is also measured in the study of Sanda and Ntsiful (2013) where they analyzed the role of employee retention in a sample of 300 SMEs located in the area of the developing country Ghana.

Last but not least, the variable employee satisfaction is used which is also measured in the study of Akehurst et al. (2009) where they explored job satisfaction and commitment in Spanish entrepreneurial SMEs.

4.4.2 Combining 3P and QIH models

Based on the definitions of the variables at the micro level and the domains and pillars in which they belong, the variables were assigned to the Quadruple Innovation helices, civil society, industry, university and government (see Table 4.9). Each variable can correspond to more than one helices. For example, the variable Corporate governance measures how

effective the company's corporate governance is, it is in the domain posture therefore this variable directly affects the helices government and civil society.

Table 4.9. The QIH model at the micro level.

QIH / 3P	Posture	Propensity	Output	Outcome	Impact
Government	Corporate governance	Ease of starting a business Time to start a business days R&D expenditures Access to information about changes in government policies and regulations	Intellectual property rights	Exports	Net investment
Industry	Lifelong learning	Organizational growth	Intellectual property rights	Employees in knowledge-intensive activities	Net investment
	Opportunity Perception	R&D expenditures	Product or process innovations	Employees in high-tech activities	Employee satisfaction Market share
Industry	Risk Acceptance	Non-R&D expenditures	Marketing or organisational innovations	Exports	Turnover per employee
	Human resources	Access to finance	Innovation in-house	Sales of new-to-market and new-to-firm product innovations	Employee retention
Industry	Startup Skills	Ease of starting a business Time to start a business days Access to information about changes in government policies and regulations			

University	Population with tertiary education	R&D expenditures	Intellectual property rights	Employees in knowledge-intensive activities	Employee retention
	Quality of education system				
	Startup Skills				
	Human resources				
Civil society	Population with tertiary education	Access to information about changes in government policies and regulations	Intellectual property rights	Employees in knowledge-intensive activities	Turnover per employee
	Lifelong learning				
	Opportunity Perception				
	Risk Acceptance				
	Corporate governance			Employees in high-tech activities	Employee satisfaction

4.5 Typology approach

For the typology at the macro, meso and micro level the K-Means algorithm was used due to the benefits this algorithm can offer. According to MacQueen (1967) “*K-means is one of the simplest unsupervised learning algorithms that solve the well-known clustering problem.*” In addition, the author mentions some of the advantages of this algorithm, which is that the procedure of the algorithm is easily programming and computationally economical on a digital computer in order to process large samples.

Moreover, Singh and Mirsa (2014) claim that other advantages of the K-means algorithm are the facts that it is “*algorithmically simple, relatively robust and gives “good enough” answers over a wide variety of data sets.*”

According to Perez et al. (2007) four are the main steps of the K-means algorithm as follows:

1. Step 1. Initialization. A set of objects to be partitioned, the number of groups and a centroid for each group are defined.
2. Step 2. Classification. For each database object its distance to each of the centroids is calculated, the closest centroid is determined and the object is incorporated to the group related to this centroid.
3. Step 3. Centroid calculation. For each group generated in the previous step, its centroid is recalculated.
4. Step 4. Convergence condition. Several convergence conditions have been used from which the most utilized are the following: stopping when reaching a given number of iterations, stopping when there is no exchange of objects among groups, or stopping when the difference among centroids at two consecutive iterations is smaller than a given threshold. If

the convergence condition is not satisfied, steps two, three and four of the algorithm are repeated (as cited in Ortega et al. 2009).

In order to create the typology for all levels, macro, meso and micro in this thesis the following steps were conducted:

1. The TOPSIS method was applied at all levels and the scores were extracted.
2. The TOPSIS scores were input into the K-Means algorithm using the SPSS software.
3. The number of clusters and the variables were tested. As regards to the number of clusters, at the macro level for the countries, 3,4 and 5 number of clusters were tested. At the meso and micro level, for the regions and for the companies, 3,4,5,6,7,8,9 and 12 number of clusters were tested. As regards to the variables, the helices of the QIH model, the pillars of the new proposed framework and the 3P elements were tested. The year 2018 and the average of all years 2013-2018 were also tested.
4. The number of clusters and the variables were chosen based on the criterion that all clusters should be statistically different.
5. The clusters' results were extracted and evaluated.
6. Based on the clusters' results, the statistical test One Way ANOVA was applied in order to find the profile for each cluster. The p-value of each variable was tested to find out the performance of each cluster in the specific variable.

Chapter 5. Assessment Results

5.1 National entrepreneurship ecosystems

At the macro level, Greece and Sweden were chosen to be studied. On the one hand, Greece was chosen due to the fact that this thesis takes place in this country and will provide useful insights. Greece is considered to be one of the moderate innovative countries since in many frameworks such as GEM, WEF, GII and GEI does not have high scores in the performance of its entrepreneurship ecosystem. Moreover, EIS in 2018 classified Greece as a Moderate Innovator and GEI in 2016 classified it also as an Innovation Driven economy, therefore in general it has a moderate entrepreneurship ecosystem.

On the other hand, Sweden is considered to be one of the most innovative countries. EIS in 2018 classified Sweden as an Innovation Leader whereas GEI in 2016 classified it as an Innovation Driven economy, therefore it has a strong entrepreneurship ecosystem. The results for the remaining countries can be found in Appendix 3.

5.1.1 Data processing

Before the data analysis, the data were gathered and prepared. The dataset with the 38 variables for 6 years from 2013 to 2018 and for 28 countries was checked for missing data where 15% of the data was missing. Different imputation approaches were applied based on each case as follows:

1. Case 1. Lack of value at the beginning of the year. In the case that for a specific country and indicator, the value at the beginning of the year was missing, while there were available the values of the following year and the last year, the method of linear interpolation was used. Appendix 2 presents the indicators and countries that have applied this method.
2. Case 2. Lack of value at the year in-between. In the case that for a specific country and indicator, the value of a specific year was missing, while there were available the values of the previous and the following year, the method of linear interpolation was used. Appendix 2 presents the indicators and countries that have applied this method.
3. Case 3. Lack of value at the latest year. In the case that for a specific country and indicator, the value of the latest year was missing, while there were available the values of the previous and the first year, the method of linear interpolation was used. Appendix 2 presents the indicators and countries that have applied this method.
4. Case 4. Only one value available for one year. In the case that for a specific country and indicator, only one value for a specific year was available, the same value was used for the remaining years. Appendix 2 presents the indicators and countries that have applied this method.
5. Case 5. Hot deck imputation.
 - 5.1. If for a specific country there was a lack of data for a specific indicator, the average Euclidean distance of the other indicators belonging to the same pillar of the specific country with other similar countries was calculated. For example, for country Greece for the variable Foreign doctorate students the values were missing for the years 2013-2018. The Euclidean distance was calculated based on the countries Spain, Italy and Portugal. Appendix 2 presents the indicators and countries that have applied this method.
 - 5.2. The final imputed value was the country's value with the shortest average Euclidean distance (or the average value of some countries). For example, the final imputed value for Greece was the average value of Spain, Italy and Portugal. Appendix 2 presents the indicators and countries that have applied this method.

Regarding the method of linear interpolation, it is a simple and useful method that provided the values that were missing and allowed to fill the gaps accurately. As regards to the method of hot deck imputation and more specifically, the Euclidean distance, according to Phillis et al. (2011) “*unknown values are imputed from other countries for which data are available by taking averages. Groups of highly similar and moderately similar countries are formed according to geographic and economic criteria.*”

The minimum Euclidean distance can be calculated according to Phillis et al. (2011) as follows: “*suppose that some basic input from indicator group g is not available for country i . Let j be an index of countries similar to i , i.e., $s_{ij}=1$ or 2 . For each pair (i, j) , the Euclidean distance d_{ijg} is computed using those normalized indicators of group g for which data are available for both i and j . The Euclidean distance is given by the square root of the average of squared indicator differences.*”

At the macro level the descriptive statistics for the 38 variables are presented in Table 5.1.

Table 5.1. Macro level Descriptive Statistics.

Variables Macro level	Average of 2013-2018		2018	
	Mean	Variance	Mean	Variance
Tertiary education (%)	40.32	72.25	41.73	70.84
Quality of education system (score 1-7)	4.21	0.71	4.13	0.83
Lifelong learning (%)	11.10	57.57	11.41	62.78
Foreign doctorate students (%)	19.62	325.87	20.78	303.41
Researchers (number)	42.50	413.12	43.82	456.07
New business entry (number)	6.56	26.02	7.26	34.68
Corruption (score 0-100)	64.50	215.71	64.68	199.78
Opportunity perception (score 0-1)	0.47	0.06	0.56	0.08
Start up skills (score 0-1)	0.64	0.03	0.68	0.05
Risk acceptance (score 0-1)	0.50	0.03	0.55	0.06
R&D public expenditures (%)	0.60	0.06	0.56	0.07
Venture capital expenditures (%)	0.08	0.00	0.09	0.01
R&D business expenditures (%)	0.97	0.44	0.99	0.43
Non-R&D innovation expenditures (%)	0.74	0.18	0.84	0.33
Access to loans (score 1-7)	3.51	0.56	4.39	0.76
Government effectiveness (score 0-100)	71.12	220.49	72.68	184.51
Ease of starting business (score 0-100)	89.44	20.77	90.15	16.42
Rule of law (score 0-100)	75.89	284.24	74.58	265.48
Time to start business (number)	11.52	59.10	10.04	56.71
Effectiveness of anti-monopoly policies (score 1-7)	4.39	0.48	4.36	0.61
Transparency of government making (score 1-7)	4.41	0.75	4.41	1.06
PCT patents (number)	2.57	6.47	2.49	5.94
Trademark applications (number)	10.92	99.80	11.71	118.09
Design applications (number)	4.35	12.49	3.82	5.28
TEA (%)	8.19	7.18	8.46	13.02
SMEs product process innovations (%)	32.25	149.26	36.28	251.32
SMEs marketing organizational innovations (%)	33.00	155.02	32.58	243.09
SMEs innovating in house (%)	27.59	116.82	30.35	211.99

Employment in knowledge-intensive (%)	14.02	13.33	14.28	12.13
Medium high-tech exports (%)	49.68	134.83	50.28	130.15
Knowledge intensive exports (%)	54.64	394.37	55.77	393.11
Sales product innovations (%)	10.85	17.10	11.72	36.99
Global Competiveness Index (score 0-100)	4.78	0.26	4.87	0.26
GDP per capita (number)	27918.33	342304825	30546.43	391808587
Unemployment (%)	9.03	20.71	6.65	12.94
Quality of life (score from 0 to more than 200)	147.70	757.57	163.49	501.30
High growth (score 0-1)	0.55	0.04	0.52	0.03
Employment in fast growing sectors (%)	4.75	3.59	4.82	4.06

5.1.2 Results based on the entrepreneurship pillars

The results at the macro level for all 28 European countries can be seen in Table 5.2. It can be seen that Greece has a rather moderate performance on the seven entrepreneurship pillars of the new proposed framework whereas Sweden has a high performance on all pillars.

These findings are also in line with the results of other frameworks such as the European Innovation Scoreboard, the Global Innovation Index, the Global Entrepreneurship Index and the World Economic Forum. For example, the EIS classifies Greece as a Moderate Innovator whereas Sweden is classified as an Innovation Leader.

In addition, GII ranked in 2018 Greece 42th out of 130 economies whereas Sweden was ranked 3rd. Moreover, GEI ranked in 2018 Greece 48th out of 137 economies whereas Sweden was ranked 9th. Last but not least, the WEF in 2018 ranked Greece 57th out of 140 economies and Sweden was ranked 9th.

Table 5.2. Results at the macro level for all 28-EU countries.

2018	Human Capital	rs = 0.9896	Culture	rs = 0.96866	Finance	rs = 0.96607	Policy	rs = 0.99562
	TOPSIS Rank	NWM RANK	TOPSIS Rank	NWM RANK	TOPSIS Rank	NWM RANK	TOPSIS Rank	NWM Rank
Belgium	9	8	12	16	5	5	7	8
Bulgaria	25	26	27	26	25	26	28	28
Czech Republic	19	19	19	18	14	14	18	18
Denmark	1	2	3	1	6	9	5	4
Germany	12	12	11	14	1	1	11	9
Estonia	11	11	1	6	8	6	9	10
Ireland	6	5	6	5	22	19	6	6
Greece	22	23	22	21	26	23	24	24
Spain	18	18	17	17	17	17	19	19
France	8	9	14	13	7	7	10	11
Croatia	27	27	24	23	20	22	25	26
Italy	23	21	26	27	23	18	21	21
Cyprus	14	14	15	12	27	27	16	17
Latvia	20	20	20	19	19	24	17	16
Lithuania	15	17	23	24	12	16	14	14

Luxembourg	3	6	10	9	9	10	8	7
Hungary	26	24	28	28	15	13	23	22
Malta	17	15	7	8	24	25	20	20
Netherlands	5	3	4	3	11	11	1	1
Austria	10	10	9	11	4	4	12	12
Poland	21	22	18	20	16	15	27	27
Portugal	13	13	16	15	13	12	13	13
Romania	28	28	25	25	28	28	26	25
Slovenia	16	16	13	10	21	20	15	15
Slovakia	24	25	21	22	18	21	22	23
Finland	4	4	5	2	3	3	3	3
Sweden	2	1	8	6	2	2	2	2
United Kingdom	7	7	2	4	10	8	4	5
2018	Outputs	rs = 0.98207	Outcomes	rs = 0.97359	Impacts	rs = 0.96552		
	TOPSIS Rank	NWM RANK	TOPSIS Rank	NWM RANK	TOPSIS Rank	NWM Rank		
Belgium	9	7	10	13	10	13		
Bulgaria	25	25	25	24	25	25		
Czech Republic	20	18	8	9	13	11		
Denmark	11	10	18	17	4	3		
Germany	6	8	3	3	2	2		
Estonia	4	4	19	19	12	10		
Ireland	17	17	1	1	1	6		
Greece	13	16	20	16	28	28		
Spain	22	23	16	20	24	20		
France	12	12	14	12	11	12		
Croatia	19	19	28	28	23	27		
Italy	14	14	17	18	27	26		
Cyprus	18	21	13	8	22	23		
Latvia	21	22	23	23	26	24		
Lithuania	15	15	21	21	16	16		
Luxembourg	3	3	9	10	5	9		
Hungary	27	26	12	10	20	18		
Malta	10	11	7	7	14	14		
Netherlands	8	6	6	6	3	1		
Austria	2	1	15	14	9	8		
Poland	26	27	24	25	17	17		
Portugal	5	5	27	27	18	19		
Romania	28	28	26	26	21	21		
Slovenia	23	20	22	22	15	15		
Slovakia	24	23	5	5	19	22		
Finland	1	2	11	15	7	5		
Sweden	7	9	4	4	8	7		

United Kingdom	16	13	2	2	6	4		
----------------	----	----	---	---	---	---	--	--

At the macro level the results of the NWM and the TOPSIS method for countries Greece and Sweden will be analyzed here. It is worth mentioning that in the TOPSIS method the same weights have been applied. This means that the indicators in each pillar have the same weight which is defined to 1. The NWM for Greece presented a rather moderate performance out of 28 countries (see Fig. 5.1).

The performance of Greece in the NWM rank differs from its performance in the TOPSIS method due to the fact, that in the first case ordinal values are used and in the second cardinal values are used.

The pillar Human Capital has a low performance, in 2018 is ranked 23rd. The pillar Culture has also a low performance in 2018 is ranked 21st. The pillar Finance has also a low performance, in 2018 is ranked 23rd. The pillar Policy has also a low performance, in 2018 is ranked 24th. Then, the pillar Outputs shows a better performance in 2018 is ranked 16th. The pillar that Greece shows a good performance is Outcomes in 2018 is ranked 16th. Last but not least, the pillar with the worst performance is Impacts which in 2018 is ranked 28th.

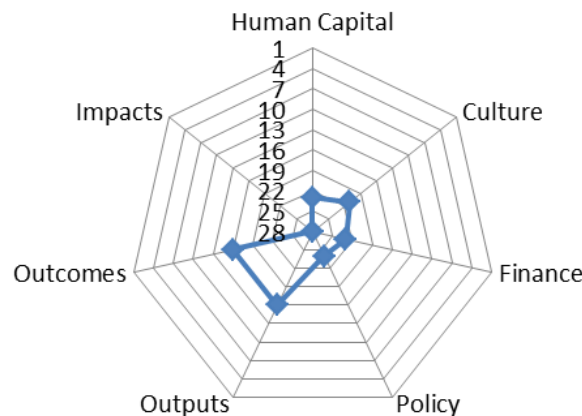


Figure 5.1. Greece performance per pillar NWM rank 2018.

The pillar Human Capital can be connected to the pillars Human resources and Research systems of EIS where Greece in 2018 is ranked 18.5th out of 36 countries. Also, GII on the pillar Human capital and research in 2018 ranked Greece 11th out of 28 countries. Moreover, WEF on the pillar Higher education and training in 2018 ranked Greece 21st out of 28 countries. The Global Entrepreneurship Index on the pillar Human capital in 2018 ranked Greece 14th out of 28 countries.

The pillar Culture can be connected to the pillars Startup skills, Cultural support, Risk acceptance and Opportunity perception of GEI which in 2018 ranked Greece 23rd out of 28 countries.

The pillar Finance can be connected to the pillars Finance and support and Firm investments of EIS, where Greece in 2018 is ranked 21st out of 28 countries. Moreover, WEF on the Financial Market Development in 2018 ranked Greece 28th out of 28 countries.

The pillar Policy can be connected to the pillar Institutions of GII where Greece in 2018 is ranked 28th out of 28 countries. Moreover, WEF on the pillar Institutions ranked Greece 28th out of 28 countries.

The pillar Outputs can be connected to the pillars Innovators and Intellectual assets of EIS, where Greece in 2018 is ranked 15.5th out of 28 countries. The pillar Outcomes can be

connected to the pillars Employment and Sales impacts of EIS, where Greece in 2018 is ranked 18.5th out of 28 countries.

The TOPSIS method also revealed for Greece a rather moderate performance out of 28 countries (see Fig. 5.2). The pillar Human Capital has a low score of 0.25 in 2018. The pillar Culture has a score of 0.36 whereas the pillar Finance has also a low score of 0.26. The pillar Policy has a score of 0.36 as well as the pillars Outputs and Outcomes have moderate scores of 0.42 and 0.46 respectively. Last but not least, the pillar Impacts has a low score of 0.16.

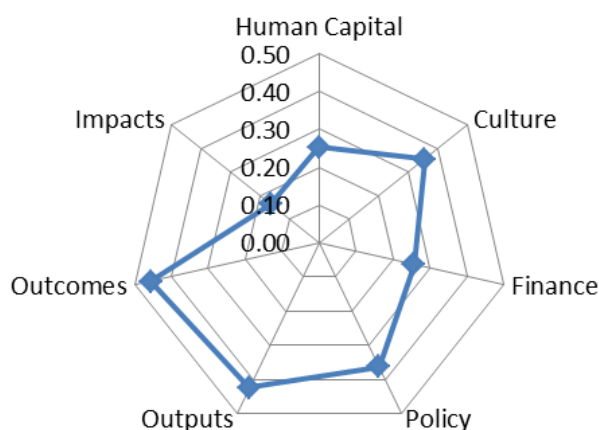


Figure 5.2. Greece performance per pillar TOPSIS score 2018.

The rather low performance of the pillar Human Capital can be justified by different studies. According to OECD (2018b) the participation rate and the completion rate in tertiary education in Greece is above most other EU members and the students perform well on a global stage however, the long periods of schooling do not necessarily result into good education, the workers' skills often are not appropriate with the needs of the workplaces whereas a limited number of employees attend on-the job training.

In addition, Kakouris (2007) by observing for more than two years the youth entrepreneurship in the career office of the University of Athens revealed that students in Greece have a negative attitude towards entrepreneurship activity.

Moreover, Karanassios et al. (2006) in their study found that Greek students although, they present entrepreneurial potential, they lack specific knowledge as regards to entrepreneurship. Last but not least, Vassiliadis and Chatzichristos (2006) confirmed that Greek students are very positive and interested in taking obligatory entrepreneurial courses in their existing curricula.

This shows the educational gap that exists in higher education in Greece and the absence of the necessary teaching methods and approaches as well as entrepreneurial courses in all discipline curricula that will help students exploit their entrepreneurial potential. The introduction of entrepreneurship courses as well as different learning methods can enhance entrepreneurial education in Greece and help students engage more in entrepreneurial activities.

The fact that Greece has a rather low performance on the pillar Culture can be explained by the fact that people do not have a great desire for entrepreneurial career (Kitsios and Sitaridis, 2017).

This might be caused due to the fact that Greek people have a negative perspective towards entrepreneurship and this is measured through the social norms of the GEM's Adult Population Survey. This negative perspective towards entrepreneurship lies in the fact that there is no respect for the profession of being an entrepreneur at a national level in comparison to other countries.

Kakouris et al. (2017) explored the 'gender gap' on a Greek sample of 70 respondents as regards to entrepreneurship. The results revealed that there is the same entrepreneurial orientation between males and females which mean that they will start a business in the same way. However, there are differences in normative beliefs, competitiveness and the role of being an entrepreneur. All these stem from the Greek culture, where men are perceived more competitive, they accept positive opinions from others as regards to male entrepreneurship and their spouses' opinion has an important impact on how they will act.

In addition, Piperopoulos (2012) found that there is no adequate entrepreneurship education at Greek universities which means that students do not have great entrepreneurial intentions and aspirations. The entrepreneurial culture is not cultivated in Greek universities as much as it could be.

Last but not least, Willias and Vorley (2015) found that prior to the economic crisis of Greece, entrepreneurship was not a priority by policy-makers constituting Greece not the right environment for starting a new business. Therefore, the institutional environment in Greece along with the economic crisis has limited and cannot support entrepreneurial activity. With these unfavorable conditions, entrepreneurial culture cannot be strengthened.

The model revealed a low performance on the pillar Finance. Bosma and Kelley (2018) support that although Greek economy has managed to adjust and rebalance by increasing its exports and investments, after a long period of economic crisis, still the domestic financing conditions are weak (as cited in Vlados and Chatzinikolaou, 2019).

Moreover, Kitsios and Sitaridis (2017) claim that entrepreneurs in Greece have fewer opportunities to funding compared to other developed or developing countries. This is in line with Vlados et al. (2017) who present the findings of a research titled "*Map the business needs of Greek Startups*" and mention that most of the entrepreneurs with 83.5% used their own capital as their main source of financing and more specifically 23.5% were financed through family and relatives whereas "*only 4.7% borrows from banking and financial institutions.*"

Vassiliadis and Vassiliadis (2014) also in their study revealed that one of the primary obstacles that Greek businesses and more specifically the Greek family businesses are facing is the unstable tax environment. In addition, Kaplanoglou et al. (2016) in their study in Greek SMEs found out that Greece is facing one of the most important tax gaps in the developed world as regards to tax compliance behaviour. Trust is an important issue and Greek people are willing to trust their money in a government that provides an effective tax administration (as cited in Vlados and Chatzinikolaou, 2019).

The model revealed also a rather low performance on the pillar Policy. According to Schwab et al. (2016) the most problematic factors for doing business in Greece is the policy instability, tax rates, inefficient government bureaucracy, as well as access to finance and tax regulations.

This is in line with Bitzenis et al. (2011), who in their study revealed that among the basic barriers of the Greek market are bureaucracy, the taxation system, corruption, corporate tax, the unfavorable labour market structure and the unstable legal system.

Moreover, Bosma et al. (2011) claim that in Greece there is an absence of reforms since no attempts to restrict or reform the Greek economy have taken place the last few years. Besides the commercial and physical infrastructure, along with the support of entrepreneurship, all the other elements which are necessary for the entrepreneurship framework conditions are adverse (as cited in Vlados and Chatzinikolaou, 2019).

In addition, Vliamos and Tzeremes (2011) claim that the institutional environment which is related to access to financial sources, to economic environment and to venture capital availability is important and can affect entrepreneurial activity since it provides the necessary

motives for individuals to engage in entrepreneurship. Greece does not have a great institutional environment, therefore it is not the right place for supporting entrepreneurship.

The performance of the pillar Outputs is better than the other pillars. According to OECD (2005) what characterizes the Greek innovation system is the strong role of government and the higher education in R&D. In this framework, it is important to note that Greece has an economy that focuses more on small enterprises rather on larger firms, notably in sectors that are technologically demanding. Due to this rather strong R&D infrastructure that exists in universities, the creation of both intellectual property rights as well as innovations is more likely to take place and then they can be transferred to companies.

Markatou (2011) claims that patents in Greece mostly are related to the construction industry and the agricultural sector. The majority of Greek patents belong to firms with 44.46% and to individuals with 50.98% whereas patents in research and academic institutions follow with much smaller percentages. Over the years there is an increase in the number of patents that are granted in Greece by individuals as well as firms.

In addition, Beneki et al. (2012) explored the relationship between innovation and economic performance of Greek SMEs. The authors revealed that there is a positive correlation between investment and innovation where Greek firms mostly invest in new technology. However, the authors also found that there is a negative correlation between innovation and private's sector expenditures for R&D. On the other hand, there is a positive correlation between innovation and public's sector expenditures for R&D. This means that the private sector should invest more in Greek SMEs and help them innovate more.

Last but not least, Markatou (2012) also support that SMEs are very important for the Greek economy and help in the development as well as the production of innovation. They can be considered as the innovation producers of the country's economy.

The pillar Outcomes also performs better than the other pillars. According to OECD (2018b) the exports have contributed to the Greek economy's expansion and labour market reforms have contributed to the improvement of its competitiveness. There is an increase of employment, however all these are happening with a slow pace, signs that show that Greece is still trying to recover after the long period of economic crisis.

Nassr et al. (2016) also support that exports of goods in Greece followed a slower pace than other European countries whereas in 2008 net exports of goods increased significantly.

Another factor for the moderate performance of Outcomes, lies in the fact that in Greece according to OECD (2016) the share of exports in goods and services has been decreased significantly in the last decade. Factors that have contributed to this decrease are among others, the structural problems in product markets, barriers to exporting, access to finance and skills.

Athanasoglou et al. (2010) claim that the specialization of Greece which is in low-technology products is constraining its export performance. Greece faces strong competition in these low-technology products from countries like Bulgaria, China and Turkey. It is notable that the share of high and high-medium technology products in Greece is only 20% of its total exports when other OECD countries have more than 70%.

In addition, Kanellos (2013) explored the characteristics of the knowledge-based entrepreneurship in high-technology sectors in Greece. The author found out that Greek founders that have a high educational background compared to those who have lower educational background employ highly qualified people, choose more scientific and research knowledge sources as well as they use their networks to recruit skilled labour. All these allow new knowledge to be created, shared and transferred into new firms' innovations and R&D activities. Therefore, educational background plays an important role on how firms operate in high-tech sectors.

The pillar with the worst performance is Impacts. According to OECD (2018b) despite the fact that the recovery of the economy has now strengthen and many reforms are taking place, poverty and especially for young and unemployed, as well as inequality is still high, mostly due to the economic crisis that Greece has faced and lasted long. GDP has started to improve after the long period of economic crisis, in 2017 it expanded by 1.3% and according to OECD (2018b) if the necessary reforms in product and labour market take place, Greece can improve its overall competitiveness.

In addition, as regards to competitiveness, according to the World Economic Forum's annual report in 2018 Greece was ranked 57th out of 140 counties, below other countries such as Bulgaria and Romania. Therefore, reforms are necessary to take place.

Another factor for the low performance of Impacts is that *"the minimum wage in the private sector is slightly below the OECD average relative to the median earnings"*, according to OECD (2018b). This factor does not help in the overall growth regarding the overall quality of citizens' life, as well as employment, where there are mainly temporary or part-time jobs, often of low quality.

The low performance of Impacts is also in line with the findings of Pappa et al. (2009). The authors found that in Greece the overall quality of life which can be connected to health, can be affected in a negative way by low socioeconomic status such as primary education and low total household income. This concerns both men and women.

In addition, OECD (n.d.a) supports that in their survey Greeks rated their life satisfaction with an average grade of 5.4 at a scale 0-10, which is one of the lowest score in the OECD countries. Another interesting fact is that, according to OECD (n.d.a), the unemployment rate for a year or longer of labour force in Greece is 15.7%, which is the highest rate in the OECD countries, where the average rate is 1.8%.

Throughout the years from 2013 to 2018 in the NWM, the pillars Human Capital, Culture, Finance, Policy, Outputs and Outcomes of Greece performed better except the pillar Impacts which remains the same (see Fig. 5.3).

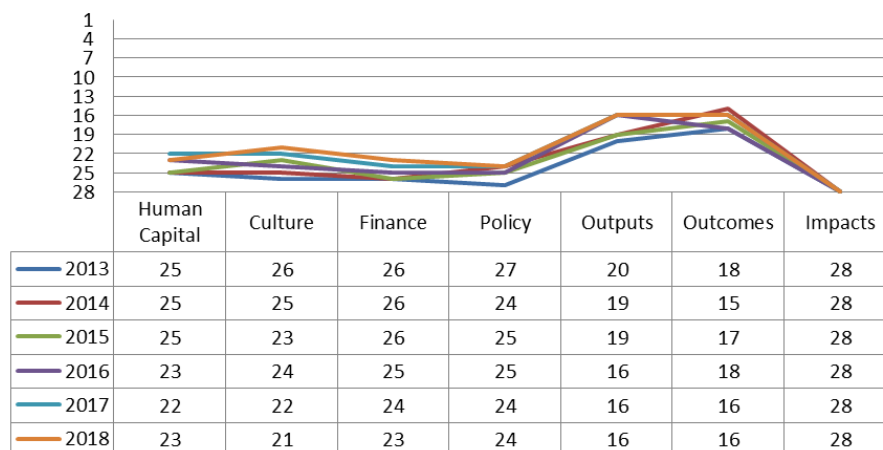


Figure 5.3. Greece performance per pillar NWM rank 2013-2018.

Throughout the years from 2013 to 2018 in the TOPSIS method, all pillars of Greece have also been improved except the pillar Policy which remains the same (see Fig. 5.4).



Figure 5.4. Greece performance per pillar TOPSIS score 2013-2018.

The NWM for Sweden presented a rather high performance out of 28 countries (see Fig. 5.5). The pillar Human Capital has a high performance, in 2018 is ranked 1st. The pillar Culture presents a slightly lower performance, in 2018 is ranked 6th. The pillar Finance has also a high performance, in 2018 is ranked 2nd. The pillar Policy has also a high performance, in 2018 is ranked 2nd. In addition, the pillar Outputs shows a slighter low performance in 2018 is ranked 9th. The pillar Outcomes has a high performance in 2018 Sweden is ranked 4th. Last but not least, the pillar Impacts presents a slightly lower performance, in 2018 Sweden is ranked 7th.

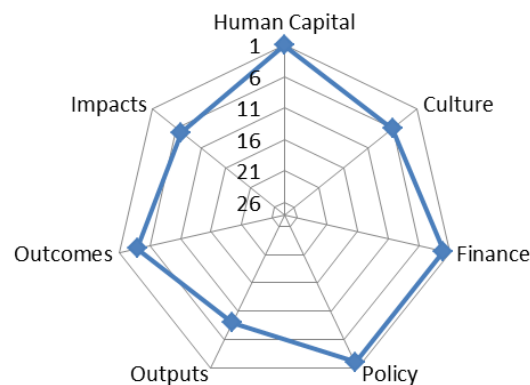


Figure 5.5. Sweden performance per pillar NWM rank 2018.

The pillar Human Capital can be connected to the pillars Human resources and Research systems of EIS where Sweden in 2018 is ranked 3rd out of 28 countries. Also, GII on the pillar Human capital and research ranked Sweden in 2018 3rd out of 28 countries. Moreover, WEF on the pillar Higher education and training in 2018 ranked Sweden 5th out of 28 countries. GEI on the pillar Human capital ranked Sweden in 2018 6th out of 28 countries.

The pillar Culture can be connected to the pillars Startup skills, Cultural support, Risk acceptance and Opportunity perception of GEI which in 2018 ranked Sweden 6.5th out of 28 countries.

The pillar Finance can be connected to the pillars Finance and support as well as Firm investments of EIS, where Sweden in 2018 is ranked 4th out of 28 countries. Moreover, WEF on the Financial Market Development in 2018 ranked Sweden 2nd out of 28 countries.

The pillar Policy can be connected to the pillar Institutions of GII where Sweden is ranked in 2018 4th out of 28 countries. Moreover, WEF on the pillar Institutions in 2018 ranked Sweden 4th out of 28 countries.

The pillar Outputs can be connected to the pillars Innovators and Intellectual assets of EIS, where Sweden is ranked 8th in 2018 out of 28 countries.

The pillar Outcomes can be connected to the pillars Employment and Sales impacts of EIS, where Sweden in 2018 is ranked 7th out of 28 countries.

The TOPSIS method also revealed for Sweden a high performance out of 28 countries (see Fig. 5.6). The pillar Human Capital has a high score of 0.71 in 2018. The pillar Culture has a score of 0.63 whereas the pillar Finance has score of 0.62 as well as the pillar Policy has a high score of 0.89. The pillar Outputs has a moderate score of 0.49, whereas the pillars Outcomes and Impacts have also high scores, 0.67 and 0.66 respectively.

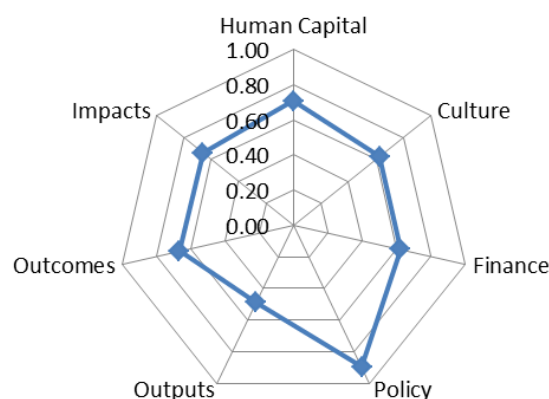


Figure 5.6. Sweden performance per pillar TOPSIS score 2018.

The pillar Human capital presents a high performance and this can be due to the fact that according to Romanainen et al. (2016) Nordic countries have a well-educated workforce. In addition, entrepreneurship is integrated at all levels of formal education in these countries. For example, there is entrepreneurship training through incubators and also Sweden has applied national strategies for entrepreneurship education.

According to OECD (2018c) the primary educational system in Sweden tries to incorporate entrepreneurship training into all academic levels from high-school to the higher education system. More specifically, in high-school entrepreneurial training is conducted through “*Young Enterprise*” where students learn how to start a new business as a project. Moreover, most of the universities have business incubators in order to train their students not only on entrepreneurship as well as on high-tech and innovative entrepreneurship.

In addition, Podrug et al. (2015) in their study found that Swedish students have positive entrepreneurial attitudes and orientation, they consider that there is an entrepreneurial climate in their schools as well as they have confidence that depends on how entrepreneurial they are, on their skills as individuals rather than the support they will receive from their environment.

Moreover, Lindberg et al. (2017) revealed through their study in a Swedish university that the participation of students in entrepreneurship education and programs can enhance and promote their entrepreneurial mindset. Through this participation in activities and exercises of entrepreneurship courses, students were found to have developed their opportunity identification capability, entrepreneurial creativity and risk management capability.

Last but not least, in Sweden students can start their own business parallel to their studies. According to Sjölundh and Wahlbin (2008) a characteristic example is the Jönköping University in Sweden where students start every year up to 50 new firms. The university offers them the support they need in order to start their firms and this support is open and student-driven. They have entrepreneurship courses, coaches and a host company with various projects as parts of their courses.

The moderate performance of the pillar Culture can be justified by the following studies. According to OECD (2018c) entrepreneurship in Sweden is viewed with a positive perspective and it is considered to have a great impact on both society and economy. Entrepreneurship which focuses on innovation, growth and high-tech is given special focus. Equally important is the fact that in the last two decades attention has been given to different groups that engage in entrepreneurial activities such as women.

Sweden is an overall risk-friendly country according to Romanainen et al. (2016) however Swedish entrepreneurs do not take risks besides the absolutely necessary. There is a safety net due to the income perspective which is satisfactory and does not lead people in starting their own business. The authors also mention that many Swedish people see an opportunity to start a business but actually few do it. This means that there are low growth ambitions in Sweden and these are a weak point for the country.

In addition, OECD (2013) reports that Sweden does not have a high rank in viewing entrepreneurship as a desirable profession and social attitudes as regards to entrepreneurship are not always being supported. However, interesting facts are that in Sweden social prestige of successful entrepreneurs and media coverage of entrepreneurship are above the average compared to other OECD countries.

According to Lindholm Dahlstrand (2007) although Sweden has a strong focus on innovation and technology and engages in technology-based entrepreneurship, the country presents a rather weak entrepreneurial culture. This weak culture according to Venkataraman (2004) can be considered as “vicious cycles”. In these cycles, people who have entrepreneurial talent are attracted to already successful and existing companies rather than utilize their talents in order to create new companies.

The high performance of the pillar Finance is contributed to many factors. In Sweden according to Romanainen et al. (2016) two are the main sources of funding, soft loans from government agencies and equity financing. The government agencies focus on the promotion of SMEs and internationalization, whereas there are also venture capital, business angels, incubators and accelerators, all focusing on how to promote innovation and business development.

According to OECD (2018c) Sweden ranks well regarding access to finance whereas there are entrepreneurial programmes and policies that support startup financing. There are also programs that support unemployed in order to start their own business. In addition, there are programs for SMEs that support high-tech and high-growth enterprises with venture capital and investments. However, there are only a few lending schemes that have public support such as ALMI which offers microloans. In Sweden public support gives priority in financing high-tech and high-growth entrepreneurship in a large-scale.

Lindholm Dahlstrand and Cetindamar (2000) claim that three are the main actors that can provide financing to a new technology-based firm in Sweden and these are: 1) government, 2) competent venture capitalists and 3) competent acquirers. The government or the public sector can provide financing and all the necessary resources from the idea to seed and startup before IPO. The second actor, the competent venture capitalists can provide financing after seed and before or after IPO. The third actor, the competent acquirers can provide financing during expansion and before IPO.

Last but not least, Momot and Momot (2021) support that Sweden has different types of financial sources depending on the firm's lifecycle. In the startup phase SMEs can be funded by founders, family and friends as well as business angels. Business angels can also finance the mature phase of a firm along with the customer and suppliers whereas in the mature phase venture capital and banks can help a firm have access to finance.

The high performance of the pillar Policy can be justified by the following studies. According to Momot and Momot (2021) the Swedish government has implemented policies to improve access to finance through business angels, equity crowdfunding investments and angel

investors. Also, Swedish organizations such as Verksamt, ALMI, etc, aim to provide advisory services, loans and venture capital on SMEs. In addition, the private sector participates in the financing with formal or informal venture capital such as Nordic Capital Fund, Yozma, etc.

According to OECD (2018c) in Sweden there is a national policy framework for entrepreneurship which has a decentralized decision structure. This means that government places the general goals and shares the grants to the organizations which are responsible for implementing these strategies. Three organizations are responsible for supporting entrepreneurship and these are: 1) ALMI, 2) Insamlingsstiftelsen IFS Rådgivningscentrum and 3) Tillväxtverket. There are organizations along with the private sector companies and non-government organizations that support different groups of entrepreneurs such as immigrant, unemployed, youth and women. With this approach equal opportunities for assistance and support to all entrepreneurs are given.

As regards to government regulations, OECD (2018c) claims that Sweden has reduced the regulatory burden on SMEs and startups as well as the aim is to treat all individuals the same and entrepreneurs are treated as employees to their own firms.

Romanainen et al. (2016) support that there is a national innovation policy in Sweden which aims to strengthen the competitiveness of firms and create favorable conditions to operate well and expand. The export strategy of Swedish firms will help in the creation of the lowest unemployment rate in the EU by 2020.

In addition, Heyman et al. (2019) revealed in their study that policy has played an important role in helping the Swedish business sector becoming more entrepreneurial. The policy reforms in Swedish began in the 1980s and were implemented in the 1990s.

These reforms, according to the authors, included tax reforms where the tax system became more favorable for anyone who wanted to start a business. Reforms in the Swedish product markets where the regulation costs in services and utilities sectors in the mid-1990s were lower than the average EU-15. Labour market reforms where the employment protection in Sweden increased. Sweden also has experienced a shift to technological developments which helped in becoming more entrepreneurial.

Moreover, Braunerhjelm and Henrekson (2012) report that the reforms which happened in Sweden in the past two decades have helped the country grow and strengthen its economy and become more entrepreneurial.

The performance of the pillar Outputs can be justified by the following studies. Sanandaji (2020a) gives some interesting findings regarding the intellectual property rights of Nordic regions. In 2019 as a whole in the Nordic region 87.8 billion euros in value was created in businesses with intense dependency on design, 182.3 billion euros on patents and 280.7 billion euros on trademarks. These elements show the significant role of the intellectual property rights in Nordic countries like Sweden.

Moreover, according to Romanainen et al. (2016) in Sweden there are government agencies that help the promotion and the overall development of SMEs. In this way SMEs can utilize their resources in order to enhance their operations, products and services as well as to improve their innovativeness through new product, process or marketing innovations.

In addition, OECD (2018c) reports that Swedish entrepreneurs with 58.3% are more likely to introduce new products and services to their customers. With 57.4% Swedish entrepreneurs are also likely to sell these products and services to customers to other countries. These percentages confirm the fact that Swedish firms continue to innovate with new products and services which sell them either domestically or internationally.

Last but not least, Andersson and Tell (2018) support that although the domestic Swedish market for patent is not significant, there is a shift of Swedish firms on international markets for patents. These firms act more on the demand rather than the supply side which shows that the impact of these few large firms could be significant in the future.

The pillar Outcomes presents also a high performance. Sanandaji (2020a) supports that the Nordic region which is constituted of the countries Finland, Denmark, Iceland and Sweden is the 12th largest economy worldwide and the strength of these countries is knowledge-intensity. Moreover, Sanandaji (2020b) claims that Sweden is the only country in the EU that has so many knowledge-intensive workers concentrated.

In addition, according to Romanainen et al. (2016) the policies that the government implements in Sweden help companies increase their exports, whereas Sweden has focused its financial support to high-growth enterprises with technological content. This kind of support can help companies increase their number of employees, exports and sales, justifying the above mentioned results of the new proposed framework.

Moreover, OECD (2018c) explains that most financing programs focus on the support of the high-tech and high-growth potential of SMEs whereas there is also in general public support for high-tech and high-growth entrepreneurship. This support help firms grow and affects also employment since new jobs are being created.

Last but not least, Nählinder (2005) claims that the knowledge-intensive business service sector in Sweden is innovative and has 81% of the firms. This kind of innovation is important because it affects employment as well as it can affect and help other firms become more innovative. Sweden is known to have high skilled labour force, language skills and a well-developed knowledge-intensive business service sector. All these can help not only Sweden's economy domestically but it can also help to globalize its products and services.

Sweden presents a good performance on the pillar Impacts and this is in line with Bris (2014) who claims that Sweden is one of the ten most competitive countries. Whereas in terms of GDP PPP per capita is ranked 12th according to the IMD World Competiveness ranking. In addition, Sweden is a country which offers high quality of life. According to OECD (n.d.b) Swedes in their survey rated their life satisfaction with an average grade of 7.3 at a scale 0-10, which is one of the highest score in the OECD countries where the average is 6.5.

Moreover, Romanainen et al. (2016) supports that Sweden has programs that offer support to unemployed citizens who want to start their own business for six months,. The overall goal of the Swedish government through the different policies that are being implemented is to have the lowest unemployment rate in the EU by 2020. Last but not least, OECD (n.d.b) reports that in Sweden, the unemployment rate of labour force for a year or longer is 1.1%, which is lower than the average of the other OECD countries which is 1.8%.

Throughout the years from 2013 to 2018 in the NWM, the pillars Culture, Finance, Outputs, Outcomes and Impacts of Sweden performed better except the pillars Human Capital and Policy which remain the same (see Fig. 5.7). These changes throughout the years are due to the fact that the position of Sweden fell because other countries have improved in the ranking.

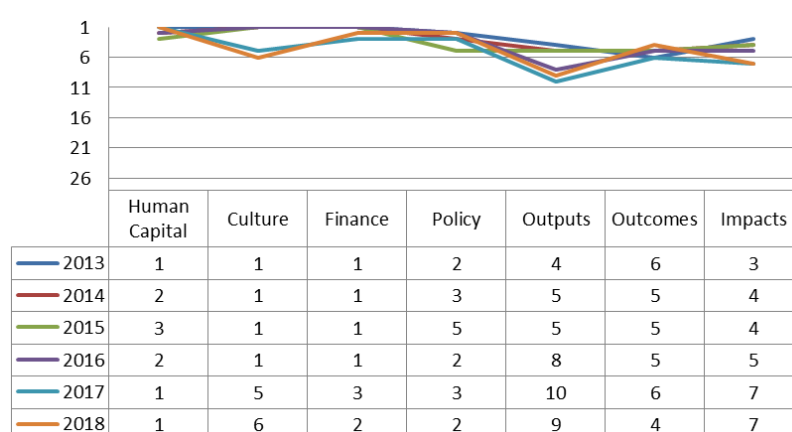


Figure 5.7. Sweden performance per pillar NWM rank 2013-2018.

Throughout the years from 2013 to 2018 in the TOPSIS method, the pillars Human Capital, Policy, Outcomes of Sweden performed better except the pillar Impacts which remains the same. The pillars Culture, Finance and Outputs have a slightly lower performance (see Fig. 5.8).

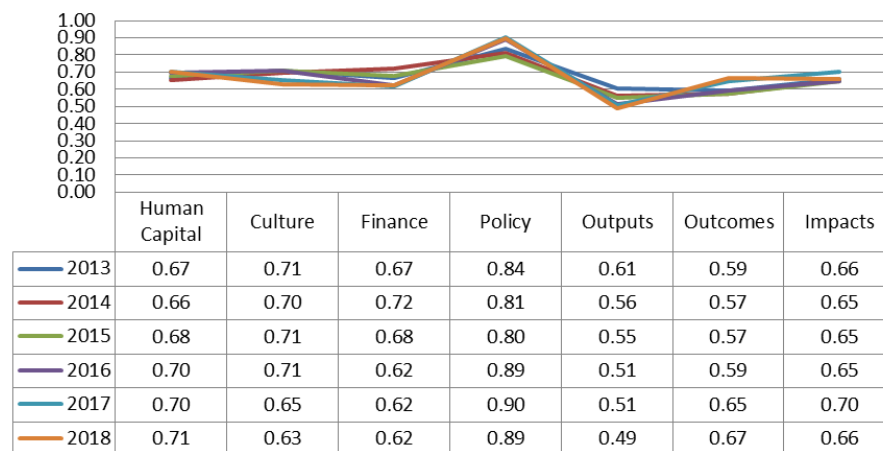


Figure 5.8. Sweden performance per pillar TOPSIS score 2013-2018.

5.1.3 Results based on the 3P model

As regards to the 3P framework based on the NWM rank, the performance of Greece can be seen through Enablers (Posture), Capabilities (Propensity) and Results (Performance). The overall performance of Greece could be characterized as moderate out of 28 regions (see Fig. 5.9).

The Results have the best performance in 2018 are ranked 16th, Enablers are ranked 22nd and Capabilities are ranked 23.5rd. The domain Results is constituted of the pillars Outputs, Outcomes and Impacts, therefore the performance of Results is linked on how these pillars perform. Although, the pillar Impacts does not perform well, the other two pillars perform well therefore the overall rank of Results is moderate.

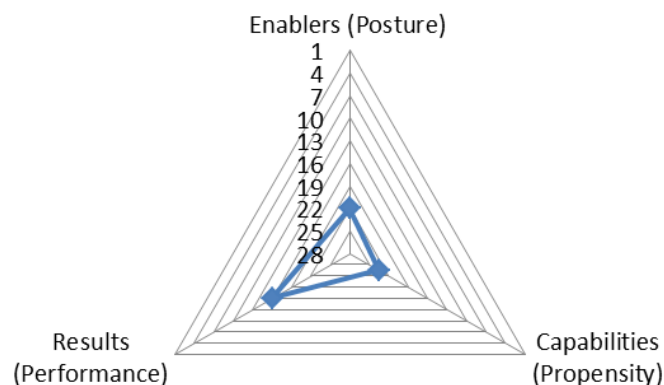


Figure 5.9. Greece 3P framework NWM rank 2018.

Enablers are constituted of the pillars Human Capital and Culture, therefore the performance of Enablers is linked on how these pillars perform. These two pillars perform moderate, therefore the overall rank of Enablers is moderate.

Last but not least, Capabilities is constituted of Finance and Policy, two pillars that present a rather moderate performance, therefore the overall rank of Capabilities is moderate.

In the TOPSIS method, the Results have the best performance in 2018 they have a score of 0.35, Enablers have a score of 0.30 and Capabilities have a score of 0.31. (see Fig. 5.10)

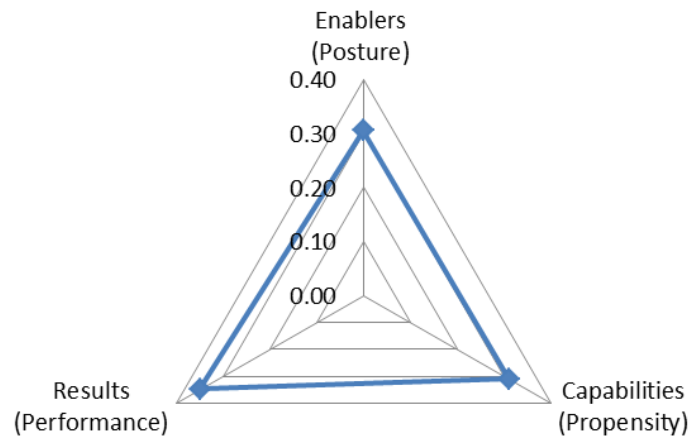


Figure 5.10. Greece 3P framework TOPSIS score 2018.

The improvement of Results can also lead to the improvement of Enablers and Capabilities in the future. Although, Greece performs better in Results, many reforms are required in order to improve Enablers and Capabilities. For example, Greece should try to cultivate a stronger entrepreneurial culture, as well as policies and programs that support entrepreneurship and funding should be implemented. In this way, Greece will be able to create a strong entrepreneurship ecosystem.

Throughout the years from 2013 to 2018 in the NWM, Enablers, Capabilities and Results have been improved (see Fig. 5.11). Enablers are ranked in 2013 25.5th and in 2018 they are ranked 22nd. Capabilities are ranked in 2013 26.5th and in 2018 they are ranked 23.5rd. Last but not least, Results in 2013 are ranked 20th and in 2018 they are ranked 16th.

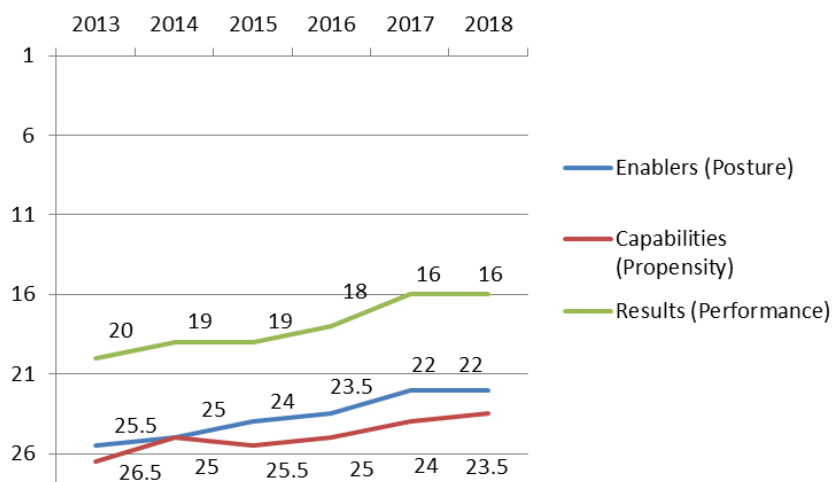


Figure 5.11. Greece 3P framework NWM rank 2013-2018.

In the TOPSIS method (see Fig. 5.12), throughout the years from 2013 to 2018, Enablers and Results present an important improvement whereas Capabilities remain the same. Enablers in 2013 have a score of 0.28 and in 2018 they have a score of 0.30. Capabilities in 2013 and in 2018 present the same score which is 0.31. Last but not least, Results in 2013 have a score of 0.28 and in 2018 they have a score of 0.35.

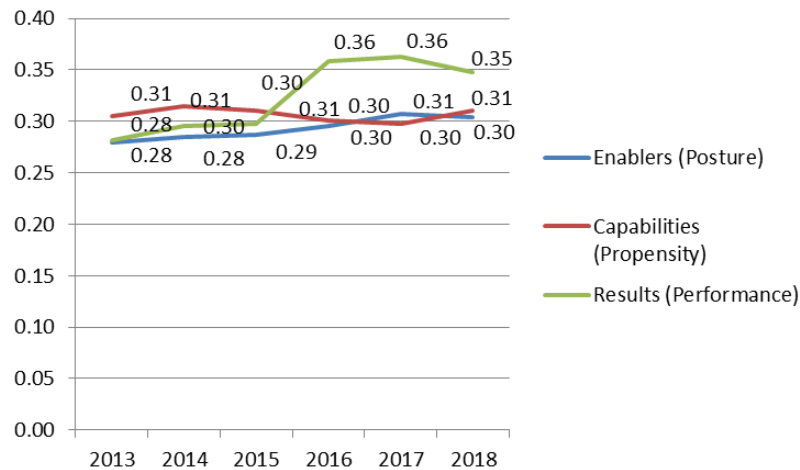


Figure 5.12. Greece 3P framework TOPSIS score 2013-2018.

As regards to the 3P framework based on the NWM rank, the performance of Sweden (see Fig. 5.13) can be seen through the Enablers (Posture), Capabilities (Propensity) and Results (Performance). As mentioned above, the performance of Enablers, Capabilities and Results is linked on the performance of each pillar that constitute these domains. The overall performance of Sweden could be characterized as high out of 28 regions.

The Enablers is constituted of Human Capital and Culture, the pillar Human capital has a high performance however, the pillar Culture has a slight lower performance, therefore Enablers retains its high performance.

The Capabilities is constituted of the pillars Finance and Policy which have a high performance, therefore it presents a high performance. Last but not least, Results is constituted of the pillars Outcomes, Outputs and Impacts which have a rather moderate performance, therefore Results also has a moderate performance.

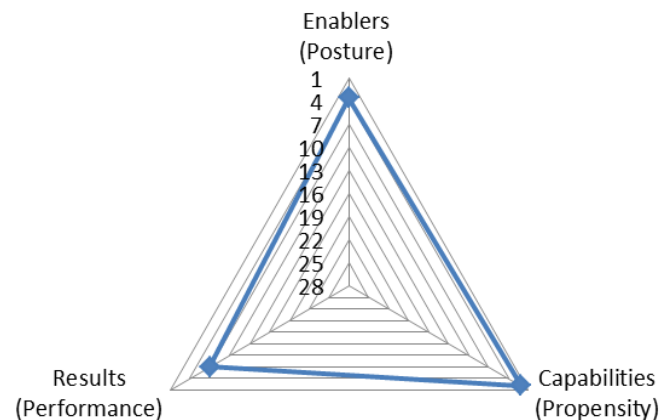


Figure 5.13. Sweden 3P framework NWM rank 2018.

Enablers and Capabilities have the best performance in 2018 are ranked 3.5th and 2nd whereas the TOPSIS score (see Fig. 5.14) are 0.67 and 0.76 respectively. Results follow with a slightly lower ranking which is 7th and the TOPSIS score is 0.60. These changes on the pillars can be explained due to the fact that the position of Sweden fell because other countries have improved in the ranking.

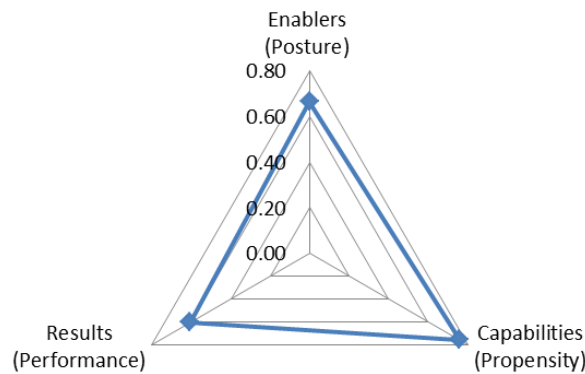


Figure 5.14. Sweden 3P framework TOPSIS score 2018.

Throughout the years from 2013 to 2018 in the NWM, Enablers, Capabilities and Results have a slightly lower performance (see Fig. 5.15). Enablers are ranked in 2013 1st and in 2018 they are ranked 3.5th. Capabilities are ranked in 2013 1.5th and in 2018 they are ranked 2nd. Last but not least, Results in 2013 are ranked 4th and in 2018 they are ranked 7th.

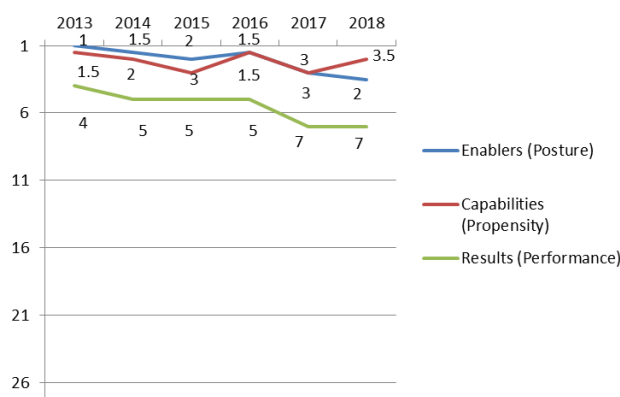


Figure 5.15. Sweden 3P framework NWM rank 2013-2018.

In the TOPSIS method, throughout the years from 2013 to 2018 (see Fig. 5.16), Enablers and Results present a slightly lower performance whereas Capabilities present a slight improvement. Enablers in 2013 have a score of 0.69 and in 2018 they have a score of 0.67. Capabilities in 2013 they have a score of 0.75 and in 2018 the score is 0.76. Last but not least, Results in 2013 have a score of 0.62 and in 2018 they have a score of 0.60.

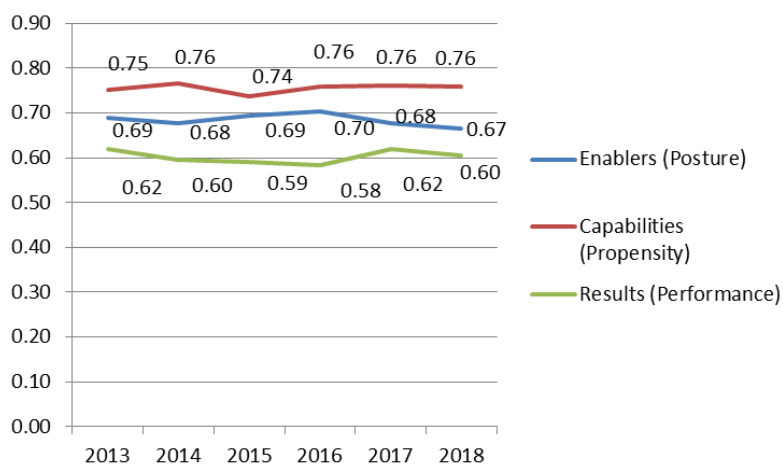


Figure 5.16. Sweden 3P framework TOPSIS score 2013-2018.

The improvement of Capabilities and Enablers can lead in the future to the improvement of Results. This means that the entrepreneurship culture that exists in Sweden along with the human capital as well as financing policies and national entrepreneurship programs can lead to the development of tangible results such as intellectual property rights, innovations, employment, exports, sales etc.

5.1.4 Results based on the QIH model

As regards to the Quadruple Innovation Helix model, the average TOPSIS score for the years 2013-2018 was calculated for Posture, Propensity, Outputs, Outcomes and Impacts (see Fig. 5.17) for Greece. The results for the remaining countries can be found in Appendix 4. The results of the QIH model revealed that Greece has a rather moderate performance on all helices as follows:

- The pillar Outcomes appears to have the best performance on all helices. The pillar Outcomes in the helices university and civil society is constituted of the variables Employment in knowledge-intensive activities and Employment fast-growing enterprises of innovative sectors, whereas in the helix government is constituted of the variables Medium and high-tech product exports and Knowledge-intensive services exports, as well as in the helix industry the pillar Outcomes is constituted of all the above mentioned variables and the variable Sales of new-to-market and new-to-firm product innovations. In all these variables Greece performs well therefore that is why the pillar Outcomes has the best performance on all helices.
- The domain Propensity follows with a good performance on three helices which are government, university and industry and a rather not so good performance on the helix civil society. The domain Propensity in the helix civil society is constituted of the variable Rule of law where Greece does not perform well.
- The pillar Outputs have a moderate performance on the helices industry and civil society whereas it has a low performance on the helices government, university. The pillar Outputs in the helix government is constituted of the following variables: PCT patents, Trademark and Design applications where Greece does not perform well. The same applies for the helix university where the pillar Outputs is constituted of the variable PCT patents.

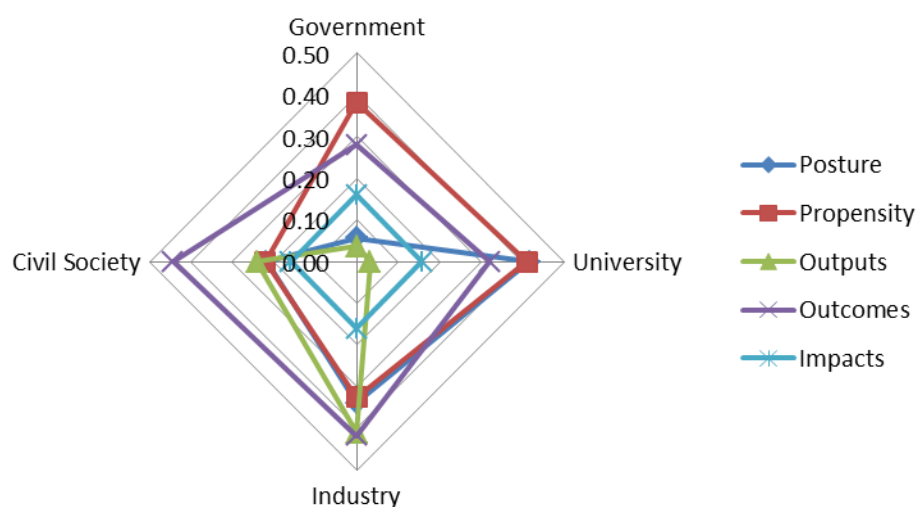


Figure 5.17. Greece QIH model Average of 2013-2018 TOPSIS score.

- The pillar Impacts has a steady and a low performance on all helices. The pillar Impacts in the helices government and civil society is constituted of the variables

Global Competiveness Index, GDP per capita, Unemployment and Quality of life Index where Greece does not perform well. In the helix industry the pillar Impacts is constituted of the variables High-Growth, Quality of life Index and Global Competiveness Index where Greece does not perform well. In the helix university the pillar Impacts is constituted of the variables Unemployment, Quality of life Index and Global Competiveness Index where Greece does not perform well.

- The domain Posture has the best performance on university and industry and a low performance on the helices civil society and government. The domain Posture is constituted in the helix government of the variable Corruption perception index where Greece does not perform well. In the helix civil society it is constituted of the following variables where also Greece does not perform well, Population with tertiary education, Lifelong learning, Opportunity perception, Risk acceptance and Corruption perception index.

As regards to the Quadruple Innovation Helix model, the average TOPSIS score for the years 2013-2018 was calculated for Posture, Propensity, Outputs, Outcomes and Impacts (see Fig. 5.18) for Sweden. The results of the QIH model revealed that Sweden has a rather high performance on all helices as follows:

- The domain Propensity, the domain Posture as well as the pillars Outcomes and Impacts have the best performance on all helices. The best performance on all helices can be explained due to the fact that Sweden performs high on all the variables that constitute the domains Propensity, Posture as well as the pillars Outcomes and Impacts.
- The pillar Outputs has the best performance on the helix university, followed by government and industry where in the helix civil society it has a slightly lower performance. The pillar Outputs in the helix civil society is constituted of the variable TEA where Sweden has a moderate performance.

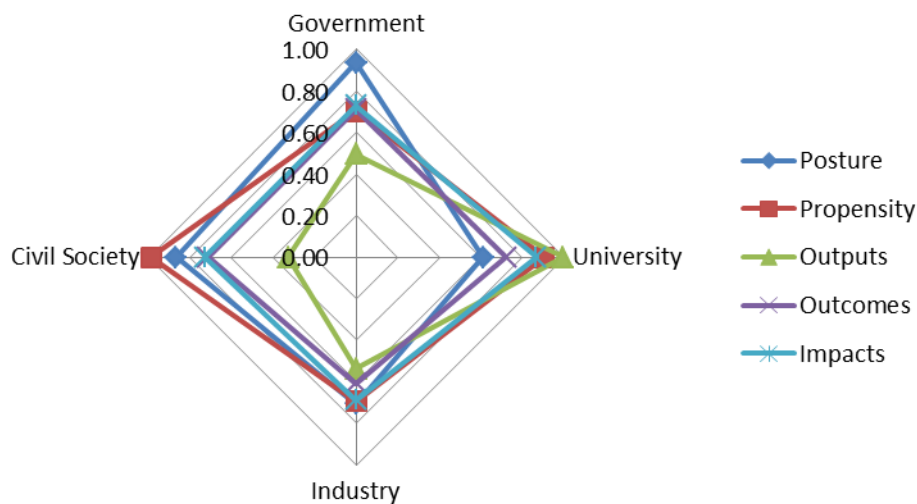


Figure 5.18. Sweden QIH model Average of 2013-2018 TOPSIS score.

5.2 Regional entrepreneurship ecosystems

At the meso level, Crete and Stockholm were chosen to be studied. On the one hand, Crete was chosen due to the fact that it is considered to be one of the most innovative regions of Greece and more specifically is the second most innovative whereas RIS in 2017 classified Crete as a Moderate Innovator.

On the other hand, Stockholm is the most innovative region of Sweden whereas RIS in 2017 classified Stockholm as an Innovation Leader, therefore it has a strong entrepreneurship ecosystem. The results for the remaining regions can be found in Appendix 3.

5.2.1 Data processing

At the meso level the regions of the EU-28 countries were studied either at the NUTS 1 or NUTS 2 level accordingly to the availability of data for all 31 variables. The NUTS 1 and NUTS 2 levels belong to the NUTS classification system which according to Eurostat (n.d.) is a hierarchical system for dividing up the economic territory of the EU for the purpose of:

- The collection, development and harmonization of European regional statistics.
- Socio-economic analyses of the regions.
 1. NUTS 1: major socio-economic regions.
 2. NUTS 2: basic regions for the application of regional policies.
 3. NUTS 3: small regions for specific diagnoses.

For the 22 European countries their regions were studied either at the NUTS 1 or NUTS 2 level. The remaining 6 European countries were studied as one region due to the fact that they have only one region, themselves. These are: Estonia, Cyprus, Latvia, Lithuania, Luxembourg and Malta.

Before the data analysis, the data were gathered and prepared. The dataset with the 31 variables for 6 years from 2013 to 2018 and for 212 regions was checked for missing data where 36% of the data were missing. Different imputation approaches were applied based on each case, as follows:

1. Case 1. Top down imputation. The value of the country (or the value of the NUTS 1 region) was available and the value of the NUTS 1 region (or NUTS 2 region) was missing. The value that was missing was imputed based on the ratio of the population or the ratio of GDP of the NUTS 1 region (or NUTS 2 region) to the total population or to the total GDP of the country (or NUTS 1 region).
2. Case 2. Bottom up imputation. The value of the NUTS 2 region was available and the value of the NUTS 1 region was missing. The value that was missing was imputed based on the ratio of the population or the ratio of GDP of the NUTS 1 region to the total population or to the total GDP of the NUTS 2 region.

The variables that were imputed based on Cases 1 and 2 are the following:

- R&D expenditure in the public sector
- R&D expenditure in the business sector
- Non-R&D innovation expenditures in SMEs
- EPO patent applications
- Trademark applications
- Design applications
- SMEs with product or process innovations

- SMEs with marketing or organisational innovations
- SMEs innovating in-house
- Employment in medium-high/high-tech manufacturing and knowledge-intensive services
- Sales of new-to-market and new-to-firm product innovations
- Exports medium and high-tech manufacturing
- Opportunity perception
- Startup skills
- Risk acceptance
- European Quality of Government Index
- Quality Pillar of EQI Index
- Impartiality Pillar of EQI Index
- Corruption Pillar of EQI Index

In addition, a normalization process took place in order to produce the relevant value rather than the absolute value of the variables based on their measurement units. In this way the comparison between different variables across different regions could take place.

This proportional approach allowed each variable to be studied and to be weighted appropriately whereas the two main imputation approaches top down and bottom up, were applied depending on each case. This method was chosen due to the fact that the weighting can be conducted according to the region's contribution to each variable and this contribution can be normalised with GDP. The variables that are a matter of economic activity can be weighted with GDP are the following:

- Employment in high-tech sectors
- Total EU expenditures
- Regional Competitiveness Index
- Unemployment rate
- Gross domestic product (GDP) per capita
- Gross fixed capital formation
- Gross value added at basic prices
- People at risk of poverty or social exclusion

The variables that are related to education can be weighted with the population since the number of the population having completed tertiary education, participating in education and training and the researchers are proportional to the population and these are the following:

- Percentage population aged 30-34 having completed tertiary education
- Participation rate in education and training (last 4 weeks)
- Researchers
- Early leavers

In Appendix 2 more details about the imputation for the 212 regions can be found. At the meso level the descriptive statistics for the 31 variables will be presented here (see Table 5.3).

Table 5.3. Meso level Descriptive Statistics.

Variables Meso level	Average of 2013-2018		2018	
	Mean	Variance	Mean	Variance
GDP per capita (number)	26912	200928169	28967	224399108
Employment in high-tech (%)	3.50	3.38	3.60	3.72
Gross fixed (number)	10067	290982572	10864	373001487
GVA (number)	61901	6063706542	66163	6760840331
Participation rate (%)	10.37	50.72	10.65	49.77
Poverty (%)	23.62	77.83	21.97	77.11
Researchers (%)	0.72	0.24	0.75	0.27
Unemployment (%)	9.53	42.22	7.29	32.3
EQI (score 0-100)	51.59	435.81	50.58	580.38
Quality of EQI (score 0-100)	56.16	374.84	60.11	553.65
Impartiality of EQI (score 0-100)	56.35	338.02	57.24	460.79
Corruption of EQI (score 0-100)	52.86	416.01	50.94	436.93
Tertiary education (%)	0.50	0.03	0.49	0.03
R&D public sector (%)	0.38	0.02	0.48	0.04
R&D business sector (%)	0.35	0.04	0.30	0.04
Non-R&D innovation (%)	0.34	0.01	0.24	0.02
EPO patents (%)	0.31	0.04	0.26	0.04
SMEs product process innovations (%)	0.46	0.04	0.42	0.03
SMEs marketing organizational innovations (%)	0.39	0.04	0.35	0.03
SMEs innovating in house (%)	0.43	0.04	0.43	0.04
Employment in medium high-tech (%)	0.52	0.03	0.50	0.03
Sales product innovations (%)	0.39	0.01	0.35	0.03
Exports medium high-tech (%)	0.44	0.03	0.63	0.06
Regional competitiveness index (score 0-1)	0.12	0.46	0.14	0.46
Opportunity perception (score 0-1)	0.51	0.05	0.56	0.07
Startup skills (score 0-1)	0.63	0.04	0.68	0.04
Risk acceptance (score 0-1)	0.50	0.03	0.58	0.04
Total expenditures (number)	576	386728	496	480118
Early leavers (%)	11.07	28.15	10.63	27.34
Trademark applications (%)	5.80	27.49	6.68	53.56
Design applications (%)	1.17	1.06	1.30	2.30

5.2.2 Results based on the entrepreneurship pillars

The results at the meso level for all Greek regions can be seen in Table 5.4. It can be seen that Crete overall is one of the best regions in Greece, although there are slight differences between the 2 techniques. Compared to other Greek regions, it performs very well in the pillars Finance and Outputs and less well in the pillar Culture whereas in the other pillars Crete has a moderate performance.

In addition, this can also be confirmed by the results of RIS where Crete is a Moderate Innovator region. In fact, Crete is among the top-20 regions of having high R&D public expenditures, a high share of Non-R&D innovation expenditures in SMEs as well as innovative SMEs collaborating with others.

Table 5.4. Results at the macro level for all 28-EU countries.

2018	rs =0.94506			rs =1			rs =0.93956	
Human Capital	TOPSIS Rank	NWM RANK	Culture	TOPSIS Rank	NWM RANK	Finance	TOPSIS Rank	NWM RANK
Anatoliki Makedonia, Thraki	164	168	Anatoliki Makedonia, Thraki	162	158	Anatoliki Makedonia, Thraki	104	87
Kentriki Makedonia	65	50	Kentriki Makedonia	162	158	Kentriki Makedonia	99	85
Dytiki Makedonia	120	112	Dytiki Makedonia	162	158	Dytiki Makedonia	142	125
Ipeiros	67	81	Ipeiros	162	158	Ipeiros	78	62
Thessalia	83	83	Thessalia	156	152	Thessalia	127	108
Ionia Nisia	138	134	Ionia Nisia	156	152	Ionia Nisia	157	144
Dytiki Ellada	91	71	Dytiki Ellada	156	152	Dytiki Ellada	58	42
Stereia Ellada	173	187	Stereia Ellada	156	152	Stereia Ellada	176	142
Peloponnisos	109	95	Peloponnisos	156	152	Peloponnisos	186	189
Attiki	29	21	Attiki	155	150	Attiki	150	160
Voreio Aigaio	179	156	Voreio Aigaio	167	162	Voreio Aigaio	125	118
Notio Aigaio	156	170	Notio Aigaio	167	162	Notio Aigaio	122	132
Kriti	102	93	Kriti	167	162	Kriti	30	21
	rs = 0.74725			rs = 0.93956			rs = 0.85557	
Policy	TOPSIS Rank	NWM RANK	Outputs	TOPSIS Rank	NWM RANK	Outcomes	TOPSIS Rank	NWM RANK
Anatoliki Makedonia, Thraki	209	202	Anatoliki Makedonia, Thraki	136	181	Anatoliki Makedonia, Thraki	203	198
Kentriki Makedonia	206	170	Kentriki Makedonia	100	105	Kentriki Makedonia	193	170
Dytiki Makedonia	211	212	Dytiki Makedonia	89	97	Dytiki Makedonia	198	163
Ipeiros	210	211	Ipeiros	160	173	Ipeiros	212	212
Thessalia	178	188	Thessalia	71	71	Thessalia	205	210
Ionia Nisia	183	206	Ionia Nisia	133	146	Ionia Nisia	207	206
Dytiki Ellada	180	192	Dytiki Ellada	74	93	Dytiki Ellada	196	167
Stereia Ellada	179	190	Stereia Ellada	107	133	Stereia Ellada	186	163
Peloponnisos	181	193	Peloponnisos	102	108	Peloponnisos	208	199
Attiki	162	139	Attiki	122	154	Attiki	98	42

Voreio Aigaio	201	210	Voreio Aigaio	130	137	Voreio Aigaio	204	207
Notio Aigaio	200	200	Notio Aigaio	119	164	Notio Aigaio	209	202
Kriti	198	194	Kriti	67	88	Kriti	200	168
	rs =0.57497							
Impacts	TOPSIS Rank	NWM RANK						
Anatoliki Makedonia, Thraki	199	204						
Kentriki Makedonia	201	181						
Dytiki Makedonia	206	209						
Ipeiros	204	210						
Thessalia	203	200						
Ionia Nisia	190	207						
Dytiki Ellada	211	205						
Stereia Ellada	202	196						
Peloponnisos	193	199						
Attiki	183	132						
Voreio Aigaio	205	212						
Notio Aigaio	198	196						
Kriti	195	198						

The NWM for Crete presented a rather moderate to low performance out of 212 regions (see Fig. 5.19). The performance of Crete in the NWM rank differs from its performance in the TOPSIS method due to the fact, that in the first case ordinal values are used and in the second cardinal values are used.

The pillar Human Capital presents a moderate performance in 2018 is ranked 93rd. The pillar Culture has a moderate to rather low performance in 2018 is ranked 162nd. The pillar Finance in 2018 is ranked 21st. The pillar Policy has also a rather low performance in 2018 is ranked 194th. Also, the pillar Outputs has a moderate performance in 2018 is ranked 88th. The pillar Outcomes has also a rather low performance in 2018 is ranked 168th whereas the pillar Impacts has a low performance in 2018 is ranked 198th.

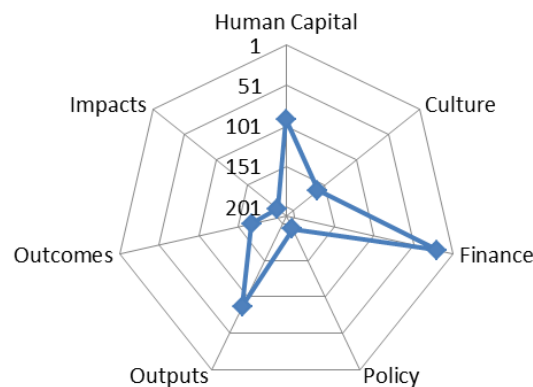


Figure 5.19. Crete performance per pillar NWM rank 2018.

The TOPSIS method also revealed for Crete a rather moderate to low performance out of 212 regions (see Fig. 5.20). The pillar Human Capital has a moderate score of 0.44 in 2018. The pillar Culture has also a moderate score of 0.40 whereas the pillar Finance has a slightly higher score of 0.46. In addition, the pillar Policy has a low score of 0.18. The pillar Outputs has a moderate score of 0.43 whereas the pillars Outcomes and Impacts have also low scores, 0.25 and 0.27 respectively.

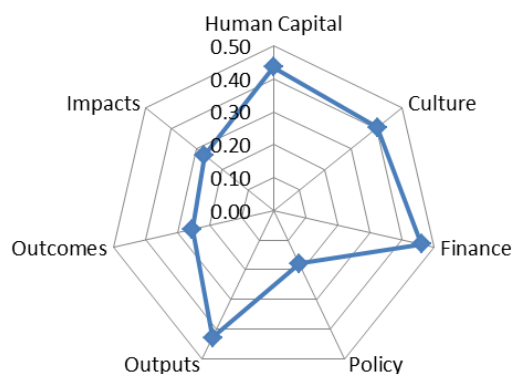


Figure 5.20. Crete performance per pillar TOPSIS score 2018.

The rather low performance of the pillar Human Capital can be explained by Nikolaidis and Bakouros (2009) who support that one of the advantages of Crete is academic and research institutions. This is due to the fact that worldwide competitive research is conducted in new technologies such as for example biomedicine, as well as they invest and participate more in research and programs. In addition, there is both quality of infrastructure as well as specialization of academic staff that can help in research. Last but not least, due to the high quality of life, qualified people come to Crete from other European countries.

Moreover, Kelessidis et al. (2012) in their study found that although entrepreneurship training in Greece is not the best, efforts have been made in this area to be improved both by the Greek state and businesses but also by professors in universities. An example is the Technical University of Crete which has created a virtual training platform for a business simulation. Through this training, students will be more prepared to start their own business.

In addition, Anagnosti et al. (2014) also found that the participation of students in an entrepreneurship education program can affect their behaviour control. Students were presented to feel more capable to start a new business after taking the class.

Furthermore, the rather low performance of Culture can be explained according to Nikolaidis and Bakouros (2009) due to the fact that in Crete there is not advanced entrepreneurial orientation and spirit of collaboration as well as there is limited number of spin-offs whereas researches and academics show limited entrepreneurship.

Kelessidis (2013) revealed that through the proper training Greek students can cultivate an entrepreneurial culture and be more capable of starting their own business. The author analyzes the measures that have been implemented at the Technical University of Crete in order to achieve this goal. The following two programs have been implemented: 1) the Nursery of ideas (UNISTEP) which help students analyse their ideas, take actions and build prototypes under the guidance of mentors and using the labs' equipment and 2) an online entrepreneurship training platform (MKE).

In addition, Lassithiotaki (2011) through her study on rural women entrepreneurship in the region of Crete revealed that among others there is a lack of entrepreneurial culture and they are unwilling to undertake risks. The author mentions that this lack of entrepreneurial culture can be due to the fact that historically entrepreneurship is less developed in rural areas for both men and women and it is more difficult for an entrepreneurial culture to be cultivated in these areas.

The fact that the pillar Finance has the best performance can also be confirmed by the results of the Regional Innovation Scoreboard where Crete is among the top 20 regions in variables related to R&D and Non-R&D expenditures which are also measured in the pillar Finance in the new proposed framework.

Moreover, the above findings can also be supported by the study of the Centre of Entrepreneurial and Technological Development of Crete (2004) which mentions that *“9.53% of the total government expenditure on Scientific and Technological research in Greece is earmarked for Crete, this fact ranks Crete in a very good position, compared to the whole of Greece”* (as cited in Nikolaidis and Bakouros 2009).

However, according to Nikolaidis and Bakouros (2009) in Crete there are not adequate funds and investment from both private sectors as well as foreign investors whereas there was a low impact on the Cretan economy from the application of national funding programs. These areas still need to be improved.

The pillar Policy has also a rather low performance due to the fact that although there are EU programs implemented in Crete such as the RITTs project, the InnoRegio and CRINNO according to Nikolaidis and Bakouros (2009) there is still *“absence of an integrated strategic plan for a regional policy on R&D, as well as innovation.”* This can be due to the fact that also there is not a concrete national policy on R&D and on innovation as well.

In addition, Papadakis et al. (2018) found that although, citizens in Crete are satisfied with the regional policy regarding strategic planning and policy implementation, there is great dissatisfaction for the public policy which was implemented by the central government along with the austerity measures during the economic crisis. This is due to the fact that there was a failure in finding solutions related to social development, entrepreneurship and welfare.

Moreover, Papadakis et al. (2018) through their research found that citizens in Crete would like more continuous training on new technologies, better management of European programs and European funds as well as better development of administrative and social skills.

Furthermore, the pillar Outputs has a moderate performance. According to OECD (2005) compared to the other regions of Greece, Crete has the highest level of R&D which is constituted of approximately 50% of public R&D and 50% of Higher Education Institutions. This can lead to the cooperation between universities and companies to create innovative products or services as well as intellectual property rights.

In addition, Nikolaidis and Bakouros (2009) claim that in Crete firms have introduced at least one innovative activity with 23.1% and this means that Crete is at the sixth place in comparison with the remaining 12 regions of Greece. This percentage concerns both manufacturing firms and firms in services.

Tsoukatos et al. (2018) found that the innovation activity of SMEs in the region of Crete is directly affected by each business characteristics such as R&D investments, high levels of marketing promotion, financial performance and exporting orientation. All these characteristics can have a positive impact on the innovation activity of SMEs and can lead to the development of product, process or marketing innovations.

The low performance of the pillar Outcomes can be explained due to the fact that Crete is competitive worldwide in the two following sectors: tourism and agriculture according to Nikolaidis and Bakouros (2009) and there are very few companies that can be considered highly technologically. Moreover, according to the Exporters' Association of Crete (n.d.) there are more than 160 firms with exports activities in the region of Crete where 56% of these exports concern food and beverage. These exports include olive oil, wine, bakery goods, raisins, herbs, citrus fruits, honey etc. Therefore, the main exports are related to the Agrofood industry, meaning that the high-tech exports of the island have a lower rate since there are also not so many highly technologically firms.

According to the report “*Smart Specialization strategy of Crete region*” of ris3.crete (2015) in Crete there is a small number of knowledge-intensive businesses. In addition, there is a lack of trained human capital in technology-intensive and knowledge-intensive sectors due to the fact that other sectors are more developed such as construction etc, which do not need a high level of education. The economy is mainly based in agriculture and tourism which have a low demand of technology.

Although, Crete has a high quality of life and many products which are globally known for their nutritional value as well as the Cretan diet that promotes good health and longevity, there are different factors that can justify the low performance of Impacts.

According to Nikolaidis and Bakouros (2009), Crete is far away from the central national market and the main European ones. In addition, the technology-based industry is not very well developed in the island in comparison to tourism and agriculture. All these factors can play a role on how competitive Crete can be as well as on jobs creation. Moreover, according to European Commission (2021) the unemployment rate in Crete is 16.6% where mostly there is seasonal employment since the tourism industry is very well developed in the island. There are also many SMEs in retail trade which employ a great number of people. Last but not least, according to the report “*Smart Specialization strategy of Crete region*” of ris3.crete (2015) in Crete there is low competitiveness of the regional economy at the European level regarding technology readiness and labour market indicators.

Throughout the years from 2013 to 2018 in the NWM, all pillars of Crete performed better except the pillars Policy and Impacts (see Fig. 5.21).

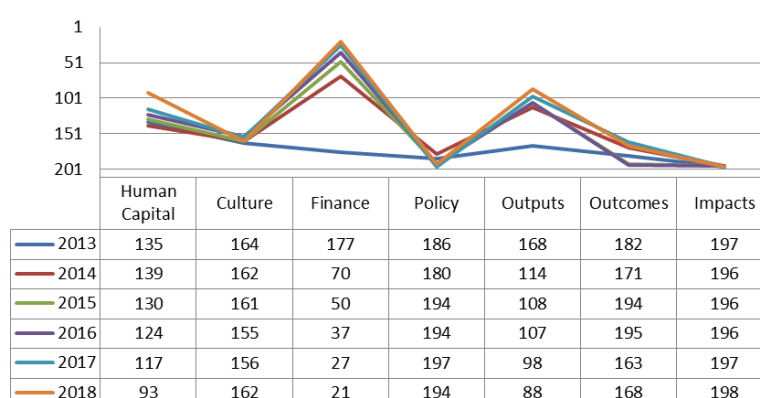


Figure 5.21. Crete performance per pillar NWM rank 2013-2018.

Throughout the years from 2013 to 2018 in the TOPSIS method, the pillars Human Capital, Finance, Outputs and Impacts of Crete performed better. The pillars Culture, Policy and Outcomes have a lower performance (see Fig. 5.22).

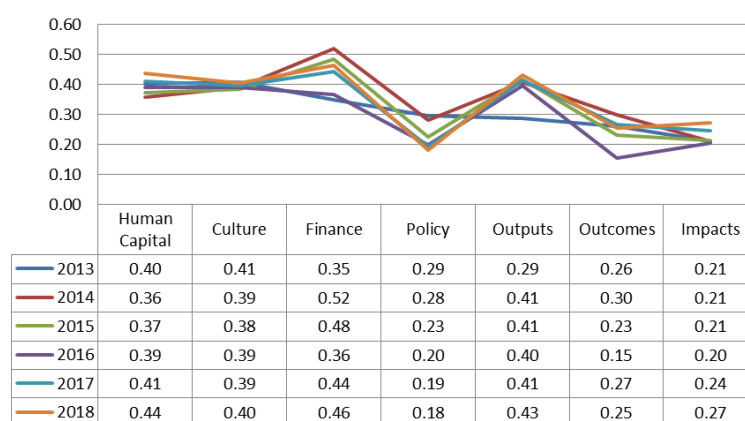


Figure 5.22. Crete performance per pillar TOPSIS score 2013-2018.

Stockholm is one of the most innovative regions therefore its overall performance can be characterized as one of the best performances out of the 212 regions and also the Regional Innovation Scoreboard classifies Stockholm as an Innovation Leader region.

In the NWM (see Fig. 5.23), the results revealed that the pillar Human Capital has the best performance in 2018 is ranked 1st along with the pillars Finance which is ranked 2nd, Policy and Outcomes which are both ranked 3rd as well as the pillar Impacts which is ranked 5th. The pillar Culture in 2018 is ranked 26th and the pillar Outputs is ranked 14th.

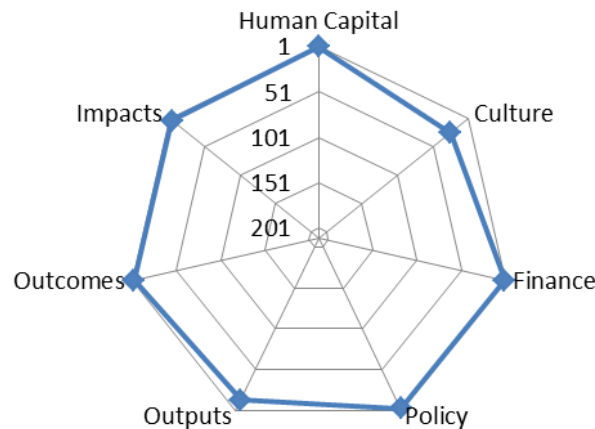


Figure 5.23. Stockholm performance per pillar NWM rank 2018.

The TOPSIS method also revealed for Stockholm a high performance out of 212 regions (see Fig. 5.24). The pillar Human Capital has a high score of 0.84 in 2018. The pillars Culture and Finance have also high scores 0.69 and 0.71 respectively. In addition, the pillar Policy has a score of 0.60. Moreover, the pillar Outputs has a moderate score of 0.53 whereas the pillar Outcomes has a score of 0.68 as well as the pillar Impacts has a moderate score of 0.59.

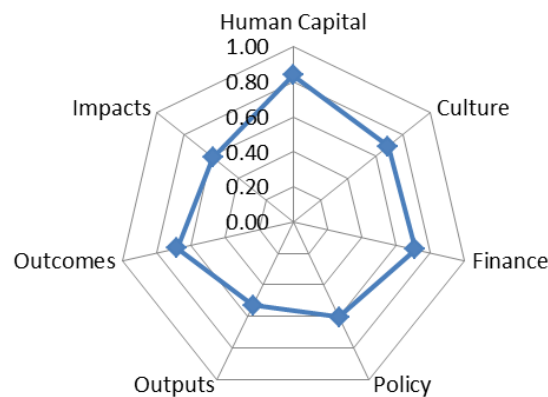


Figure 5.24. Stockholm performance per pillar TOPSIS score 2018.

The high performance of the pillar Human Capital is in line with the study of Lindqvist and Baltzopoulos (2011) where the authors claim that in the region of Stockholm there are important universities as well as specialized university colleges. In Stockholm there is also a significant number of researchers which constitute 27% of the national total and the tertiary education constitutes 23% of the population.

Blenker et al. (2004) claim that in Sweden there is the Stockholm School of Entrepreneurship which is a network based university. It is a cooperation of four different institutions in Stockholm and the aim is to cultivate innovation and entrepreneurship through different courses. Teaching and research take place within these four institutions and this school

basically works as a place of resources and a point of contact for different teachers and researchers.

In addition, Fuchs et al. (2008) also support that entrepreneurship education at a regional level, for example in Sweden has been enhanced through the National Entrepreneurship Programme implemented by the Swedish government in order to support both regional and local initiatives regarding entrepreneurship education.

Furthermore, the pillar Culture has a good performance. It is known that entrepreneurship culture is viewed rather positively at the national level in Sweden therefore is logical that Stockholm also presents a good performance on this pillar. Moreover, according to Sanandaji (2020b) Stockholm is the strongest region of Sweden. This strong performance of Stockholm is due to the strong startup culture and the venture capital funding. The author claims that Stockholm is *“a Nordic miniature version of Silicon Valley”*.

Moreover, Davidsson (1995) in his study of analyzing culture, structure and entrepreneurship in the regions of Sweden, found that Stockholm had the higher value in culture and the indicator Entrepreneurial Values Index compared to the other regions.

Lindqvist and Baltzopoulos (2011) claim that in the region of Stockholm there is a thriving entrepreneurial culture. This culture is strengthened through the initiatives of regional universities that focus on implementing positive attitudes towards cooperation.

The pillar that Stockholm also has a good performance is Finance. Lindqvist and Baltzopoulos (2011) support that in Stockholm there is high gross expenditure in R&D as a ratio of GDP (GERD) 4.3% which is higher both than the national and the EU27 average. In addition, the share of private investments in GERD is higher than the EU27 average, a fact that can be explained from the presence of ICT companies such as Ericsson, IBM Svenska that focuses on research.

Also, according to the authors, Stockholm receives funding from the national level through different sources such as for example the European Regional Development Funds, the European Social Funds programme and others. From the European Structural Fund Stockholm received 8.5 million euros for its Operational Programme which is higher than the development funding received by the Swedish regional authorities. In addition, Stockholm received 1billion euros from the European Social Funds for its operational programme in 2013-2017.

Moreover, Goudriaan (2016) in his study found that startups in Stockholm attract to a significant degree international investors and that funding was seemingly in abundance.

The pillar Policy has also a very good performance. Lindqvist and Baltzopoulos (2011) support that in Sweden all NUTS 3 regions including Stockholm are required to present Regional Development Plans which can be supplemented with plans for regional growth or innovation strategies. These plans are conducted in cooperation of different actors such as universities, public sector, business etc. Moreover, in Stockholm there are clusters and innovation systems initiatives, such as a three-year initiative for the increase of innovation and entrepreneurship as well as Smart Specialization policies.

According to the European Commission (n.d.) in Stockholm different policies have been implemented such as the Innovation Stockholm which is a regional innovation strategy. This strategy had an Action Plan with five areas, research and innovation infrastructure, innovation procurement, supply of capital, cross-sector approach and global attraction as well as 40 different activities. Innovation Stockholm has become the main platform in Stockholm for innovation activities.

In addition, the European Commission (n.d.) explains that another policy initiative at the region of Stockholm is the International Centre for Life Sciences. This is a policy for research and innovation in the health care sector. Last but not least, the regional structure of

Stockholm's governance includes different actors at different levels and has both public and private initiatives.

The performance of the pillar Outputs can be explained, according to Lindqvist and Baltzopoulos (2011), due to the fact that in Stockholm there is strong presence of research-intensive companies in the ICT sectors and the presence of life sciences clusters that develop a high number of patents. SMEs are also strengthened through initiatives such as the Stockholm Environmental Technology Centre. This is also in line with OECD (2006) which supported that Stockholm was ranked as one of top regions on high-tech patents.

According to s3platform (n.d.) in Stockholm there is a significant number of small research based companies that have great impact in attracting international talent, investments as well as capital. These research based companies have the knowledge and the resources to create new innovative products or services as well as intellectual property rights.

Moreover, also s3platform (n.d.) claims that in the region of Stockholm the one third of the total R&D expenditures of Sweden as well as many startups companies can be found. This means that research is very strong in the region and helps in the creation of innovative startups.

The high performance of the pillar Outcomes is in line with Lindqvist and Baltzopoulos (2011) who claim that in Stockholm the knowledge-intensive services sector constitutes a large share of its economy and the local employment in these services is 25%. In addition, the authors support that Stockholm has a high-tech specialization such as biotechnology.

According to s3platform (n.d.) Stockholm is ranked as the most knowledge-intensive region outside US. The area is constituted of 19 higher education institutions, three best performing universities and clusters which are globally competitive.

In addition, Lindqvist and Baltzopoulos (2011) also report that the different innovative projects that take place in Stockholm have managed to increase the companies' exports and create new jobs. For example, through the project Environmental Technology for Growth where 140 companies participated, they managed to increase their services by 30% and create 32 new jobs.

The pillar Impacts has also a very good performance. Stockholm has high GDP per capita approximately 60% which is above the EU27 average and low unemployment rate. According to OECD (2006) Stockholm is characterized for its high quality of life due to different factors such as strong public health, high educational attainment and low poverty (as cited in Lindqvist and Baltzopoulos 2011).

According to s3platform (n.d.) Stockholm is trying to build a society that will be sustainable in the long term, economically stable as well as the society will contribute with solutions to the global problems. Stockholm also is a multicultural region which supports different lifestyles and different ways of thinking.

According to the European Commission (n.d.) Stockholm has an unemployment rate of 6.1% which is lower than the average EU which is 6.3%. Regarding employment, 9.9% work at the information and communication sector and 4.1% in the financial and insurance activities. These facts can confirm the high performance of the pillar Impacts.

Throughout the years from 2013 to 2018 in the NWM, Stockholm performed better in the pillars Human Capital, Finance, Outputs and Outcomes. The pillars Culture, Policy and Impacts have a lower performance (see Fig. 5.25). These changes throughout the years are due to the fact that the position of Stockholm fell because other regions have improved in the ranking.

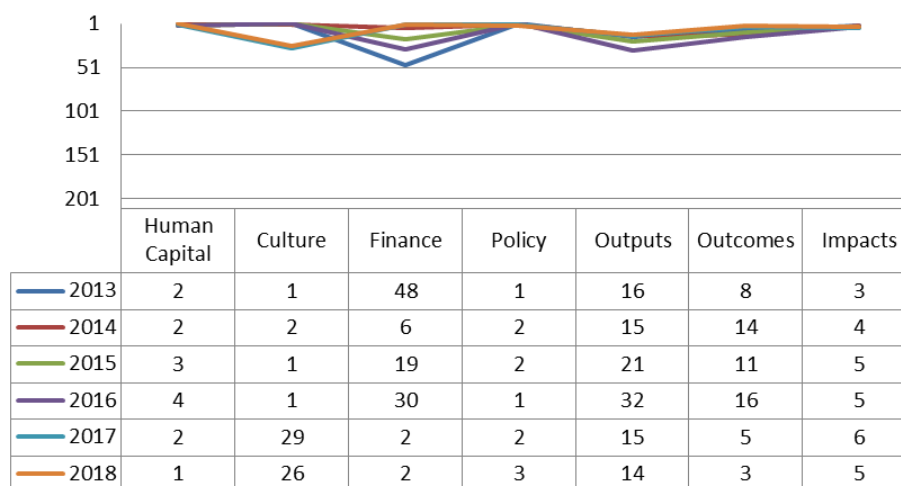


Figure 5.25. Stockholm performance per pillar NWM rank 2013-2018.

Throughout the years from 2013 to 2018 in the TOPSIS method, the pillars Culture, Outcomes and Impacts of Stockholm have a lower performance whereas the pillar Outputs remain the same. The pillars Human Capital, Finance and Policy have a better performance (see Fig. 5.26).

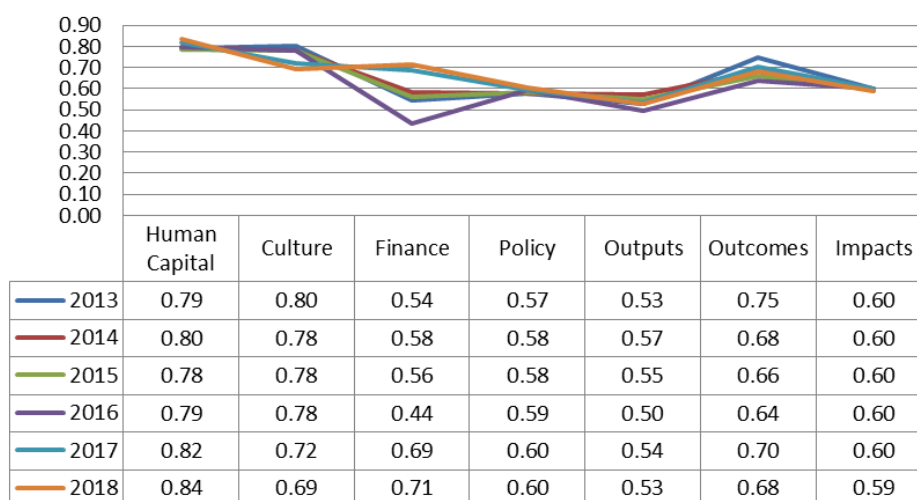


Figure 5.26. Stockholm performance per pillar TOPSIS score 2013-2018.

5.2.3 Results based on the 3P model

As regards to the 3P framework based on the NWM rank, the performance of Crete can be seen through Enablers (Posture), Capabilities (Propensity) and Results (Performance). The overall performance of Crete could be characterized as moderate out of 212 regions.

Enablers in 2018 have a slightly better performance and they are ranked 127.5th in the NWM Rank and the TOPSIS score in 2018 is 0.42. Enablers is constituted of Human Capital and Culture. Although, Culture has a rather steady and moderate performance throughout the years, the pillar Human Capital performs better, therefore the overall rank of Enablers remains moderate.

Capabilities have a moderate performance in 2018 than Enablers and Results, they are ranked 107.5th in the NWM Rank (see Fig. 5.27) and the TOPSIS score (see Fig. 5.28) is 0.32. Capabilities is constituted of Finance and Policy, although the pillar Policy has a rather low performance, the pillar Finance performs well, therefore the overall rank of Capabilities remains moderate.

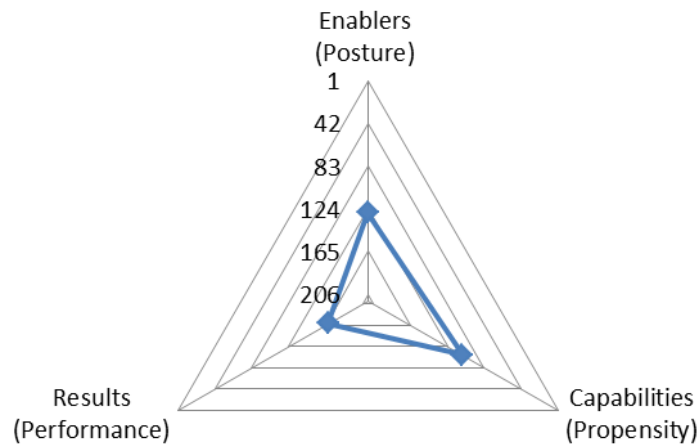


Figure 5.27. Crete 3P framework NWM rank 2018.

Last but not least, the Results follow with a rather not so good performance in 2018, they are ranked 168th in the NWM Rank and the TOPSIS score is 0.32. Results is constituted of the pillars Outputs, Outcomes and Impacts, where Outputs has a moderate performance and the other two pillars have a low performance. Therefore, the overall rank of Results is rather moderate.

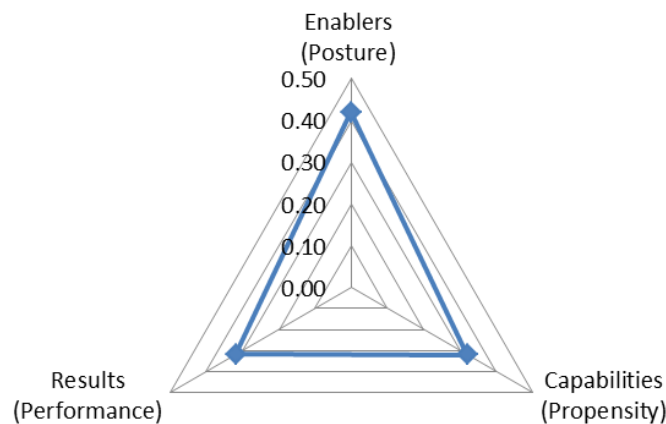


Figure 5.28. Crete 3P framework TOPSIS score 2018.

The improvement of Enablers can lead in the future to the improvement of both Capabilities and Results. This means that Crete has an entrepreneurial culture along with the human capital that exists in the area such as universities and research institutions and they should be exploited in different ways in order to perform better as well as to the develop results such as intellectual property rights, innovations, employment, exports, etc. In this way, Crete can enhance its entrepreneurship ecosystem.

Throughout the years from 2013 to 2018 in the NWM (see Fig. 5.29), Enablers, Capabilities and Results have been improved. Enablers are ranked in 2013 149.5th and in 2018 they are ranked 127.5th. Capabilities are ranked in 2013 181.5st and in 2018 they are ranked 107.5th. Last but not least, Results in 2013 are ranked 182nd and in 2018 they are ranked 168th.

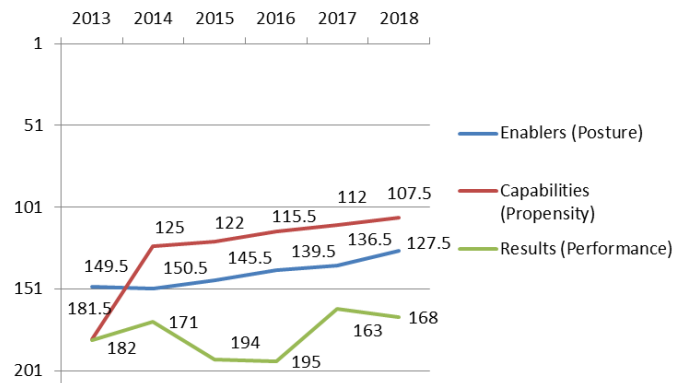


Figure 5.29. Crete 3P framework NWM rank 2013-2018.

Throughout the years from 2013 to 2018 in the TOPSIS method (see Fig.5.30), Enablers and Results have been improved whereas Capabilities remain the same. Enablers in 2013 have a score of 0.40 and in 2018 they have a score of 0.42. Capabilities in 2013 and in 2018 have a score of 0.32. Last but not least, Results in 2013 have a score of 0.25 and in 2018 they have a score of 0.32.

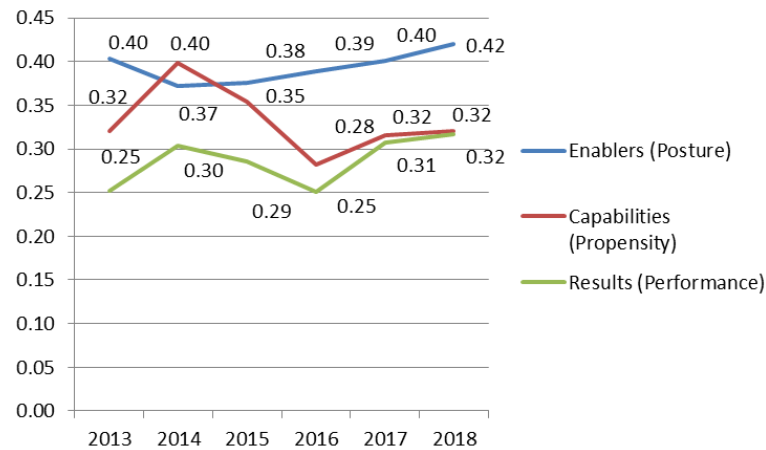


Figure 5.30. Crete 3P framework TOPSIS score 2013-2018.

As regards to the 3P framework based on the NWM rank (see Fig.5.31), the performance of Stockholm can be seen through Enablers (Posture), Capabilities (Propensity) and Results (Performance). The overall performance of Stockholm could be characterized as high out of 212 regions.

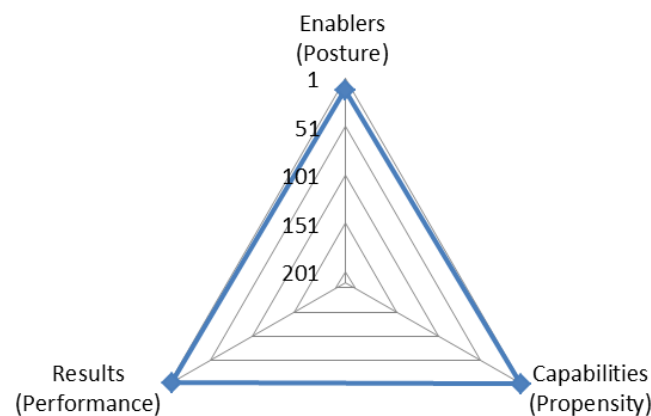


Figure 5.31. Stockholm 3P framework NWM rank 2018.

It can be observed that all domains, Enablers, Capabilities and Results have a high performance and this can be explained due to the fact that the pillars that constitute these domains also perform high for Stockholm.

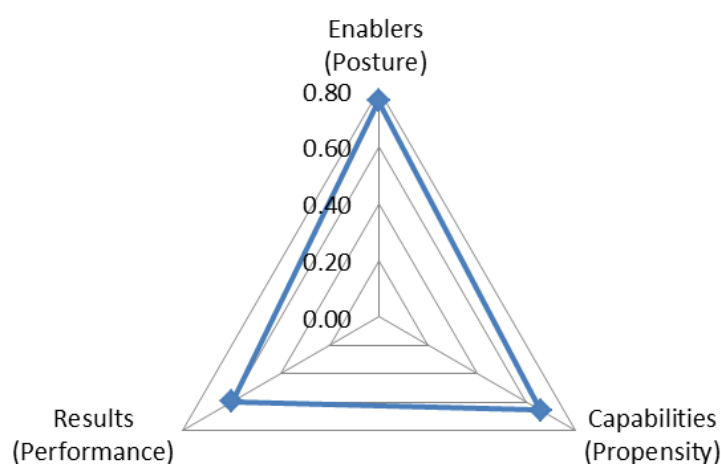


Figure 5.32. Stockholm 3P framework TOPSIS score 2018.

In 2018 Enablers are ranked 13.5th and the TOPSIS score is 0.76 (see Fig.5.32), Capabilities are ranked 2.5nd and the TOPSIS score is 0.66 and Results are ranked 5th and the TOPSIS score is 0.60.

The high performance of Stockholm shows that Enablers and Capabilities meaning the human capital in combination with the entrepreneurial culture, the financing policies as well as the entrepreneurship programs that exist in the region are fully utilized and they translate into results such as intellectual property rights, innovations, employment, exports, sales etc. All these lead to the creation of a strong entrepreneurship ecosystem.

Throughout the years from 2013 to 2018 in the NWM (see Fig.5.33), Capabilities and Results have been improved whereas Enablers present a slighter low performance. Enablers are ranked in 2013 1.5st and in 2018 they are ranked 13.5th. Capabilities are ranked in 2013 24.5th and in 2018 they are ranked 2.5nd. Last but not least, Results in 2013 are ranked 8th and in 2018 they are ranked 5th.

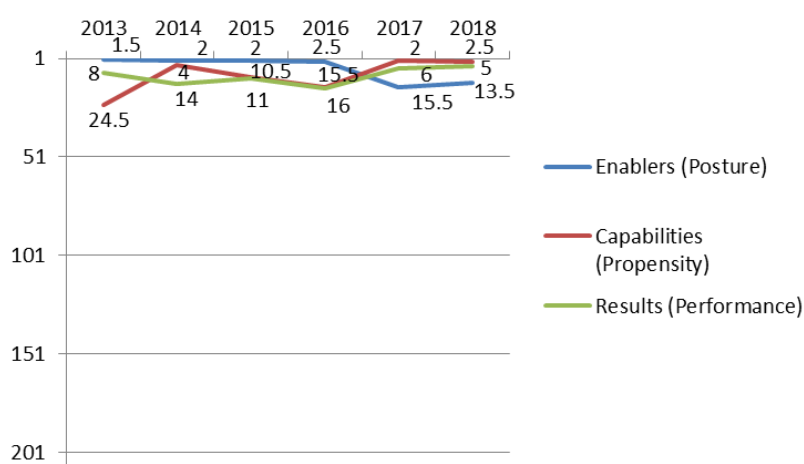


Figure 5.33. Stockholm 3P framework NWM rank 2013-2018.

Throughout the years from 2013 to 2018 in the TOPSIS score (see Fig. 5.34), Enablers and Results present a slightly lower performance whereas Capabilities improved. Enablers have a score of 0.80 in 2013 and in 2018 they have a score of 0.76. Capabilities have a score of 0.56

in 2013 and in 2018 they have a score of 0.66. Last but not least, Results in 2013 have a score of 0.63 and in 2018 they have a score of 0.60.

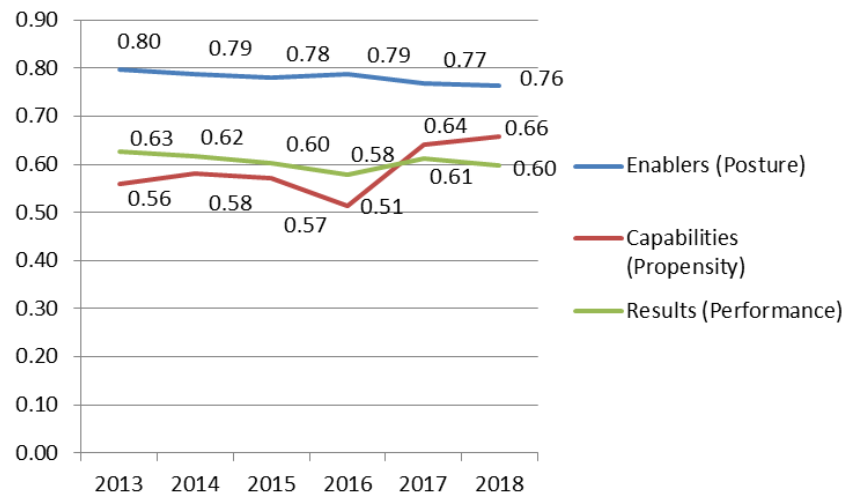


Figure 5.34. Stockholm 3P framework TOPSIS score 2013-2018.

5.2.4 Results based on the QIH model

As regards to the Quadruple Innovation Helix model, the average TOPSIS score for the years 2013-2018 was calculated for Posture, Propensity, Outputs, Outcomes and Impacts (see Fig. 5.35) for Crete. The results for the remaining regions can be found in Appendix 4. The results of the QIH model revealed that Crete has a rather low performance on all helices as follows:

- The domain Posture appears to have the best performance on the helix university. The domain Posture in the helix university is constituted of the variables Population with tertiary education, Researchers, Startup skills and Early leavers where Crete performs well therefore that is why the domain Posture has the best performance on the helix university.

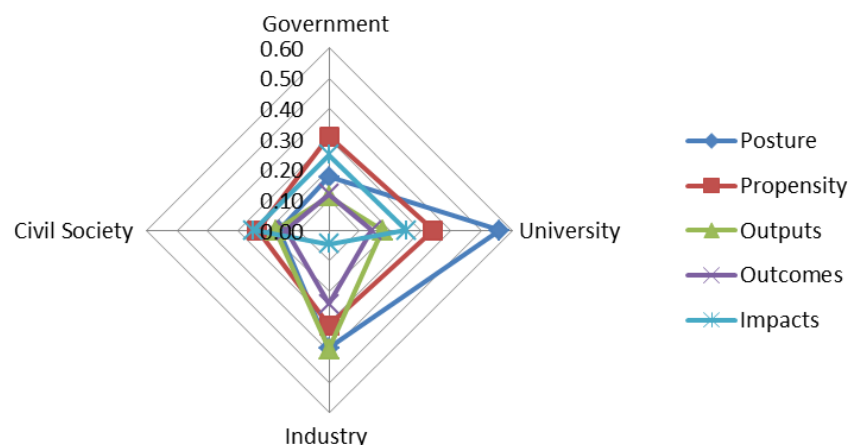


Figure 5.35. Crete QIH model Average of 2013-2018 TOPSIS Score.

- The domain Propensity, the pillars Outputs, Outcomes and Impacts present a low performance on all helices. This can be explained due to the fact that Crete has a rather moderate to low performance on all the variables that constitute these helices. Although, Crete has a strong academic infrastructure with universities and research institutions they seem to not contribute to the creation of an efficient entrepreneurship

ecosystem. Also, important is the fact that the structure of the local economy which is mainly based on tourism and agriculture does not help in innovations, exports, specialized employment, etc.

As regards to the Quadruple Innovation Helix model, the average TOPSIS score for the years 2013-2018 was calculated for Posture, Propensity, Outputs, Outcomes and Impacts (see Fig. 5.36) for Stockholm. The results of the QIH model revealed that Stockholm has a rather high performance on all helices as follows:

- The domain Propensity has a rather low performance on the helix university. The domain Propensity in the helix university is constituted of the variables R&D expenditure in the public sector and Total EU expenditures where Stockholm does not perform well therefore that is why the domain Propensity has this low performance on the helix university.

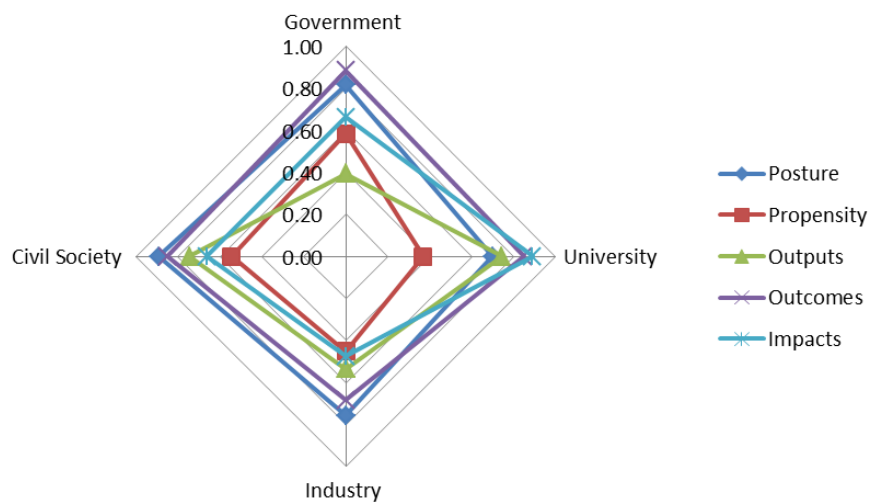


Figure 5.36. Stockholm QIH model Average of 2013-2018 TOPSIS Score.

- The domain Posture, the pillars Outputs, Outcomes and Impacts present a rather high performance on all helices. This can be explained due to the fact that Stockholm has a high performance on all the variables that constitute these helices. Stockholm is the strongest region of Sweden. It has a strong academic infrastructure with universities and research institutions, a strong startup culture and venture capital funding which allows the creation of a strong entrepreneurship ecosystem.

5.3 Firm level entrepreneurship ecosystems

5.3.1 Survey details and respondents' profile

At the micro level, a survey was conducted on the Agrofood industry at the region of Crete based on 28 variables which were analysed in depth in Section 4.4. The survey was conducted on May 2020 and the questionnaire was sent to approximately 200 companies and clusters, however the response rate was 60% .

Moreover, at the micro level the descriptive statistics for the 28 variables will be presented here (see Table 5.5) along with the basic information of the companies such as the distribution of companies to sectors, the years of operation, the number of employees and the turnover. The results for all companies can be found in Appendix 3.

Table 5.5. Micro Level Descriptive Statistics.

Variables Micro level	Mean	Variance
Employees with tertiary education (percentage, 0%-75% or more)	27.34	675.61
Participation of employees in lifelong learning (percentage, 0%-75% or more)	15.82	465.97
Human resources in science and technology (percentage, 0%-75% or more)	11.87	370.90
Quality of education system (number, 1=Not at all, 5=A lot)	3.05	0.89
Corporate governance (number, 1=Not at all effective, 5=A lot effective)	3.66	0.80
Opportunity perception (number, 1=Not at all, 5=A lot)	3.67	0.66
Risk acceptance (number, 1=Not at all, 5=A lot)	3.40	0.71
Start up skills (number, 1=Not at all, 5=A lot)	3.23	0.68
R&D expenditures (percentage, 0%-75% or more)	9.96	125.27
Non-R&D expenditures (percentage, 0%-75% or more)	18.62	361.26
Access to finance (number, 1=Not at all satisfactory, 5=A lot satisfactory)	2.93	1.33
Orgazational growth (number, 1=Not at all effective, 5=A lot effective)	3.58	0.55
Access to information (number, 1=Not at all satisfactory, 5=A lot satisfactory)	3.15	0.68
Ease of starting a business (number, 1=Not at all, 5=A lot)	2.41	0.85
Time to start a business (number, 1=Not at all satisfactory, 5=A lot satisfactory)	2.43	0.82
Intellectual property rights (number, 0-25 or more)	2.47	5.72
Product or process innovations (number, 0-25 or more)	5.11	45.17
Marketing or organizational innovations (number, 0-25 or more)	5.36	44.99
Innovation in-house (percentage, 0%-75% or more)	27.47	926.58
Employees in knowledge-intensive activities (percentage, 0%-75% or more)	18.22	350.37
Employees in high-tech activities (percentage, 0%-75% or more)	12.59	284.76
Exports (percentage, 0%-75% or more)	28.94	944.65
Sales (percentage, 0%-75% or more)	15.62	318.94
Market share (percentage, 0%-75% or more)	17.13	365.07
Net investment (percentage, 0%-75% or more)	15.03	276.74

Employee retention (percentage, 0%-10%-90% 100%)	78.92	784.11
Employee satisfaction (number, 1=Not at all, 5=A lot)	3.94	0.39
Turover per employee (number, company's annual turnover / company's total number of employees)	30668	636667540

The companies with 31.67% belong to sector Other (see Fig. 5.37) which includes herbs, pastries, meat products, water, juices etc, following with 29.17% is the sector Olive oil and with 12.50% the sector Wine.

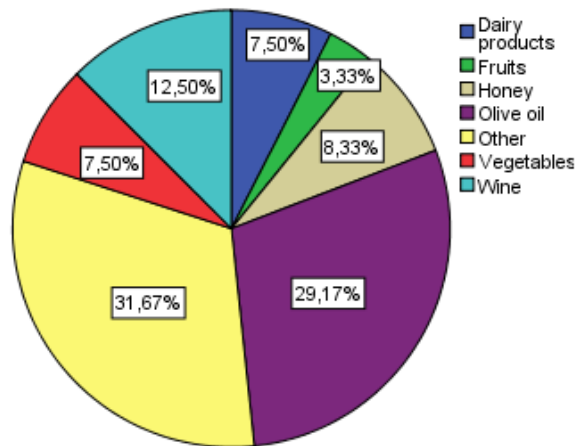


Figure 5.37. Distribution of companies to sectors.

The companies with 64.17% operate from 15 years and more (see Fig. 5.38), with 25% operate from 6 to 15 years and with 10.83% operate from 0 to 5 years.

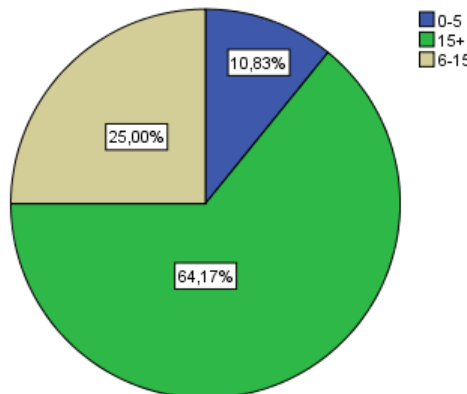


Figure 5.38. Years of operation.

The companies with 60.83% have from 1 to 10 employees (see Fig. 5.39), with 34.17% they have from 11 to 50 employees and with 5% they have more than 50 employees.

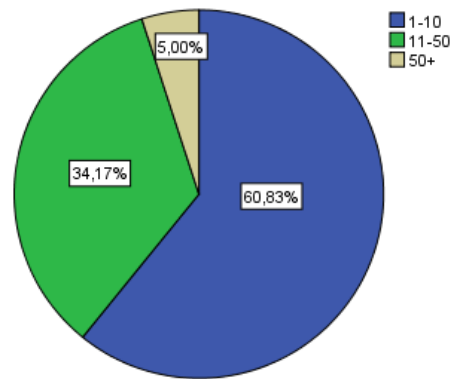


Figure 5.39. Number of employees.

The companies with 73.33% have turnover above 200.000 euros (see Fig. 5.40), with 16.67% they have below 100.000 euros and with 10% they have turnover between 100.000 and 200.000 euros.

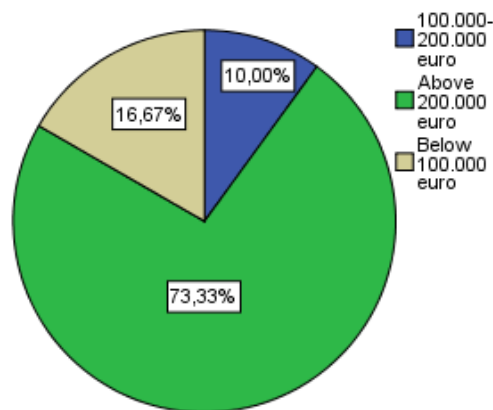


Figure 5.40. Turnover of companies.

5.3.2 Results based on the entrepreneurship pillars

As regards to the performance of the Cretan Agrofood industry per pillar (see Fig. 5.41) based on the TOPSIS method, it can be observed that the industry performs better on the pillars Culture, Policy and Impacts whereas the other pillars have a rather moderate to low performance.

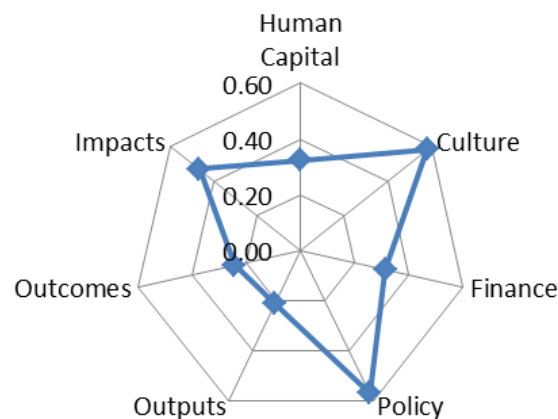


Figure 5.41. Cretan Agrofood industry performance per pillar TOPSIS score.

As regards to the sectors performance per pillar (see Fig. 5.42) based on the on the NWM rank, it can be observed that all the sectors have a rather moderate performance across all pillars.

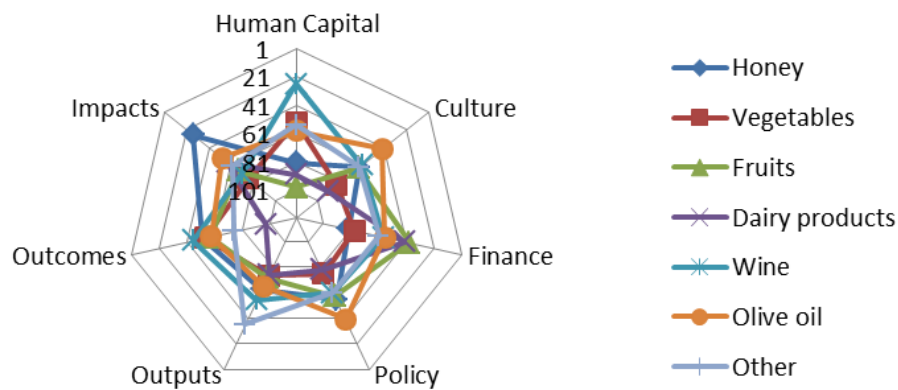


Figure 5.42. Sectors performance per pillar NWM rank.

The sector Wine performs better than the others sectors on the pillars Human capital and Outcomes, the sector Olive oil has the best performance on the pillar Culture and Policy, Fruits perform better on the pillar Finance, Other performs better on the pillar Outputs, whereas Honey has the best performance on the pillar Impacts.

As regards to the sectors performance per pillar (see Fig. 5.43) based on the TOPSIS method, it can be observed that all sectors perform better on the pillars Culture, Policy and Impacts whereas on the pillars Human capital, Finance, Outputs and Outcomes they a rather low performance.

The performance of the sectors in the NWM rank differs from their performance in the TOPSIS method due to the fact, that in the first case ordinal values are used and in the second cardinal values are used.

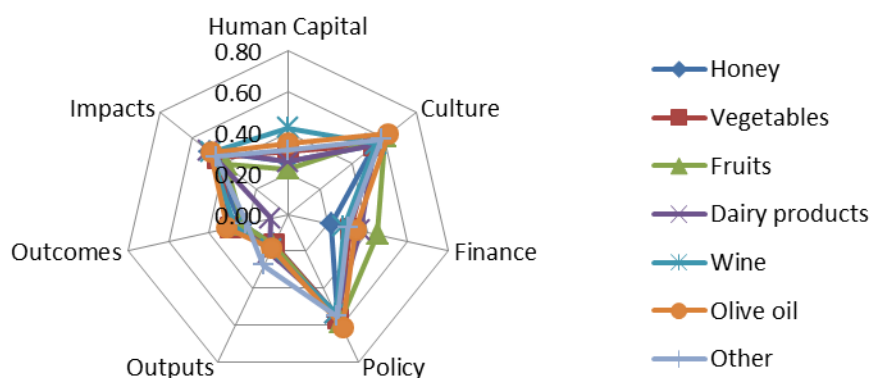


Figure 5.43. Sectors performance per pillar TOPSIS score.

Regarding the low performance of all sectors on the pillar Human Capital, it can be justified due to the fact that according to OECD (2005) the level of education for the residents of Crete based on the NSSG data are lower than the national average. Also, the majority of the population over 10 years of age has completed only elementary education while the main specialization of Cretan economy is the primary sector and tourism.

The companies that were studied across all sectors in the pillar Human Capital revealed that the percentage of their employees who have tertiary education or a university degree in science and technology is very low, whereas their employees do not attend educational

programs and they are moderate prepared from the education system to meet the job requirements.

Moreover, Fernández-Serrano et al. (2019) found in their study that in low income regions human capital can be a main barrier for innovation. These findings are in line with the findings of the macro and meso level, where Greece and Crete also do not perform well on this pillar.

The pillar Culture presents a rather moderate to low performance on all sectors. The companies that were studied consider their corporate governance effective, they utilize entrepreneurial opportunities, they take risks to a moderate degree and believe that young employees in the region of Crete possess to a moderate degree the necessary skills to start a new business.

However, according to “Smart Specialisation Strategy of the region of Crete” (2015) there is a lack of innovation culture in the region of Crete. Mazzarol et al. (2014) in their study in Australian SMEs also claim that *“entrepreneurial leadership that is willing to embrace innovation, take calculated risks”* can help the overall performance of a company. These findings are in line with the findings of the macro and meso level, where in Greece and in Crete there is also a lack of an entrepreneurial culture.

The pillar Finance, presents a rather low to moderate performance on all sectors. The companies that were studied revealed that they invest only a small percentage of their turnover on R&D and Non-R&D expenditures whereas access to funding should be more easy. According to “Smart Specialisation Strategy of the region of Crete” (2015) the Regional Operational Programme of Crete (ROP) 2014-2020 has invested in the agro-alimentary sector only 17% of the total budget compared to 43% to Knowledge Complex and 23% to the Environmental sector.

This means that in the Agrofood industry it is not easy to have access to finance that can lead to the improvement of the companies’ productions. This is also in line with the results of the meso level where in Crete there are not adequate funds and investments that can support entrepreneurship. In addition, Nikolaidis and Bakouros (2009) found that the absence of external funding is a barrier for companies in the food and beverage sector in order to innovate.

As regards to the pillar Policy, it presents a rather moderate performance on all sectors, this is due to the fact that the companies that were studied consider their organizational growth effective, however they are satisfied to a moderate degree with access to information about changes in government policies and information, with how easy the procedures and the required time are in order to start a new business.

In addition, according to “Smart Specialisation Strategy of the region of Crete” (2015) there are European and National strategies and programs such as the Horizon and initiatives such as Forthnet that have been implemented in order to support innovation and entrepreneurship at the regional level. More companies in Crete should be able to utilize these programs in order to be further enhanced.

The pillar Outputs has a rather low performance and this is due to the fact that the companies across all sectors have introduced intellectual property rights or innovations whether those are product or process innovations, marketing or organizational innovations but the number of these is rather low, they have licensed and developed from 1 to 5 intellectual property rights and innovations respectively.

The study of Nikolaidis and Bakouros (2009) in the Cretan food and beverage sector also confirms the fact that these companies have introduced a new product in the market with 35% whereas the percentage of an organisational innovation is 15%, however the process innovations is better with 57%. Also, Harel et al. (2019) in their study in SMEs regarding innovation, found that more of 95% of these firms employ at least one type of innovation.

Furthermore, the pillar Outcomes also presents a rather low performance on all sectors which can be explained due to the fact that the companies that were studied revealed that the percentage of jobs related to knowledge-intensive and high-tech activities is rather low, as well as the exports and the sales from new or significantly improved products are also rather low.

In addition, Crete according to OECD (2005) is a knowledge-intensive area with high level research centers, however the transfer of knowledge from them to farmers remains limited due to a lot of factors such as for example there are under developed relationships between firms and research centers. This means that the companies cannot support knowledge-intensive or high-tech activities since they do not cooperate with research centers as well as they have employees who lack the necessary skills.

This is also confirmed by Nikolaidis and Bakouros (2009) who found in their study that there is a lack of communication between companies and academics in the food and beverage sector. Also, the study of Micheels and Gow (2012) in the agricultural sector in USA showed that organizational learning and experience can be associated to firm performance. Therefore, when there is no cooperation between research centers and companies, the latter will have a lower performance.

However, the improvement of human capital as regards to their research skills is also a priority on the Regional Operational Programme of Crete (ROP) 2014-2020 in the Agro-alimentary sector as well as a priority is to provide easier access to them.

Last but not least, as regards to the pillar Impacts, it has a moderate performance. This is due to the fact that although the companies that were studied present a moderate employee retention and satisfaction, they have low market shares and net investments.

Moreover, according to “Smart Specialisation Strategy of the region of Crete” (2015) in Crete the primary sector is very well established and its exports contribute significantly to the region’s GDP. Crete produces many PDO and high nutritional value products which not only are healthy but also they promote the Cretan diet which is globally known.

The fact that Cretan products have high quality and are globally known since many companies in the Agrofood industry export their products is in line with the study of Ruzzier et al. (2007) who found that the dimensions product, time and performance are a consistent part of SMEs’ internationalization.

5.3.3 Results based on the 3P model

As regards to the 3P framework based on the TOPSIS method (see Fig. 5.44), all sectors have a rather high performance on Enablers and Capabilities as well as a rather moderate performance on Results. Enablers have a score of 0.45, Capabilities have a score of 0.44 and Results have a score of 0.31.

The high performance of Enablers and Capabilities show that although, there is entrepreneurial culture in the Cretan Agrofood industry as well as policies that can help this industry, that does not translate into Results and more specifically tangible results such as intellectual property rights innovations, employment, exports, sales, employee retention etc. Therefore, in the future all sectors should focus on how to translate their entrepreneurial culture and how to exploit the existing regional policies in order to be able to create a stronger entrepreneurship ecosystem.

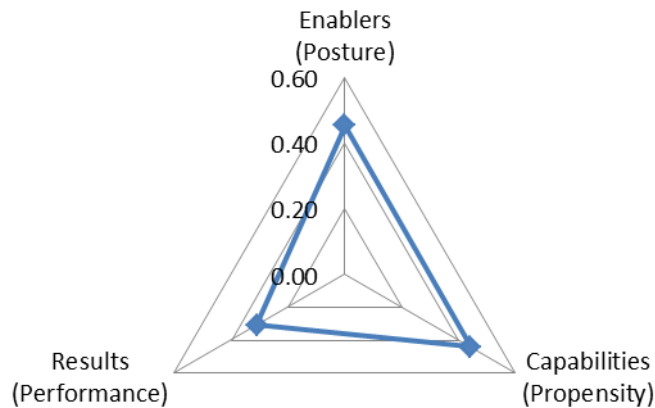


Figure 5.44. Cretan Agrofood industry 3P framework TOPSIS score.

As regards to the 3P framework based on the NWM rank (see Fig. 5.45), all sectors have a rather moderate to low performance across Enablers, Capabilities and Results. This can be explained due to the fact that the performance of the pillars that constituted these domain directly affect their performance. This also applies to the TOPSIS method.

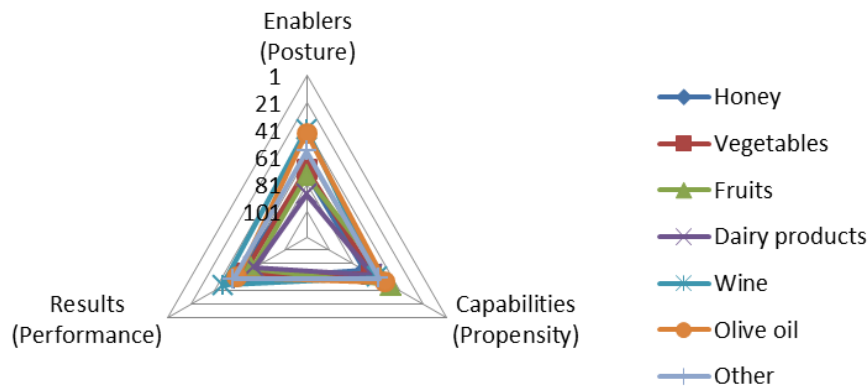


Figure 5.45. Sectors performance 3P framework NWM rank.

As regards to the 3P framework based on the TOPSIS method (see Fig. 5.46), all sectors have a rather high performance on Enablers and Capabilities as well as a rather moderate performance on Results. Enablers is constituted of Human Capital and Culture, where although, Human Capital does not perform well, Culture performs well, so the overall performance of Enablers remains high.

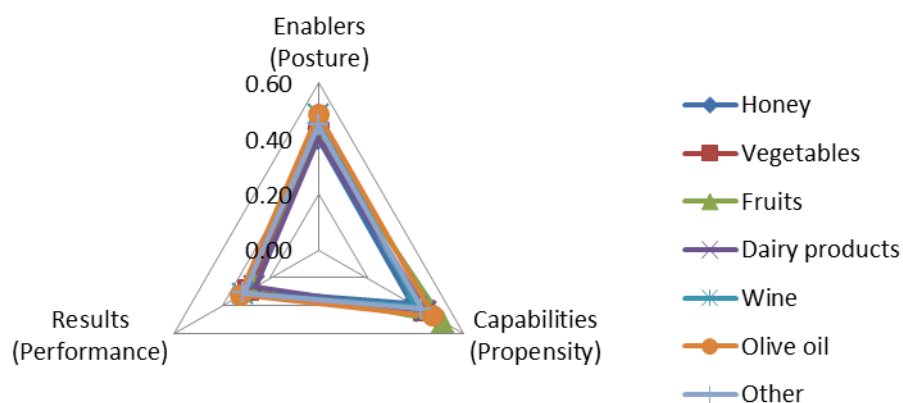


Figure 5.46. Sectors performance 3P framework TOPSIS score.

Capabilities is constituted of Finance and Policy, where although, Finance does not perform well, Policy performs well, therefore the overall performance of Capabilities remains high. Results is constituted of Outputs, Outcomes and Impacts which do not perform well, therefore the overall performance of Results is rather low.

The sectors Wine and Olive oil present the highest performance on Enablers and Results which mean that they utilize the most their human capital along with their entrepreneurial culture, recognizing opportunities and taking risks in order to create new innovative products, new job positions, sales, etc.

In addition, the sectors Olive oil and Fruits present a high performance on Capabilities which means that they utilize the available policies and programs the most in order to improve their entrepreneurship competitiveness.

Last but not least, the lowest performance on Enablers present the sectors Honey and Dairy products, whereas on Capabilities Honey presents the lowest performance. On Results the lowest performance present the sectors Fruits and Dairy products. These findings could be explained due to the fact that these sectors represent a very small size of the sample. The sector Honey represents the 8.33% of the sample, Dairy products along with Vegetables represent the 7.50% and the 3.33% of the sample respectively.

5.3.4 Results based on the QIH model

As regards to the Quadruple Innovation Helix model (see Fig. 5.47) based on the average TOPSIS score for the year 2020, the results revealed that the Cretan Agrofood industry has a moderate performance on all helices except university. The results for all companies can be found in Appendix 4.

The low performance of the Agrofood industry in the helix industry can be explained due to the fact that the Agrofood industry in this helix is constituted of the variables Population with tertiary education, Quality of education system, Startup skills, Human resources, R&D expenditures, Intellectual property rights, Employees in knowledge-intensive activities, Employees in high-tech activities, Market share, Employee retention and Employee satisfaction where the Agrofood industry does not perform well.

Another fact for this low performance can be explained through the level of education of residents in Crete where according to OECD (2005) is very low since the majority of the population over 10 years of age has completed only elementary education and in addition, the structure of its economy and its specialization is mainly based on the primary sector and tourism.

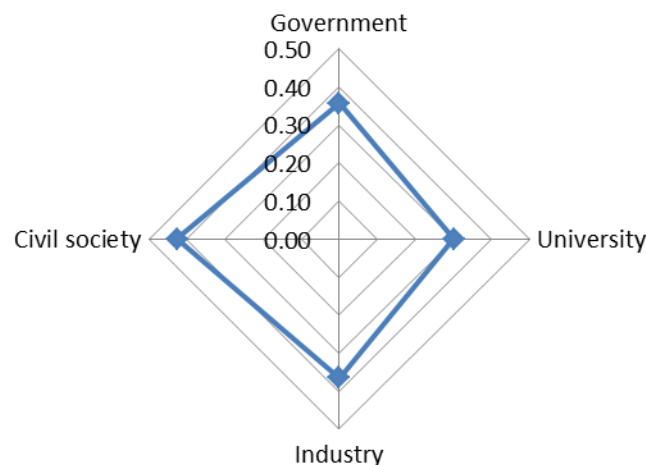


Figure 5.47. Cretan Agrofood industry per QIH TOPSIS score.

As regards to the different sectors' performance per the QIH model (see Fig. 5.48) based on the average TOPSIS score for the year 2020, the results revealed a moderate performance on all helices except university. On the helices civil society and government the sector Dairy products has the lowest performance. This can be explained due to the fact that the sector Dairy products does not perform well on the variables that constitute this helix. Another fact is that Dairy products constitute a small size of the sample with only 7.50%.

On the helix industry the sectors Olive oil and Wine have the highest performance due to the fact that these sectors perform well on the variables that constitute the helix industry. Another important fact is the size of these sectors which constitute the 41.67% of the sample.

Last but not least, on the helix university the sectors Wine, Olive oil and Dairy products have the highest performance. This means that these sectors perform well on the variables that constitute the helix university.

Another element that could contribute to this performance is that the sectors Wine, Olive oil and Dairy products are three sectors that constitute a large size of the sample, in total 49.17%. In addition, these sectors need specialization to create new innovative products, they cooperate with universities and research institutions and they invest more in human capital.

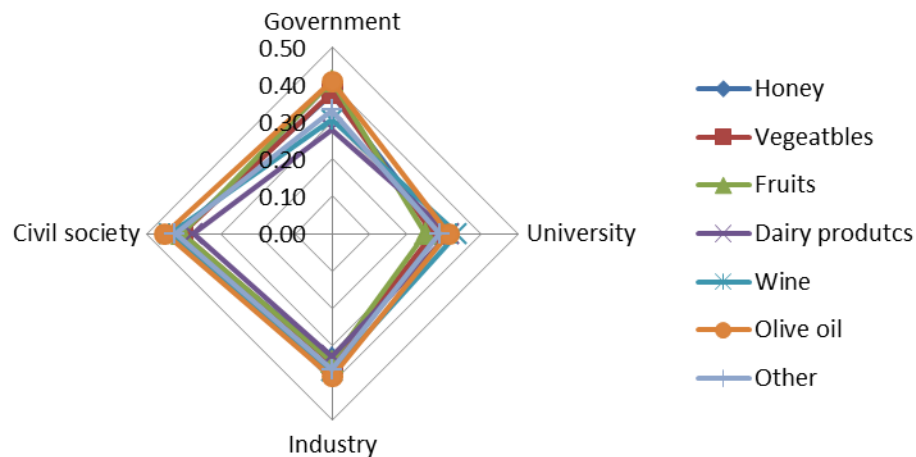


Figure 5.48. Sectors performance per QIH TOPSIS score.

5.4 Case studies

5.4.1 Objectives and interviews

As regards to the qualitative research, a case study was selected as a method and more specifically three case studies were conducted. This method was considered appropriate since according to Yin (2014) *“a case study is an empirical inquiry that investigates a contemporary phenomenon (“the case”) in depth and within its real world especially when the boundaries between phenomenon and context may not be clearly evident.”*

Moreover, according to Carayannis et al. (2015a) the case study approach can help in revealing and building theory by taking into consideration different patterns, context factors and relationships in order to study the phenomenon and gain a better understanding.

Based on the pillars of the model the research objectives of the case study were created as follows:

1. Historical and general company data.
2. Human resource management.

3. Entrepreneurship culture.
4. R&D financing and actions.
5. Company policy and strategy.
6. Patents and trademarks.
7. Exports.
8. Company development.

Based on these research objectives the interview questions were designed as follows:

1. How the company started and what are its general elements (products it produces, what is the competition, what is the company's position in the competition).
2. How the management of human resources is conducted (how recruitment is done, what criteria are used, if and how employees participate in educational programs, how it is decided to involve employees in educational programs, if and how the effectiveness of such educational programs is measured).
3. Entrepreneurship culture (how a business opportunity is discovered, how much the owner is willing to take a risk in a business endeavor, what the owner thinks are the most important characteristics of an entrepreneur).
4. R&D financing and actions (if and which R&D actions are taken place, if there are cases of organizational, marketing or process innovations, if there is a separate R&D department or employees who deal exclusively with such actions, if there is cooperation with other companies, universities, agencies, etc, for such actions, how such R&D actions are funded, if there have been failed R&D efforts, generally how the company is funded).
5. How the company's policy and strategy are decided and known.
6. Patents and trademarks (if there are registered patents and trademarks, which are and in which geographical area they concern, how the registration process took place, ie with / without an external consultant, if they are considered successful and why).
7. Exports (what percentage of products is exported, in which markets, how was the targeting decided in the specific markets).
8. Company development (how much the company has been developed in the last 10 years in terms of sales, infrastructure, staff, what are the goals and estimates for the future).

Three participants took part in this research that represent three different sectors. These are the following:

1. Company Avoel which specializes in the production of homogenized food items based solely on fresh avocado.
2. Company Stathakis Family which specializes in honey production.
3. Company Mills of Crete which specializes in flour.

The interviews were structured and took place via telephone in April 2020. Approximately the duration was 30 minutes as well as the interviews were recorded with the consent of the interviewees. The data from the interviews were transcribed and analysed as regards to the themes of the research objectives and in combination with the results of the survey.

5.4.2 Avoel

The company Avoel started in 2014 and has as its exclusive object the production of homogenized food items where they are based exclusively on fresh avocados from Crete. The owner of the company highlighted that there is no competition in the concept of fresh avocado

pulp in the market, at least in Southeast Europe. However, he also highlighted that there are frozen avocado products that circulate in Europe, mainly in Great Britain and France whereas these products originate from Latin America, Mexico, Colombia and Chile where these areas have a large quantity of avocado trees.

First, as regards to Human resource and management, the owner of the company explained that he only employs four persons. He used advertisement for the recruiting purposes, there are also job descriptions for each position and based on this job description the person concerned is selected, trained and tested. The employees participate in education through training only on their assigned object and if new needs might arise whereas their effectiveness is measured in practice.

The findings that there is no continuous participation on education and training can also be confirmed by the results of the pillar Human Capital at the micro, as well as at the macro and meso level where this pillar has a rather low performance. The level of education in Crete is rather low and in Greece in general the needs of the workplaces do not match the skills of their employees whereas most of them do not attend on-the job training.

Moreover, as regards to Entrepreneurship Culture, the owner of Avoel takes into consideration three things in order to discover an opportunity: 1) market gap, 2) if what he wants to produce is innovative and in line with trends of the era such as environmental friendly and 3) the special features of an area such as the geographical location of Crete which favors the production of avocados.

The owner explained that he takes risks even in the most difficult times such as in the Greek economic crisis. He believes that a combination of different elements can form a good entrepreneur such as the insight to be able to see forward, the synthesis of dissimilar things as well as different professions and sciences.

These findings can be characterized as an exception since the pillar Culture at the micro, macro and meso level does not perform well. Due to the fact that people do not have a great desire for entrepreneurial career (Kitsios and Sitaridis, 2017) whereas also in Crete there is not advanced entrepreneurial orientation and spirit of collaboration (Nikolaidis and Bakouros, 2009).

As regards to R&D financing and actions, the owner of the company is the one that deals with R&D himself which is funded with the company's resources whereas there have been failed R&D efforts. The company applies mostly product and process innovation whereas as much as they can organizational innovation. Every year a different product category is developed but for the company a new product is a new package which has completely different features from the previous ones. For two and a half years the company worked with Harokopio University whereas now the company is cooperating with other companies for joint product development. As regards to the funding of the company the owner did not want to discuss it.

These findings are in line with the results at the micro level where all sectors have introduced intellectual property rights or innovations whether those are product or process innovations, marketing or organizational innovations. They are also in line with the results at the macro and meso level where Greece and Crete have a rather strong R&D infrastructure. The collaboration of universities and companies can allow the creation and transfer of new knowledge that will eventually lead to new innovations and products. Also, as regards to funding, the Agrofood industry, according to studies, is a sector that does not have easy access to finance.

Furthermore, regarding the Company policy and strategy, the owner claimed that he discuss the company's policy and strategy with his employees. The company's policy and strategy can also be enhanced by utilizing European and National strategies and programs such as the Horizon and initiatives such as Forthnet. These programs and initiatives at the national and regional levels can be utilized by Cretan companies to support their innovation and entrepreneurship.

Then, as regards to Patents and trademarks, the owner of Avoel clarified that there are two patents that are in Greece and in Europe which concern a production process and there is one at the European and at the Greek level that is a trademark as well as distinctive titles whereas the registration process was done without an external consultant. He considers only the trademarks successful, the rest are not, because in production technology it is not so clear what one secures.

These findings are in line with the results at the micro level where the companies have licensed and developed from 1 to 5 intellectual property rights and innovations respectively. Also, the rather strong R&D infrastructure of Greece and Crete can help in creating new intellectual property rights and innovations.

As regards to Exports, the owner of Avoel claimed that 50% of the production is exported, 50% is in the Greek market and the reference markets for abroad are Middle East, Cyprus, Germany, England, Slovakia and Czech Republic. The efforts of the company with the production of its products can attract the attention of a new specific market.

The findings that the company exports half of its production can also be confirmed from the results at the micro level where most of the companies that were studied also export their production. Cretan products are high nutritional value products that not only are healthy but also they promote the Cretan diet which is globally known. However, in Greece, in general as well as in Crete, there are still consequences from the economic crisis that affect the ways that companies operate and export their products.

Last but not least, regarding the Company development, Avoel has been productive since 2015, it is improving in terms of sales and infrastructure and it has more employees now. The commercial goal is to have a presence in the whole European market, mainly in the large retail market of European supermarkets and also the goal is to adopt a new production technology, however it is too expensive. The third goal is to make avocados a daily necessity to consumers in order to replace animal fats that harm people's health with avocados.

5.4.3 Mills of Crete

The company Mills of Crete operates more than 50 years in the region of Crete and belongs to the ten largest mills in Greece whereas it produces 360 tons of grind per day. Its innovation can be found in the 300 codes of flour and 60 animal feed codes as well as in the specialization in oatmeal and whole meal flour.

First, as regards to Human resource and management, the Quality Management Director of the company, supported that recruitment is done by a management team and depending on the position they are trying to fill as well as the criteria they use depend on each position whereas the method is interview. Moreover, there is an annual training program in all departments, in various subjects related to each department separately and in each seminar goals are set that must be met. In the next seminar if there is a deviation, it is presented whereas the effectiveness of such educational programs is measured with goal setting.

These findings can be characterized as an exception since the results at the micro level showed that the pillar Human Capital has a rather low performance which means that the employees of the survey's companies do not participate on education and training. The results also at the macro and meso level revealed a low performance in this pillar since residents in Crete have a low level of education and in Greece in general there is a limited number of employees who attend on-the job training.

Furthermore, he explained that regarding Entrepreneurial Culture and more specifically the discovery of business opportunities, there is a well-staffed marketing department that monitors the market and at the same time participates in international exhibitions of top management. The company gets a high enough risk because it also produces various products that several times have come out much faster than the consumer audience was ready. Due to

the economic crisis the company gives one year margin for the depreciation of investments. As the most important characteristics of entrepreneurs, he considers insight and listening.

Again, these findings can be characterized as an exception since the pillar Culture at the micro, macro and meso level does not perform well. People in Greece have a negative perspective towards entrepreneurship due to various factors whereas also in the region of Crete there is a lack of innovation and entrepreneurship culture. However, this company invests in new business opportunities and takes risks through the consideration of future consequences.

Moreover, as regards to R&D financing and actions, the Quality Management Director of the company pointed out that there is a separate section of R&D products quite well staffed, R&D actions are funded internally whereas there have been failed R&D efforts. The company applies more process and product innovation, there is cooperation with other companies and universities as well as the company is funded by product sales and the banking system.

These findings are in line with the results at the micro level where all sectors have introduced intellectual property rights or innovations. They are also in line with the results at the macro and meso level where Greece and Crete have a rather strong R&D infrastructure. The collaboration of universities and companies helps in the development of new knowledge that will eventually lead to new innovations and products, as mentioned before. Also, as regards to funding, access to finance is one of the most problematic factor for doing business in Greece and by extension also in Crete, therefore companies turn to loans or internal funding.

Then, regarding the Company policy and strategy, he describes that the policy and strategy are developed through the training seminars and in case of modification or change, each department is informed separately. The company's policy and strategy can be affected by the most problematic factors for doing business in Greece and therefore in Crete such as policy instability, tax rates, inefficient government bureaucracy, as well as access to finance and tax regulations.

Moving forward, to Patents and trademarks, he described that the company has only one trademark which is "mold health" and concerns flour with specialized properties that help the health of the consumer. The registration process was done internally and it is considered successful because it created a small buying audience looking for it.

These findings are in line with the results at the micro level where the companies have licensed and developed from 1 to 5 intellectual property rights and innovations respectively. Also, the rather strong R&D infrastructure of Greece and Crete can help in creating new intellectual property rights and innovations, as mentioned before.

As regards to Exports, the Quality Management Director of the company explained that from the production around 2% to 3% is exported in the European Union's markets. Targeting specific markets came from the company's specialization in producing a specific type of flour that helps very specific producers. These producers make pastry sheet for kadaifi or pastry sheet for baklava therefore it came from the sale itself and then there were various other products that some customers also asked for.

These findings are in line with the results at the micro level where most of the companies that were studied also export their production. However, Mills of Crete exports a small percentage of its production. This can be due to the fact that in Greece, in general as well as in Crete there are still many reforms that take place due to the economic crisis which has affected the ways that companies operate and export their products.

Last but not least, regarding the Company development, Mills of Crete at the beginning was developed, staffed quite well in all departments, but gradually due to the economic situation of the country it has remained stable in terms of sales as well as there has been a decline but also stability over the last two years in terms of growth. The goals for the future are not only economic to sell more products but also to create innovative and diversified products useful to

customers. The company aims to more specialization in the future, it expects stability with low growth. The development of new products such as oatmeal can bring growth and the company overall tries to develop products with a higher profit margin.

5.4.4 Stathakis Family

The company Stathakis Family is a family business since 1953 and specializes in honey production by owning 2401 beehives and from 2011 they standardize their own production whereas they produce about 45 tons up to 70 tons in a year. The main competition is the imported cheap honey.

First, as regards to Human resource and management, the owner of the company clarified that recruitment is not done because it is a family business, constituted of four siblings and a salesman in Athens whereas they do not participate in any educational program.

These findings are in line with the results at the micro, macro and meso level where they showed that the pillar Human Capital has a rather low performance since residents in Crete have a low level of education and in Greece in general there is a limited number of employees who attend on-the job training.

Moving forward to the Entrepreneurial Culture, the owner described that he and his siblings discuss first the financial benefits of the opportunity for the company and then they decide how to proceed, however the company does not take risks at all. The most important characteristics of an entrepreneur are honesty, sincerity and respect for the staff. The owner commented that an entrepreneur, who achieves the financial goals and treats staff poorly, is a failed entrepreneur.

These findings are in line with the results at the micro, macro and meso level where the pillar Culture has a rather not so good performance. In general in Greece and in Crete there is not a great desire for entrepreneurial career, people have a negative perspective towards entrepreneurship due to various factors whereas also in the region of Crete there is a lack of innovation and entrepreneurship culture as well as there is not advanced entrepreneurial orientation and spirit of collaboration.

Moreover, as regards to R&D financing and actions, the owner explained that the company participates in a European program in order to receive some radar and measure the phenomenon of bee loss and extinction. The company deals with R&D itself whereas it applies process, product and marketing innovations. There is collaboration with the Aristotle University of Thessaloniki and with an organization in Chania. These R&D actions are funded by the company's funds, so far there have not been failed R&D efforts and the company is funded by the honey sales.

These findings are in line with the results at the micro level where all sectors have introduced intellectual property rights or innovations whether those are product or process innovations, marketing or organizational innovations. They are also in line with the results at the macro and meso level where Greece and Crete have a rather strong R&D infrastructure. The collaboration of universities or other research institutions and companies can help Stathakis Family to enhance its products and to perform better. Also, as regards to funding, for the Agrofood industry, according to studies, is a little difficult to have access to finance, therefore internal funding is a solution.

Furthermore, regarding Patents and trademarks, the owner claimed that all the brands of the company are registered as well as the logo and the name, the fonts and the visuals both at the Greek and at the European level. The registration process took place at a law firm in Chania. They are successful because they are modern, the logos of one of their products have been awarded in an international competition for its placement and in general they hear very good comments from the world. These findings are in line with the results at the micro level where

the companies have licensed and developed from 1 to 5 intellectual property rights and innovations respectively.

As regards to Exports, the owner of Stathakis Family described that 29% of the production is exported within Europe, 21% in third countries, the rest in the Greek market and 7.5% is the wholesale sales that are given to others who want to standardize. The company is interested in increasing its exports to 80% and reducing them from the Greek market because this increase will have more profit and more benefits for their business.

These findings are in line with the results at the micro level where most of the companies that were studied also export their production. However, Stathakis Family aims to export more than 80% of their production because the Greek market is less profitable. This can be due to the fact that at the macro level as well as at the meso level there are still many reforms that take place due to the economic crisis which has affected the ways that companies operate.

Last but not least, regarding Company development, Stathakis Family has done great progress since the only thing the company did was to produce honey and sell it in wholesale. From 2011 the company has proceeded to owning a privately place where the standardization takes place, they make their own brand and develop new products such as pastels. The goals for the future include further development in markets abroad as well as to produce and improve the quality as well as the quantity of their honey.

5.5 Comparison and Discussion

The results of the model at the macro, meso and micro level revealed significant findings. First, at the macro level, the model revealed a rather low performance of the country Greece out of 28 countries, these results are in line with the results of the existing frameworks such as the European Innovation Scoreboard, the Global Innovation Index, the Global Entrepreneurship Index and the World Economic Forum that also present a moderate to rather low performance of Greece. The high performance of Sweden was as expected whereas also here the results are in line with the results of the existing frameworks mentioned above that present Sweden as one of the most innovative countries.

Furthermore, at the meso level, the model revealed again a moderate performance of the region Crete out of 212 regions and this is aligned to the results of the macro level and it can also be confirmed by the results of the Regional Innovation Scoreboard where Crete is overall classified as a Moderate Innovator region. The model revealed a high performance of the region Stockholm out of 212 regions and this is aligned to the results of the macro level and it can also be confirmed by the results of the Regional Innovation Scoreboard where Stockholm is overall classified as an Innovation Leader.

At the macro level, the pillars Outputs and Outcomes can be considered as strengths for Greece since these pillars performed better than the other pillars. These findings are in line with the findings of other studies that support that Greece has a strong R&D infrastructure in higher education. Through this infrastructure universities could cooperate with companies to transfer new knowledge and create both intellectual property rights as well as innovations.

For Greece, the pillars Human Capital, Culture, Policy, Finance and Impacts can be considered as weaknesses and areas that should be improved, especially Impacts. This is due to the fact that these pillars have performed not so well both in the NWM as well as in the TOPSIS method. This is also in line with other studies which support that although, Greeks have entrepreneurial potential, they lack of knowledge, they do not attend on the job trainings and they do not have cultivated an entrepreneurial culture. Moreover, there are policies that do not help businesses thrive as well as access to finance or funding is not easy. All these lead to a low competitiveness of the country, there is still inequality, poverty and unemployment due to the economic crisis that Greece has faced, however many reforms are taking place to strengthen the country's economy.

The pillars Human Capital, Finance, Policy, Outcomes and Impacts can be considered as strengths for Sweden. These findings are in line with the findings of other studies that support that Sweden has a strong entrepreneurship ecosystem since entrepreneurship education starts at schools and continues to universities, there are national programs and policies that provide financing, funding and help to anyone who wants to start a new business, as well as Sweden focuses on knowledge-intensive and high-tech sectors.

For Sweden the pillars Culture and Outputs can be considered as weaknesses and as areas that should be improved. This is due to the fact that these pillars have a slightly lower performance than the other pillars. Although, Sweden has a strong entrepreneurial culture, entrepreneurship is not always viewed as a desirable profession as well as people are satisfied with their income and they do not have the motive to start their own business. In addition, in Sweden the domestic market for patents is not significant, since there is a shift in the international market.

At the meso level, the pillars Human Capital, Finance and Outputs can be considered as strengths for Crete since these pillars performed better than the other pillars. These findings are in line with the findings of other studies that support that Crete has a strong R&D infrastructure in higher education and competitive worldwide research is conducted. In addition, Crete is among the 20 top regions regarding R&D and Non-R&D expenditures whereas Cretan companies introduce innovations such as product, process innovations, etc.

For Crete the pillars Culture, Policy, Outcomes and Impacts can be considered as weaknesses and as areas that should be improved. In Crete there is a lack of an entrepreneurial culture, however efforts have been made to incorporate entrepreneurship education at universities. Moreover, there is also a lack of regional policy on innovation as well as the main focus of the economy is tourism and agriculture, rather than high-tech entrepreneurship.

For Stockholm the pillars Human Capital, Finance, Policy, Outcomes and Impacts can be considered as strengths since these pillars performed better than the other pillars. These findings are in line with the findings of other studies which support that Stockholm has incorporated entrepreneurship education both in schools and universities, it has also a strong startup culture and venture capital funding. There are also Regional Development Plans which can be supplemented with plans for regional growth or innovation strategies. In Stockholm there is a strong presence of research-intensive companies and the knowledge-intensive sector along with the high-tech sector constitute large shares of the region's economy whereas unemployment and poverty are low.

The pillars Culture and Outputs for Stockholm have a slightly lower performance than the other pillars and can be considered as weaknesses and areas that should be improved. This is due to the fact that as mentioned above, at the national level, in Sweden entrepreneurship is not always viewed as a desirable profession since people are satisfied with their income and they do not have the motive to start their own business. In addition, in Sweden the domestic market for patents is not significant, since there is a shift in the international market. Therefore this also applies at the regional level.

At the micro level, the model revealed that both the Agrofood industry as well as all sectors perform better on the pillars Culture, Policy as well as Impacts and they present a rather low performance on the pillars Human Capital, Finance, Outputs and Outcomes. This is due to the fact that companies in this industry have an entrepreneurial culture and they try to take risks even in difficult periods due to the economic crisis that Greece has faced. In addition, they also try to take advantage the few national programs that support entrepreneurship such as the program Horizon in order to develop better products and increase their sales and exports.

This is also in line with most of the findings from the three case studies, Avoel, Mills of Crete and Stathakis Family that were conducted. These companies try to recognize business opportunities and take risks, they focus on R&D and cooperate with universities or other companies in order to transfer new knowledge, to create better and innovative products, as

well as to develop intellectual property rights. Last but not least, all these companies export their production outside the Greek market.

As regards to the 3P framework, the performance of the pillars directly affect the three firm factors which are Enablers (Posture), Capabilities (Propensity) and Results (Performance) at all levels, macro meso and micro. This means for example that when a pillar has a better performance than the other, this affects the overall rank and score of these domains.

Although, Greece performs better in Results, many reforms are required in order to improve both Enablers and Capabilities and to create a strong entrepreneurship ecosystem. Crete could be characterized as a moderate region out of 212 regions whereas the improvement of Enablers can lead in the future to the improvement of both Capabilities and Results.

Sweden has already a strong entrepreneurship ecosystem, however, the improvement of Capabilities and Enablers can lead in the future to the improvement of Results. As regards to Stockholm, it has also a strong entrepreneurship ecosystem since it has a high performance on all the domains, Enablers, Capabilities and Results.

The Agrofood industry has a rather moderate and not a strong entrepreneurship ecosystem, therefore the high performance of Enablers and Capabilities can lead to the future in the improvement of Results. The same applies for the performance of all different sectors.

Regarding the results of the QIH model at all levels, the variables that constitute each helix directly affect how each helix will perform. At the macro level, the results revealed that Greece a rather moderate performance on all helices and Sweden has a rather high performance on all helices.

At the meso level, Crete has a rather low performance on all helices except the domain Posture on the helix university due to the fact that Crete has a strong R&D infrastructure at universities which needs to be better exploited. Stockholm has a rather high performance on all helices, since it has a strong entrepreneurship ecosystem.

Last but not least, as regards to the QIH model at the micro level, the Cretan Agrofood industry as well as all sectors have a rather moderate performance on all helices except university.

At all levels, macro, meso and micro in terms of policy and business implications, for Greece and Crete, changes should be made in the education system in order to match better the needs of the workplaces such as for example the Agrofood industry as well as there should be job training through for example the attendance of seminars. Entrepreneurship education should be incorporated in Greek schools and universities such as in the example of Sweden and Stockholm where there are entrepreneurship schools where students create startups or they develop their entrepreneurship mindset through different courses, exercises and activities.

An entrepreneurial culture should be cultivated both at the country's and the region's level through for example national programs and policies such as those programs and policies that are being implemented in Sweden and Stockholm. In this way, more people will have the desire to become entrepreneurs and more universities will cooperate with companies to transfer new knowledge that will lead eventually to the creation of innovations, better products and the achievement of better entrepreneurship results in all industries such as for example the Cretan Agrofood industry.

More opportunities should be created for funding entrepreneurs both at the country's and the region's level with better conditions on tax rates, tax regulations and access to finance such as in Sweden and Stockholm where there is support for anyone who want to start their own business. In this way, entrepreneurs at the national and regional level as well as at the Cretan Agrofood industry will be able to invest more on a technology that will further help in enhancing their products and increasing their sales.

Better policies should be designed at both the national and the regional level on different themes for example, there is inefficient government bureaucracy therefore actions should be taken to try to make it more efficient. Already some steps are being done such as for example there are issues which can be resolved digitally now, not only for someone who is already an entrepreneur but also someone who wants to start a business. Sweden and Stockholm has managed to simplify all these procedures which can be done digitally.

Although, the structure of the economy in Greece is mainly based on tourism and agriculture, efforts should be made to exploit better the research that is conducted in Greek universities that are globally competitive in order to strengthen more the development of both innovations and intellectual property rights through the collaboration of them with SMEs or large companies. Focus should be also given in how high-tech and knowledge-intensive firms can be created in Greece such as in Sweden and Stockholm where there are highly technologically and knowledge-intensive firms.

Last but not least, policies should also be applied to tackle poverty, inequality and unemployment in general in Greece and improve the overall quality of life in both the national and regional level. Greece is still facing the consequences due to the long economic crisis but with better policies it can recover and strengthen its entrepreneurship ecosystem. Sweden and Stockholm have managed to create strong entrepreneurship ecosystems as well as to build open and multicultural societies that want to be sustainable in the long term and support different lifestyles as well as different ways of thinking.

Chapter 6. Entrepreneurship Ecosystems Typology

6.1 Results for national ecosystems

At the macro level, based on the K-means algorithm and the TOPSIS score of the four helices of the QIH model, the 28 countries were grouped into 3 clusters (see Table 6.1). The K-means was tested as regards to the number of clusters 3, 4 and 5 clusters for the countries, for the year 2018 and the average of all years 2013-2018. As well as the K-means was tested at all levels for the variables that were going to be used, which are the following: the helices of the QIH model, the 7 pillars of the new proposed framework and the domains of the 3P framework.

The Quadruple Innovation Helix model, the 3 clusters as well as the average of all years 2013-2018 were chosen due to the fact that they provided better results where all countries are statistically different across all helices. The typology's contribution lies in the fact that this is the first research that categorizes countries, regions and companies based on the QIH model.

Table 6.1. K-means per helices 3 clusters results at the macro level (Average of 2013-2018).

Clusters	Countries
Cluster 1	Belgium, Denmark, Germany, Ireland, France, Luxembourg, Netherlands, Austria, Finland, Sweden, United Kingdom
Cluster 2	Bulgaria, Greece, Croatia, Italy, Romania
Cluster 3	Czech Republic, Estonia, Spain, Cyprus, Latvia, Lithuania, Hungary, Malta, Poland, Portugal, Slovenia, Slovakia

Figure 6.1 shows the final clusters centers for the countries. It can be seen that cluster 1 and cluster 2 have the greater distance and cluster 2 and cluster 3 have the lowest distance (see Table 6.2). This means that cluster 1 is very different from clusters 2 and 3 whereas cluster 2 is less different than cluster 3.

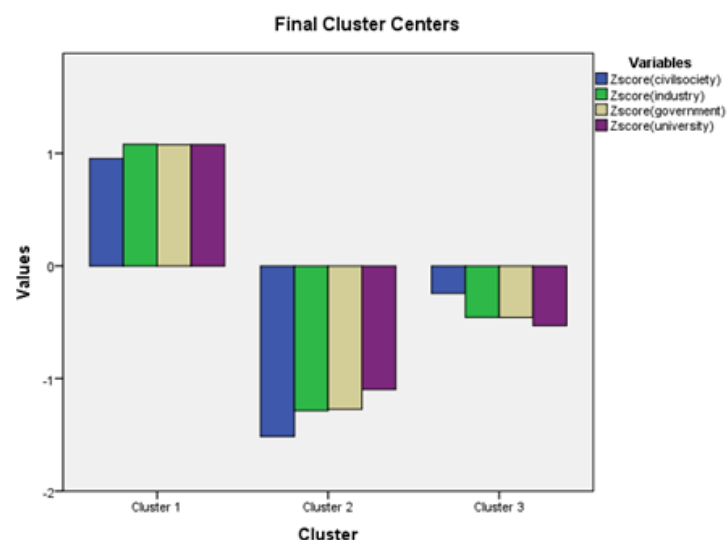


Figure 6.1. Final Cluster Centers for countries

Table 6.2. Distances between Final Cluster Centers.

Cluster	1	2	3
1		4.685	2.956
2	4.685		1.813
3	2.956	1.813	

The aim is to check the differences between the groups for each helix, therefore all possible comparisons take place. The results revealed that all helices are different for all groups except the helix university in clusters 2 and 3.

Table 6.3 shows the dependent variables which are the four helices, as well as the I column shows the number of the cluster that is being examined to the other two clusters in the J column. Also, the Mean Difference can be seen which shows the mean difference between each pair of clusters that is being examined. The Std. Error is the estimated standard deviation of the sample mean whereas Sig. is the p-value. Last but not least, the 95% Confidence Interval is the test of reliability of the mean difference with lower and upper values.

It can be seen (see Table 6.3) that all clusters are statistically different in all helices since Sig. (p-value) = $0 \leq 0,050$, except clusters 2 and 3 where Sig. (p-value) = $0,057 \geq 0,050$ which means that they are not statistically different in the helix university.

Table 6.3. Post Hoc Tests, Multiple Comparisons, Tukey HSD.

Multiple Comparisons							
Tukey HSD							
Dependent Variable	(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Zscore(civilsociety)	1	2	2.469	.236	.000	1.880	3.058
		3	1.198	.183	.000	.742	1.654
	2	1	-2.469	.236	.000	-3.058	-1.880
		3	-1.271	.233	.000	-1.852	-.690
	3	1	-1.198	.183	.000	-1.654	-.742
		2	1.271	.233	.000	.690	1.852
Zscore(industry)	1	2	2.333	.203	.000	1.826	2.839
		3	1.560	.157	.000	1.168	1.953
	2	1	-2.333	.203	.000	-2.839	-1.826
		3	-.772	.201	.002	-1.272	-.272
	3	1	-1.560	.157	.000	-1.953	-1.168
		2	.772	.201	.002	.272	1.272
Zscore(government)	1	2	2.350	.205	.000	1.838	2.861
		3	1.535	.159	.000	1.139	1.931
	2	1	-2.350	.205	.000	-2.861	-1.838
		3	-.815	.203	.001	-1.320	-.310
	3	1	-1.535	.159	.000	-1.931	-1.139
		2	.815	.203	.001	.310	1.320
Zscore(university)	1	2	2.176	.237	.000	1.587	2.765

	2	3	1.609	.183	.000	1.153	2.065
		1	-2.176	.237	.000	-2.765	-1.587
		3	-.567	.233	.057	-1.148	.014
	3	1	-1.609	.183	.000	-2.065	-1.153
		2	.567	.233	.057	-.014	1.148

After having found the clusters for the countries, the profile of each cluster was found by using the 38 variables of the secondary data in order to describe with specific characteristics each cluster. For the variables the average of the years 2013-2018 was calculated as with the helices. The Compare Means and a One Way ANOVA with a post hoc test Tukey HSD were used. An example will be given here and in the same way the other 37 variables were processed and can be found in Appendix 5. First, the means of the clusters were found for the variable tertiary education which is measured as a percentage (see Table 6.4).

By looking Table 6.4 it can be seen that cluster 1 has the highest mean which shows that cluster 1 has high tertiary education whereas cluster 2 has the lowest mean which shows that cluster 2 has low tertiary education.

Table 6.4. Means of clusters for variable Tertiary Education.

Cluster	Mean	N	Std. Deviation
1	44.682	11	6.473
2	31.300	5	6.295
3	40.065	12	8.266

It can be seen that only clusters 1 and 2 are statistically different as regards to the variable tertiary education (see Table 6.5) since $p\text{-value} = 0.006 \leq 0.050$.

Table 6.5. Post Hoc Tests, Multiple Comparisons, Tukey HSD.

(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	13,382	3.933	.006	3.586	23.178
	3	4.617	3.044	.300	-2.965	12.198
2	1	-13,382	3.933	.006	-23.178	-3.586
	3	-8.765	3.881	.081	-18.433	.902
3	1	-4.617	3.044	.300	-12.198	2.965
	2	8.765	3.881	.081	-.902	18.433

The following variables did not have significant differences within the 3 clusters: New business entry density, Startup skills, Non-R&D innovation expenditures, Ease of starting a business, Time to start a business days, Trademark applications, Design applications, TEA, Employment fast-growing enterprises of innovative sectors, Medium and high-tech product exports, Sales of new-to-market and new-to-firm product innovations, High-Growth.

Cluster 1 has the following characteristics:

1. High lifelong learning
2. High foreign doctorate students
3. High researchers
4. High corruption perception index
5. High risk acceptance

6. High R&D expenditure in the public sector
7. High R&D expenditure in the business sector
8. High government effectiveness
9. High rule of law
10. High effectiveness of anti-monopoly policy
11. High employment in knowledge-intensive activities
12. High knowledge-intensive services exports
13. High Global Competitiveness Index
14. High Quality of life Index
15. Low unemployment

Cluster 2 has the following characteristics:

1. Low tertiary education
2. Low quality education system
3. Low opportunity perception
4. Low venture capital expenditures
5. Low ease of access to loans
6. Low transparency of government policymaking
7. Low PCT patents
8. Low SMEs with product or process innovations
9. Low GDP per capita

Cluster 3 has the following characteristics:

1. Low PCT patents
2. Low SMEs with product or process innovations
3. Low SMEs with marketing or organizational innovations
4. Low SMEs innovating in-house
5. Low GDP per capita

The results of the typology at the macro level (see Table 6.6) where the countries were grouped into 3 clusters, can be also compared to the European Innovation Scoreboard (EIS) classification scheme where according to European Commission (2018) countries are classified as regards to their innovation performance in four categories as follows:

1. Innovation Leaders are all countries with a relative performance more than 20% above the EU average in 2017.
2. Strong Innovators are all countries with a relative performance between 90% and 120% of the EU average in 2017.
3. Moderate Innovators are all countries with a relative performance between 50% and 90% of the EU average in 2017.
4. Modest Innovators are all countries with a relative performance below 50% of the EU average in 2017.

Although, here the results of the European Innovation Scoreboard show the performance of the countries for the year 2018, all EIS reports have been studied for the years 2013-2018 in this thesis. Therefore, if one wanted to classify the countries based on their innovation performance for the average of the years 2013-2018, the results would reveal approximately the same classification of the countries in the same group as each year.

Table 6.6. Macro typology results compared to EIS and GEI.

K-means clusters	European Innovation Scorecard Innovation performance of countries (2018)				GEI performance of countries (2016)	
	Innovation Leaders	Strong Innovators	Moderate Innovators	Modest Innovators	Innovation Driven	Efficiency Driven

Cluster 1 Belgium Denmark Germany Ireland France Luxembourg Netherlands Austria Finland Sweden United Kingdom	Denmark Luxembourg Netherlands Finland Sweden United Kingdom	Belgium Germany Ireland France Austria			Belgium Denmark Germany Ireland France Luxembourg Netherlands Austria Finland Sweden United Kingdom	
Cluster 2 Bulgaria Greece Croatia Italy Romania			Greece Croatia Italy	Bulgaria Romania	Greece Italy	Croatia Bulgaria Romania
Cluster 3 Czech Republic Estonia Spain Cyprus Latvia Lithuania Hungary Malta Poland Portugal Slovenia Slovakia		Slovenia	Czech Republic Spain Cyprus Lithuania Malta Portugal Slovakia Estonia Latvia Hungary Poland		Slovenia Czech Republic Spain Cyprus Portugal Slovakia Estonia	Lithuania Latvia Hungary Poland

Moreover, they can be also compared to the Global Entrepreneurship Index (GEI) which classifies, according to Acs et al. (2016), countries in three categories as regards to their innovation economic development which are the following:

1. Innovation Driven.
2. Efficiency Driven.
3. Factor Driven.

In the new proposed typology at the macro level, in cluster 1 there are 11 countries which are Denmark, Luxembourg, Netherlands, Finland, Sweden, United Kingdom, these are classified as Innovation Leaders in the EIS and Belgium, Germany, Ireland, France, Austria which are classified as Strong Innovators in EIS as well as all these countries are classified as Innovation Driven in GEI.

In cluster 2 there are 5 countries which are Bulgaria, Greece, Croatia, Italy and Romania, where according to the EIS Greece, Croatia, Italy are classified as Moderate Innovators and Bulgaria and Romania are classified as Modest Innovators. According to GEI Greece and Italy are classified as Innovation Driven and Croatia, Bulgaria, Romania are classified as Efficiency Driven.

In cluster 3 there are 12 countries which are Czech Republic, Estonia, Spain, Cyprus, Latvia, Lithuania, Hungary, Malta, Poland, Portugal, Slovenia, Slovakia where according to the EIS Slovenia is classified as Strong Innovator and the remaining countries are Moderate

Innovators. According to GEI, Lithuania, Latvia, Hungary, Poland are classified as Efficiency Driven and the remaining countries are Innovation Driven.

This classification of the countries in clusters allows the finding of characteristics for each cluster. In cluster 1 countries have characteristics that include high human capital, culture, finance, policy, outcomes and impacts. In cluster 2 countries have characteristics that include low human capital, culture, finance, policy, outputs and impacts whereas in cluster 3 countries have characteristics that include low outputs and impacts.

According to Suseno et al. (2018) human capital can have a significant effect on a nation's innovation performance, the authors found that countries like Germany, Sweden, United Kingdom that are highly innovative have high human capital. Therefore, countries in cluster 1, which are also classified as Innovation Leaders and Strong Innovations according to EIS and as Innovation Driven according to GEI, present higher human capital in comparison to clusters 2 and 3.

As regards to culture, Cox and Khan (2017) used the Hofstede's cultural dimensions and found that cultural dimensions can have an important impact on a nation's decisions regarding its innovation capabilities. Cultural values such as individualism where individualistic societies are the ones that place a higher value on personal goals and creativity. Moreover, low masculinity where feminine cultures are oriented more on relationships and gender equality as well as various values such as sharing information and collaboration take place more easily.

Furthermore, pragmatism/long-term orientation where people in pragmatic societies are more open to change and in adapting traditions based on each condition. They encourage change in modern education and believe truth lies on three factors which are situation, context and time. Last but not least, indulgence where people in indulgent societies not only satisfy their basic and natural needs but they also place attention in enjoying life, having fun and be optimistic. All these dimensions can help nations be more innovative.

Countries in cluster 1 which are more innovative and have higher culture, for example they have higher risk acceptance compared to countries in clusters 2 and 3. Specifically countries in cluster 2 are less innovative and present lower culture, for example low opportunity perception.

As regards to finance, countries in cluster 1 which are more innovative have higher finance than countries in clusters 2 and 3 which are less innovative. Efthyvoulou and Vahter (2016) in their survey on 11 countries using the Community Innovation Survey data found that financial constraints, such as the lack of funds can have a negative effect on innovation performance. Countries in cluster 1 such as for example Sweden, Germany present high R&D expenditures in both public and business sector in comparison to countries in cluster 2 such as for example Bulgaria, Romania which are less innovative and present low venture capital expenditures.

Esser (2007) tested how the World Bank Governance indicators such as voice and accountability, political stability/no violence, government effectiveness, regulatory quality, rule of law and control of corruption can be connected to the innovation performance of countries using the Global Innovation Scoreboard Indicators.

The author found that control of corruption, government effectiveness and rule of law have a strong association with the Summary Innovation index which shows the innovative performance of a country. The remaining variables have a moderate association whereas the author also makes the hypothesis that the presence of an institutional culture helps countries to become more innovative.

Therefore, the finding that countries in cluster 1 which are more innovative have high government effectiveness and high rule of law in comparison to countries in cluster 2 which have low transparency of government policymaking can be confirmed since also the author

mentions that Nordic and Continental EU member states can create better policies that can enhance innovation.

The finding that in cluster 2 and cluster 3 countries present low intellectual property rights and low innovation in their SMEs is due to the fact that these countries are Moderate and Modest Innovators according to EIS and Innovation and Efficiency Driven according to GEI. Also, according to Høgeforster (2014) for countries in the Baltic Sea region, which can be found in cluster 3, supports that there is a lack of qualified workforce and better educated managers that prevents SMEs from reaching their full innovation potential. This fact can also lead in low intellectual property rights since the creation of them due to lack of qualified workforce can be difficult.

Moreover, Apak and Atay (2014) support that there is low development in SMEs at the Balkan countries which can be found also in cluster 2 and it is a sign why they present low innovation, despite the fact that for the Balkan countries the SMEs can be seen as an important economic driver according to the authors.

Countries in cluster 1 which are more innovative present high outcomes and impacts. As regards to outcomes, Añón Higón and Driffield (2011) found in UK which is an innovative country that innovation can lead SMEs to exports. As regards to impacts Maradana et al. (2017) found that innovation indicators can be connected to per capita economic growth and Doğan (2016) supports that innovation can be a determinant of competitiveness *“defined as the sum of institutions, policies and production factors forming the productivity level of a country.”*

The results of the typology can be also connected to the results of Chapter 5. Greece is in cluster 2 which has low human capital characteristics, low entrepreneurial culture, low access to finance and transparency of government policymaking, as well as low intellectual property rights and low competitiveness. These findings are in line with the results of Greece where in the pillars Human Capital, Culture, Policy, Finance and Impacts, the country performs not well and has a rather moderate performance also in the pillars Outputs and Outcomes. As well as, these findings are in line with the results of the QIH model where Greece has a rather moderate performance on all helices.

On the contrary, Sweden which belongs in cluster 1 where most of the innovative countries are, presents high characteristics across both all pillars of the model as well as all helices of the QIH model.

It could be argued that the performance across all four helices should be high, as in the case of Sweden, in order to be in cluster 1 and have high characteristics, such as Human Capital, Culture, Finance, Policy, Outputs, Outcomes and Impacts.

6.2 Results for regional ecosystems

At the meso level, based on the K-means algorithm and the TOPSIS score of the four helices of the QIH model, the 212 regions were grouped into 5 clusters (see Table 6.7). The K-means was tested as regards to the number of clusters 3, 4, 5, 6, 7, 9 and 12 clusters for the regions, for the year 2018 and the average of all years 2013-2018. As well as the K-means was tested as regards to the variables that were going to be used, as mentioned at the macro level.

The helices of the QIH model, the 5 clusters and the average of all years 2013-2018 were chosen due to the fact that they provided better results where all regions are statistically different across all helices. When the number of clusters increased, the clusters were no longer statistically different across all helices.

Table 6.7. K-means per helices 5 clusters results at the meso level (Average of 2013-2018).

Clusters	Regions
Cluster 1	Bruxelles (Belgium)
	Région Wallonne (Belgium)
	Praha (Czech Republic)
	Sjælland (Denmark)
	Syddanmark (Denmark)
	Midtjylland (Denmark)
	Nordjylland (Denmark)
	Niederbayern (Germany)
	Oberfranken (Germany)
	Unterfranken (Germany)
	Schwaben (Germany)
	Brandenburg (Germany)
	Bremen (Germany)
	Hamburg (Germany)
	Gießen (Germany)
	Kassel (Germany)
	Braunschweig (Germany)
	Hannover (Germany)
	Lüneburg (Germany)
	Weser-Ems (Germany)
	Düsseldorf (Germany)
	Köln (Germany)
	Münster (Germany)
	Detmold (Germany)
	Arnsberg (Germany)
	Koblenz (Germany)
	Trier (Germany)
	Rhein Hessen-Pfalz (Germany)
	Saarland (Germany)
	Dresden (Germany)
	Chemnitz (Germany)
	Leipzig (Germany)
	Schleswig-Holstein (Germany)
	Thüringen (Germany)
	Southern and Eastern (Ireland)
	Est (France)
	Ouest (France)
	Sud-Ouest (France)
	Centre-Est (France)
	Méditerranée (France)
	País Vasco (Spain)
	Comunidad de Madrid (Spain)
	Groningen (Netherlands)
	Lombardia (Italy)
	Overijssel (Netherlands)
	Gelderland (Netherlands)
	Flevoland (Netherlands)
	Utrecht (Netherlands)
	Noord Holland (Netherlands)
	Zuid Holland (Netherlands)
	Limburg (Netherlands)
	Ostösterreich (Austria)
	Südösterreich (Austria)
	Westösterreich (Austria)
	Zahodna Slovenia (Slovenia)
	Bratislavský kraj (Slovakia)
	Etelä-Suomi (Finland)
	Länsi Suomi (Finland)

	Pohjois ja Itä (Finland) Åland (Finland) Småland med öarna (Sweden) Norra Mellansverige (Sweden) Mellersta Norrland (Sweden) Övre Norrland (Sweden) North West (UK) East Midlands (UK) West Midlands (UK) East of England (UK) South West (UK) Scotland (UK) Luxembourg
Cluster 2	Vlaams Gewest (Belgium) Hovedstaden (Denmark) Stuttgart (Germany) Karlsruhe (Germany) Freiburg (Germany) Tübingen (Germany) Oberbayern (Germany) Oberpfalz (Germany) Mittelfranken (Germany) Berlin (Germany) Darmstadt (Germany) Île de France (France) Noord Brabant (Netherlands) Helsinki Uusimaa (Finland) Stockholm (Sweden) Östra Mellansv (Sweden) Sydsverige (Sweden) Västsverige (Sweden) London (UK) South East (UK)
Cluster 3	Strední Čechy (Czech Republic) Jihozápad (Czech Republic) Severovýchod (Czech Republic) Jihovýchod (Czech Republic) Střední Morava (Czech Republic) Moravskoslezsko (Czech Republic) Mecklenburg-Vorpommern (Germany) Sachsen-Anhalt (Germany) Border, Midland and Western (Ireland) Attiki (Greece) Vzhodna Slovenija (Slovenia) North East (UK) Yorkshire and The Humber (UK) Wales (UK) Northern Ireland (UK) Eesti (Estonia) Kypros (Cyprus) Malta (Malta) Comunidad Foral de Navarra (Spain) Aragón (Spain) Cataluña (Spain) Bassin Parisien (France) Nord - Pas-de-Calais (France) Piemonte (Italy) Provincia Autonoma Trento (Italy) Veneto (Italy) Friuli-Venezia Giulia (Italy)

	<p>Emilia Romagna (Italy) Toscana (Italy) Lazio (Italy) Közép Magyaró (Hungary) Friesland (Netherlands) Drenthe (Netherlands) Zeeland (Netherlands) Mazowieckie (Poland) Malopolskie (Poland) Dolnoslaskie (Poland) Bucuresti Ilfov (Romania) Pomorskie (Poland) Lisboa (Portugal)</p>
Cluster 4	<p>Severna i iztochna Bulgaria (Bulgaria) Anatoliki Makedonia (Greece) Kentriki Makedonia (Greece) Dytiki Makedonia (Greece) Ipeiros (Greece) Thessalia (Greece) Ionia Nisia (Greece) Dytiki Ellada (Greece) Stereia Ellada (Greece) Peloponnisos (Greece) Voreio Aigaio (Greece) Notio Aigaio (Greece) Kriti (Greece) Extremadura (Spain) Ciudad Autónoma de Ceuta (Spain) Ciudad Autónoma de Melilla (Spain) Canarias (Spain) Jadranska Hrvatska (Croatia) Molise (Italy) Campania (Italy) Puglia (Italy) Basilicata (Italy) Calabria (Italy) Sicilia (Italy) Sardegna (Italy) NordVest (Romania) Centru (Romania) NordEst (Romania) SudEst (Romania) Sud Muntenia (Romania) SudVest Oltenia (Romania)</p>
Cluster 5	<p>Yugozapadna i yuzhna tsentralna Bulgaria (Bulgaria) Severozápad (Czech Republic) Galicia (Spain) Principado de Asturias (Spain) Cantabria (Spain) La Rioja (Spain) Castilla y Leó (Spain) Castilla-la Mancha (Spain) Comunidad Valen (Spain) Illes Balears (Spain) Andalucía (Spain) Región de Murcia (Spain) Kontinentalna Hrvatska (Croatia) French overseas departments (France) Valle d'Aosta (Italy) Liguria (Italy)</p>

	Provincia Autonoma Bolzano/Bozen (Italy) Umbria (Italy) Marche (Italy) Abruzzo (Italy) Közép Dunánt (Hungary) Nyugat Dunantul (Hungary) Dél Dunántúl (Hungary) Észak-Magyarország (Hungary) Észak Alföld (Hungary) Dél Alföld (Hungary) Lódzkie (Poland) Slaskie (Poland) Lubelskie (Poland) Podkarpackie (Poland) Swietokrzyskie (Poland) Podlaskie (Poland) Wielkopolskie (Poland) Zachodniopomorskie (Poland) Lubuskie (Poland) Opolskie (Poland) Kujawsko-Pomorskie (Poland) Warminsko-Mazurskie (Poland) Norte (Portugal) Algarve (Portugal) Centro (Portugal) Alentejo (Portugal) Região Autónoma dos Açores (Portugal) Região Autónoma da Madeira (Portugal) Vest (Romania) Západné Slovensko (Slovakia) Stredné Slovensko (Slovakia) Východné Slovensko (Slovakia) Latvija (Latvia) Lietuva (Lithuania)
--	--

Figure 6.2 shows the final clusters centers for the regions. It can be seen that cluster 2 and cluster 4 have the greater distance and cluster 1 and cluster 3 have the lowest distance (see Table 6.8). This means that clusters 2 and 4 are very different whereas cluster 1 is less different than cluster 3.

Table 6.8. Distances between Final Cluster Centers.

Cluster	1	2	3	4	5
1		1.748	1.476	4.526	3.012
2	1.748		3.212	6.251	4.753
3	1.476	3.212		3.054	1.547
4	4.526	6.251	3.054		1.553
5	3.012	4.753	1.547	1.553	

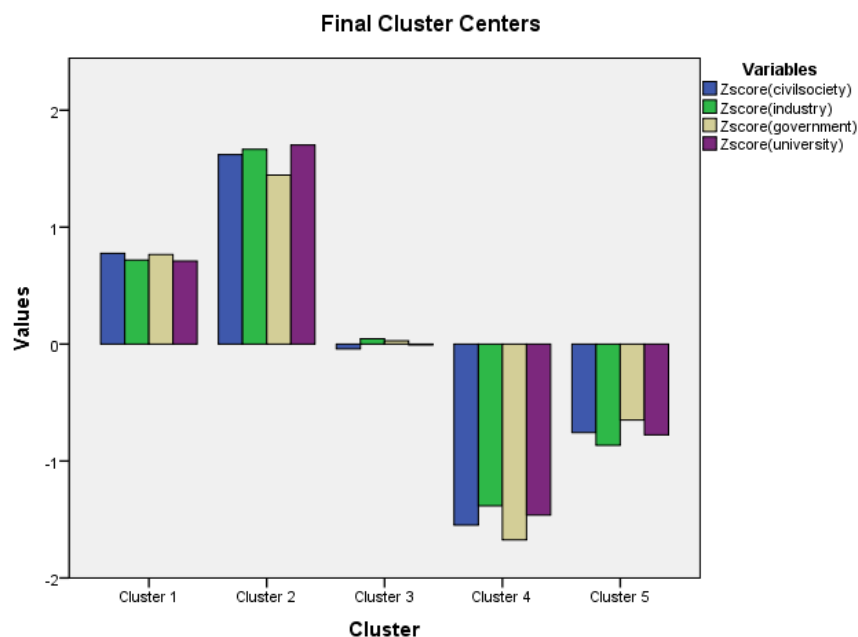


Figure 6.2. Final Cluster Centers for regions.

Table 6.9 shows the dependent variables which are the four helices, as well as the I column shows the number of the cluster that is being examined to the other two clusters in the J column. Also, the Mean Difference can be seen which shows the mean difference between each pair of clusters that are being examined. The Std. Error is the estimated standard deviation of the sample mean whereas Sig. is the p-value. Last but not least, the 95% Confidence Interval is the test of reliability of the mean difference with lower and upper values.

It can be seen (see Table 6.9) that all clusters are statistically different in all helices since Sig. (p-value) = $0 \leq 0,050$.

Table 6.9. Post Hoc Tests, Multiple Comparisons, Tukey HSD.

Multiple Comparisons							
Tukey HSD							
Dependent Variable	(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Zscore(civilsociety)	1	2	-.844	.063	.000	-1.018	-.671
		3	.817	.049	.000	.681	.952
		4	2.324	.054	.000	2.176	2.471
		5	1.532	.046	.000	1.406	1.659
	2	1	.844	.063	.000	.671	1.018
		3	1.661	.068	.000	1.473	1.849
		4	3.168	.071	.000	2.972	3.365
		5	2.376	.066	.000	2.195	2.558
	3	1	-.817	.049	.000	-.952	-.681
		2	-1.661	.068	.000	-1.849	-1.473

		4	1.507	.060	.000	1.343	1.671
		5	.715	.053	.000	.570	.861
	4	1	-2.324	.054	.000	-2.471	-2.176
		2	-3.168	.071	.000	-3.365	-2.972
		3	-1.507	.060	.000	-1.671	-1.343
		5	-.792	.057	.000	-.948	-.635
	5	1	-1.532	.046	.000	-1.659	-1.406
		2	-2.376	.066	.000	-2.558	-2.195
		3	-.715	.053	.000	-.861	-.570
		4	.792	.057	.000	.635	.948
Zscore(industry)	1	2	-.947	.083	.000	-1.174	-.720
		3	.674	.064	.000	.496	.851
		4	2.101	.070	.000	1.908	2.295
		5	1.584	.060	.000	1.418	1.750
	2	1	.947	.083	.000	.720	1.174
		3	1.621	.089	.000	1.375	1.867
		4	3.049	.094	.000	2.791	3.306
		5	2.531	.086	.000	2.294	2.769
	3	1	-.674	.064	.000	-.851	-.496
		2	-1.621	.089	.000	-1.867	-1.375
		4	1.428	.078	.000	1.213	1.643
		5	.911	.069	.000	.720	1.101
	4	1	-2.101	.070	.000	-2.295	-1.908
		2	-3.049	.094	.000	-3.306	-2.791
		3	-1.428	.078	.000	-1.643	-1.213
		5	-.517	.075	.000	-.722	-.312
	5	1	-1.584	.060	.000	-1.750	-1.418
		2	-2.531	.086	.000	-2.769	-2.294
		3	-.911	.069	.000	-1.101	-.720
		4	.517	.075	.000	.312	.722
Zscore(government)	1	2	-.680	.078	.000	-.895	-.465
		3	.737	.061	.000	.569	.904
		4	2.439	.066	.000	2.256	2.622
		5	1.415	.057	.000	1.259	1.572
	2	1	.680	.078	.000	.465	.895
		3	1.417	.084	.000	1.185	1.649
		4	3.119	.088	.000	2.876	3.362
		5	2.095	.082	.000	1.871	2.320
	3	1	-.737	.061	.000	-.904	-.569
		2	-1.417	.084	.000	-1.649	-1.185
		4	1.702	.074	.000	1.499	1.905
		5	.678	.065	.000	.499	.858

	4	1	-2.439	.066	.000	-2.622	-2.256
		2	-3.119	.088	.000	-3.362	-2.876
		3	-1.702	.074	.000	-1.905	-1.499
		5	-1.024	.070	.000	-1.218	-.830
	5	1	-1.415	.057	.000	-1.572	-1.259
		2	-2.095	.082	.000	-2.320	-1.871
		3	-.678	.065	.000	-.858	-.499
		4	1.024	.070	.000	.830	1.218
Zscore(university)	1	2	-.992	.080	.000	-1.212	-.771
		3	.718	.063	.000	.546	.890
		4	2.173	.068	.000	1.986	2.361
		5	1.487	.058	.000	1.326	1.648
	2	1	.992	.080	.000	.771	1.212
		3	1.710	.087	.000	1.471	1.948
		4	3.165	.091	.000	2.915	3.415
		5	2.479	.084	.000	2.249	2.709
	3	1	-.718	.063	.000	-.890	-.546
		2	-1.710	.087	.000	-1.948	-1.471
		4	1.455	.076	.000	1.247	1.664
		5	.769	.067	.000	.585	.954
	4	1	-2.173	.068	.000	-2.361	-1.986
		2	-3.165	.091	.000	-3.415	-2.915
		3	-1.455	.076	.000	-1.664	-1.247
		5	-.686	.072	.000	-.885	-.487
	5	1	-1.487	.058	.000	-1.648	-1.326
		2	-2.479	.084	.000	-2.709	-2.249
		3	-.769	.067	.000	-.954	-.585
		4	.686	.072	.000	.487	.885

After having found the clusters for the regions, the profile of each cluster was found by using the 31 variables of the secondary data in order to describe with specific characteristics each cluster. For the variables the average of the years 2013-2018 was calculated as with the helices. The Compare Means and a One Way ANOVA with a post hoc test Tukey HSD were used. An example will be given here and in the same way the other 30 variables were processed and can be found in Appendix 5. First, the means of the clusters were found for the variable researchers which is measured as a percentage (see Table 6.10).

Table 6.10. Means of clusters for variable Researchers.

Cluster	Mean	N	Std. Deviation
1	0.881	71	0.443
2	1.495	20	0.540
3	0.678	40	0.285
4	0.441	31	0.365
5	0.391	50	0.183

It can be seen that the following clusters are statistically different as regards to the variable Researchers (see Table 6.11) since Sig. (p-value) = $0,000 \leq 0,050$, cluster 1 except with clusters 3, cluster 2, cluster 3 expect with cluster 4, cluster 4 expect with clusters 3 and 5, as well as cluster 5 except with cluster 4. By looking Table 6.21 it can be seen that cluster 2 has the highest mean which shows that cluster 2 has high Researchers whereas cluster 5 has the lowest mean which shows that cluster 5 has low Researchers.

Table 6.11. Post Hoc Tests, Multiple Comparisons, Tukey HSD.

Multiple Comparisons						
Dependent Variable: researchers						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-.614	.093	.000	-.871	-.357
	3	.203	.073	.046	.002	.403
	4	.440	.079	.000	.222	.658
	5	.490	.068	.000	.303	.677
2	1	.614	.093	.000	.357	.871
	3	.817	.101	.000	.539	1.095
	4	1.054	.106	.000	.763	1.345
	5	1.104	.097	.000	.836	1.373
3	1	-.203	.073	.046	-.403	-.002
	2	-.817	.101	.000	-1.095	-.539
	4	.237	.088	.059	-.005	.480
	5	.287	.078	.003	.072	.502
4	1	-.440	.079	.000	-.658	-.222
	2	-1.054	.106	.000	-1.345	-.763
	3	-.237	.088	.059	-.480	.005
	5	.050	.084	.976	-.182	.282
5	1	-.490	.068	.000	-.677	-.303
	2	-1.104	.097	.000	-1.373	-.836
	3	-.287	.078	.003	-.502	-.072
	4	-.050	.084	.976	-.282	.182

The following variable did not have significant differences within the 3 clusters: Non-R&D innovation expenditures.

Cluster 1 has the following characteristics:

1. High SMEs innovating in-house
2. High participation rate in education and training
3. High quality pillar of EQI Index
4. High impartially pillar of EQI Index

Cluster 2 has the following characteristics:

1. High researchers
2. High tertiary education
3. High R&D expenditure in the public sector
4. High SMEs with marketing or organizational innovations
5. High exports medium and high-tech manufacturing
6. High gross fixed capital formation
7. High gross value added
8. High participation rate in education and training
9. Low employment in high-tech
10. High EQI
11. High quality pillar of EQI Index
12. High impartially pillar of EQI Index
13. High corruption pillar of EQI Index
14. High gross domestic product (GDP) per capita
15. High total EU expenditures
16. High opportunity perception
17. High regional competitiveness index

Cluster 3 has the following characteristics:

1. High EU trademarks
2. High EU designs applications
3. High risk acceptance

Cluster 4 has the following characteristics:

1. Low employment in high-tech sectors
2. Low EPO patent applications
3. Low EU design applications
4. Low SMEs with product or process innovations
5. Low employment in medium-high/high-tech manufacturing and knowledge-intensive services
6. High poverty
7. High unemployment
8. High early leavers
9. High startup skills
10. Low risk acceptance
11. Low R&D expenditure in the business sector

Cluster 5 has the following characteristics:

1. Low R&D expenditure in the business sector
2. Low researchers
3. Low EPO patent applications
4. Low SMEs with product or process innovations
5. High EU design applications
6. Low sales of new-to-market and new-to-firm product innovations

The results of the typology at the meso level (see Table 6.12) where the regions were grouped into 5 clusters, can be also compared to the Regional Innovation Scoreboard (RIS) classification scheme where according to European Commission (2018b) regions are classified as regards to their innovation performance in four categories as follows:

1. The first group of Innovation Leaders includes 53 regions with performance more than 20% above the EU average in 2017.

2. The second group of Strong Innovators includes 60 regions with performance between 90% and 120% of the EU average in 2017.
3. The third group of Moderate Innovators includes 85 regions with performance between 50% and 90% of the EU average in 2017.
4. The fourth group of Modest Innovators includes 22 regions with performance below 50% of the EU average in 2017.

Table 6.12. Meso typology results compared to RIS.

K-means clusters	Regional Innovation Scorecard Innovation performance of regions (2017)			
	Innovation Leaders	Strong Innovators	Moderate Innovators	Modest Innovators
Cluster 1				
Bruxelles (Belgium)	Bremen (Germany)	Région Wallonne (Belgium)	Lombardia (Italy)	
Région Wallonne (Belgium)	Hamburg (Germany)	Bruxelles (Belgium)	Comunidad de Madrid (Spain)	
Praha (Czech Republic)	Gelderland (Netherlands)	Praha (Czech Republic)		
Sjælland (Denmark)	Utrecht (Netherlands)	Sjælland (Denmark)		
Syddanmark (Denmark)	Zuid Holland (Netherlands)	Syddanmark (Denmark)		
Midtjylland (Denmark)	Limburg (Netherlands)	Southern and Eastern (Ireland)		
Nordjylland (Denmark)	Länsi Suomi (Finland)	Oberfranken (Germany)		
Niederbayern (Germany)	Övre Norrland (Sweden)	Schwaben (Germany)		
Oberfranken (Germany)	East Midlands (UK)	Gießen (Germany)		
Unterfranken (Germany)	West Midlands (UK)	Kassel (Germany)		
Schwaben (Germany)	East of England (UK)	Hannover (Germany)		
Brandenburg (Germany)	South West (UK)	Düsseldorf (Germany)		
Bremen (Germany)	Luxembourg	Detmold (Germany)		
Hamburg (Germany)	Midtjylland (Denmark)	Arnsberg (Germany)		
Gießen (Germany)	Braunschweig (Germany)	Dresden (Germany)		
Kassel (Germany)	Köln (Germany)	Schleswig-Holstein (Germany)		
Braunschweig (Germany)	Rheinhessen (Germany)	Holstein (Germany)		
Hannover (Germany)	Centre Est (France)	Thüringen (Germany)		
Lüneburg (Germany)	Etelä Suomi (Finland)	Sud-Ouest (France)		
Weser-Ems (Germany)	Noord Holland (Netherlands)	Overijssel (Netherlands)		
Düsseldorf (Germany)	Scotland (UK)	Ostösterreich (Austria)		
Köln (Germany)	Groningen (Netherlands)	Südösterreich (Austria)		
Münster (Germany)	North West (UK)	Westösterreich		
Detmold (Germany)	Unterfranken (Germany)			
Arnsberg (Germany)				
Koblenz (Germany)				
Trier (Germany)				
Rheinhessen-Pfalz (Germany)				
Saarland (Germany)				
Dresden (Germany)				
Chemnitz (Germany)				
Leipzig (Germany)				
Schleswig-Holstein (Germany)				
Thüringen (Germany)				
Southern and Eastern (Ireland)				
Est (France)				

<p>Ouest (France)</p> <p>Sud-Ouest (France)</p> <p>Centre-Est (France)</p> <p>Méditerranée (France)</p> <p>País Vasco (Spain)</p> <p>Comunidad de Madrid (Spain)</p> <p>Groningen (Netherlands)</p> <p>Lombardia (Italy)</p> <p>Overijssel (Netherlands)</p> <p>Gelderland (Netherlands)</p> <p>Flevoland (Netherlands)</p> <p>Utrecht (Netherlands)</p> <p>Noord Holland (Netherlands)</p> <p>Zuid Holland (Netherlands)</p> <p>Limburg (Netherlands)</p> <p>Ostösterreich (Austria)</p> <p>Südösterreich (Austria)</p> <p>Westösterreich (Austria)</p> <p>Zahodna Slovenija (Slovenia)</p> <p>Bratislavský kraj (Slovakia)</p> <p>Etelä-Suomi (Finland)</p> <p>Länsi Suomi (Finland)</p> <p>Pohjois ja Itä (Finland)</p> <p>Åland (Finland)</p> <p>Småland med öarna (Sweden)</p> <p>Norra Mellansverige (Sweden)</p> <p>Mellersta Norrland (Sweden)</p> <p>Övre Norrland (Sweden)</p> <p>North West (UK)</p> <p>East Midlands (UK)</p> <p>West Midlands (UK)</p> <p>East of England (UK)</p> <p>South West (UK)</p> <p>Scotland (UK)</p> <p>Luxembourg</p>		<p>(Austria)</p> <p>Zahodna Slovenija (Slovenia)</p> <p>Pohjois- ja Itä-Suomi (Finland)</p> <p>Småland med öarna (Sweden)</p> <p>Nordjylland (Denmark)</p> <p>Niederbayern (Germany)</p> <p>Brandenburg (Germany)</p> <p>Lüneburg (Germany)</p> <p>Weser Ems (Germany)</p> <p>Münster (Germany)</p> <p>Koblenz (Germany)</p> <p>Trier (Germany)</p> <p>Saarland (Germany)</p> <p>Chemnitz (Germany)</p> <p>Leipzig (Germany)</p> <p>Est (France)</p> <p>Ouest (France)</p> <p>Méditerranée (France)</p> <p>País Vasco (Spain)</p> <p>Bratislavský kraj (Slovakia)</p> <p>Norra Mellansverige (Sweden)</p> <p>Mellersta Norrland (Sweden)</p> <p>Flevoland (Netherlands)</p>		
<p>Cluster 2</p> <p>Vlaams Gewest (Belgium)</p> <p>Hovedstaden (Denmark)</p> <p>Stuttgart (Germany)</p> <p>Karlsruhe (Germany)</p> <p>Freiburg (Germany)</p> <p>Tübingen (Germany)</p> <p>Oberbayern (Germany)</p> <p>Oberpfalz (Germany)</p>	<p>Vlaams Gewest (Belgium)</p> <p>Hovedstaden (Denmark)</p> <p>Stuttgart (Germany)</p> <p>Karlsruhe (Germany)</p> <p>Freiburg (Germany)</p> <p>Tübingen (Germany)</p>	<p>Oberpfalz (Germany)</p>		

Mittelfranken (Germany) Berlin (Germany) Darmstadt (Germany) Île de France (France) Noord Brabant (Netherlands) Helsinki Uusimaa (Finland) Stockholm (Sweden) Östra Mellansverige (Sweden) Sydsverige (Sweden) Västsverige (Sweden) London (UK) South East (UK)	(Germany) Oberbayern (Germany) Mittelfranken (Germany) Berlin (Germany) Darmstadt (Germany) Île de France (France) Noord Brabant (Netherlands) Helsinki Uusimaa (Finland) Stockholm (Sweden) Östra Mellansverige (Sweden) Sydsverige (Sweden) Västsverige (Sweden) London (UK) South East (UK)			
Cluster 3 Strední Čechy (Czech Republic) Jihozápad (Czech Republic) Severovýchod (Czech Republic) Jihovýchod (Czech Republic) Strední Morava (Czech Republic) Moravskoslezsko (Czech Republic) Mecklenburg-Vorpommern (Germany) Sachsen-Anhalt (Germany) Border, Midland and Western (Ireland) Attiki (Greece) Vzhodna Slovenija (Slovenia) North East (UK) Yorkshire and The Humber (UK) Wales (UK) Northern Ireland (UK) Eesti (Estonia) Kypros (Cyprus) Malta (Malta) Comunidad Foral de Navarra (Spain)	North East (UK) Yorkshire and The Humber (UK)	Mecklenburg-Vorpommern (Germany) Sachsen (Germany) Border, Midland and Western (Ireland) Bassin Parisien (France) Nord - Pas-de-Calais (France) Drenthe (Netherlands) Friesland (Netherlands) Zeeland (Netherlands) Wales (UK) Northern Ireland (UK)	Strední Čechy (Czech Republic) Jihozápad (Czech Republic) Severovýchod (Czech Republic) Jihovýchod (Czech Republic) Strední Morava (Czech Republic) Moravskoslezsko (Czech Republic) Comunidad Foral de Navarra (Spain) Aragón (Spain) Cataluña (Spain) Friuli-Venezia Giulia (Italy) Emilia Romagna (Italy) Malopolskie (Poland) Közép-Magyarország (Hungary)	Bucuresti Ilfov (Romania)

Aragón (Spain) Cataluña (Spain) Bassin Parisien (France) Nord - Pas-de-Calais (France) Piemonte (Italy) Provincia Autonoma Trento (Italy) Veneto (Italy) Friuli-Venezia Giulia (Italy) Emilia Romagna (Italy) Toscana (Italy) Lazio (Italy) Közép-Magyarország (Hungary) Friesland (Netherlands) Drenthe (Netherlands) Zeeland (Netherlands) Mazowieckie (Poland) Malopolskie (Poland) Dolnoslaskie (Poland) Bucuresti Ilfov (Romania) Pomorskie (Poland) Lisboa (Portugal)			Dolnoslaskie (Poland) Pomorskie (Poland) Lisboa (Portugal) Vzhodna Slovenia (Slovenia) Eesti (Estonia) Malta Attiki (Greece) Kypros (Cyprus) Piemonte (Italy) Provincia Autonoma Trento (Italy) Veneto (Italy) Toscana (Italy) Lazio (Italy) Mazowieckie (Poland)	
Cluster 4 Severna i iztochna Bulgaria (Bulgaria) Anatoliki Makedonia (Greece) Kentriki Makedonia (Greece) Dytiki Makedonia (Greece) Ipeiros (Greece) Thessalia (Greece) Ionia Nisia (Greece) Dytiki Ellada (Greece) Stereia Ellada (Greece) Peloponnisos (Greece) Voreio Aigaio (Greece) Notio Aigaio (Greece) Kriti (Greece) Extremadura (Spain) Ciudad Autónoma de Ceuta (Spain) Ciudad Autónoma de Melilla (Spain) Canarias (Spain) Jadranska Hrvatska (Croatia) Molise (Italy) Campania (Italy) Puglia (Italy) Basilicata (Italy) Calabria (Italy) Sicilia (Italy) Sardegna (Italy)			Campania (Italy) Puglia (Italy) Basilicata (Italy) Calabria (Italy) Sicilia (Italy) Sardegna (Italy) Extremadura (Spain) Anatoliki Makedonia (Greece) Kentriki Makedonia (Greece) Dytiki Makedonia (Greece) Ipeiros (Greece) Thessalia (Greece) Dytiki Ellada (Greece) Stereia Ellada (Greece) Voreio Aigaio (Greece) Kriti (Greece) Jadranska Hrvatska (Croatia) Molise (Italy)	NordVest (Romania) Centru (Romania) NordEst (Romania) SudEst (Romania) Sud Muntenia (Romania) SudVest Oltenia (Romania) Canarias (Spain) Ionia Nisia (Greece) Peloponnisos (Greece) Notio Aigaio (Greece) Severna i iztochna Bulgaria (Bulgaria)

NordVest (Romania) Centru (Romania) NordEst (Romania) SudEst (Romania) Sud Muntenia (Romania) SudVest Oltenia (Romania)				
Cluster 5 Yugozapadna i yuzhna tsentralna Bulgaria (Bulgaria) Severozápad (Czech Republic) Galicia (Spain) Principado de Asturias (Spain) Cantabria (Spain) La Rioja (Spain) Castilla y Leó (Spain) Castilla-la Mancha (Spain) Comunidad Valenciana (Spain) Illes Balears (Spain) Andalucía (Spain) Región de Murcia (Spain) Kontinentalna Hrvatska (Croatia) French overseas departments (France) Valle d'Aosta (Italy) Liguria (Italy) Provincia Autonoma Bolzano/Bozen (Italy) Umbria (Italy) Marche (Italy) Abruzzo (Italy) Közép-Dunántúl (Hungary) Nyugat-Dunántúl (Hungary) Dél Dunántúl (Hungary) Észak-Magyarország (Hungary) Észak Alföld (Hungary) Dél Alföld (Hungary) Łódzkie (Poland) Ślaskie (Poland) Lubelskie (Poland) Podkarpackie (Poland) Świętokrzyskie (Poland) Podlaskie (Poland) Wielkopolskie (Poland) Zachodniopomorskie (Poland)			Yugozapadna i yuzhna tsentralna Bulgaria (Bulgaria) Severozápad (Czech Republic) Galicia (Spain) Principado de Asturias (Spain) Cantabria (Spain) La Rioja (Spain) Castilla y Leó (Spain) Castilla la Man (Spain) Comunidad Valenciana (Spain) Illes Balears (Spain) Andalucía (Spain) Región de Murcia (Spain) Kontinentalna Hrvatska (Croatia) Valle d'Aosta (Italy) Liguria (Italy) Provincia Autonoma Bolzano/Bozen (Italy) Umbria (Italy) Marche (Italy) Abruzzo (Italy) Közép-Dunántúl (Hungary) Nyugat- Dunántúl (Hungary) Dél Dunántúl (Hungary) Észak- Magyarország (Hungary) Észak Alföld (Hungary)	Lubelskie (Poland) Świętokrzyskie (Poland) Podlaskie (Poland) Wielkopolskie (Poland) Zachodniopomor skie (Poland) Lubuskie (Poland) Opolskie (Poland) Kujawsko- Pomorskie (Poland) Warmisko- Mazurskie (Poland) Vest (Romania)

Lubuskie (Poland)			Dél Alföld (Hungary)	
Opolskie (Poland)			Lódzkie (Poland)	
Kujawsko-Pomorskie (Poland)			Slaskie (Poland)	
Warminsko-Mazurskie (Poland)			Podkarpackie (Poland)	
Norte (Portugal)			Norte (Portugal)	
Algarve (Portugal)			Algarve (Portugal)	
Centro (Portugal)			Centro (Portugal)	
Alentejo (Portugal)			Alentejo (Portugal)	
Região Autónoma dos Açores (Portugal)			Região Autónoma dos Açores (Portugal)	
Região Autónoma da Madeira (Portugal)			Região Autónoma da Madeira (Portugal)	
Vest (Romania)			Západné Slovensko (Slovakia)	
Západné Slovensko (Slovakia)			Stredné Slovensko (Slovakia)	
Stredné Slovensko (Slovakia)			Východné Slovensko (Slovakia)	
Východné Slovensko (Slovakia)			Latvija (Latvia)	
Latvija (Latvia)			Lietuva (Lithuania)	
Lietuva (Lithuania)				

In the new proposed typology at the meso level, in cluster 1 there are 71 regions which are classified as Innovation Leaders, Strong and Moderate Innovators according to RIS and most of them are Strong Innovators. In cluster 2 there are 20 regions which according to RIS are classified as Innovation Leaders and only one region is classified as Strong Innovator.

In cluster 3 there are 40 regions with the majority of them to be Moderate Innovators according to RIS. The remaining are classified as Strong Innovators, while two regions are classified as Innovation Leaders and only region is classified as Modest Innovator. In cluster 4 there are 29 regions which are classified as Moderate and Modest Innovators according to RIS and most of them are Moderate Innovators. Last but not least in cluster 5 there are 49 regions which are classified as Moderate and Modest Innovators according to RIS and most of them are Moderate Innovators.

This classification of the regions in clusters allows the finding of characteristics for each cluster. Clusters 1 and 2 consequently have the most innovative regions in comparison to clusters 4 and 5 followed by cluster 3. Clusters 1 and 2 have characteristics that include high human capital, culture, finance, policy, outputs, outcomes and impacts whereas cluster 3 present high outputs.

According to Lee (2011) social and institutional factors play a significant role between innovation and within-regions inequality and for example Scandinavian economies such as Denmark, Sweden and Finland have accomplished to combine high levels of innovation with low inequality.

One can conclude that the Scandinavian regions are among the most innovative regions. Furthermore, besides the Scandinavian economies, countries that have strong social and institutional infrastructure can provide the space for the development of high innovation which include a number of different dimensions within their regions and these countries can belong to Western Europe such as Germany, Belgium, Austria, France, Ireland, Netherlands and UK, to Southern Europe such as Spain, Italy as well as to Central Europe such as Slovakia and Czech Republic and this can be confirmed by the EIS.

Moreover, Crudu (2019) supports that innovative entrepreneurs can be found mainly in countries that have both higher development and income. The author also explains that this is due to the fact that governments of these countries promote the appropriate policies in order to foster and strengthen the entrepreneurial and innovation climates. Most of the regions of clusters 1 and 2 belong to countries that are highly developed and have high incomes consequently it is reasonable for these regions to present high characteristics in comparison to regions that belong to clusters 4 and 5.

Clusters 4 and 5 are constituted of regions that are classified Moderate Innovators and Modest Innovators according to RIS. The regions that are classified as Moderate Innovators belong to the following countries which according to EIS are also Moderate Innovators, Italy, Spain, Greece, Croatia, Czech Republic, Hungary, Poland, Portugal, Slovakia, Latvia and Lithuania however, although the country Bulgaria is classified as Modest Innovator some of its regions are Moderate Innovators according to RIS.

The regions that are classified as Modest Innovators belong to the following countries which according to EIS are also Modest Innovators, Romania and Bulgaria however, although the countries Greece, Spain and Poland are classified as Moderate Innovators some of its regions are Modest Innovators according to RIS.

Clusters 4 and 5 present the lower characteristics as regards to clusters 1, 2 and 3 and these include low human capital, culture, finance, policy, outputs, outcomes and impacts.

OECD (2018d) supports that innovation can be found on very few regions and mostly the capitals of the regions. Countries in Eastern and Southern Europe present the lowest numbers of patent applications in terms of research and development resources, for example Greece, Poland and Latvia, are countries that can be found in clusters 4 and 5 and have below 100 patent applications per million inhabitants per year.

In addition, Gössling and Rutten (2007) found that wealth in terms of GRP per capita, talent in terms of workforce with higher education and cultural diversity in terms of non-nationals in the population can have a positive impact on a region's innovation whereas GDP is negative correlated to innovation.

The authors also support that the environment of a region matters as well as the combination of various factors that can influence its innovation since every region is unique, the innovative environment can be found more on smaller regions at NUTS 2 level rather than larger regions at NUTS 1 level because at the NUTS 2 level greater differences exist. Last but not least, the economic development matters since for example countries and regions can invest and specialize in specific economic activities such as for example a region could have invested in the tourist industry which is based mostly on the personal services and consequently this region presents lower levels of innovation.

Therefore regions that can be found in clusters 4 and 5 and belong to countries that are not highly developed, reasonably present low characteristics since they do not have the wealth, talent, cultural diversity as well as the appropriate policies which will allow them to perform better compared to regions that can be found in clusters 1, 2 and 3.

The results of the typology can be also connected to the results of Chapter 5. Crete is in cluster 4 which has low human capital characteristics, high startup skills which belong to the

entrepreneurial culture, low intellectual property rights and low competitiveness. These findings are in line with the results of Crete where in the pillars Culture, Policy, Outcomes and Impacts has a rather low performance. As well as, these findings are in line with the results of the QIH model where Crete has a rather low performance on all helices.

On the other hand, Stockholm which belongs in cluster 2 where most of the innovative regions are, presents high characteristics across both all pillars of the model as well as all helices of the QIH model.

It could be argued that the performance across all four helices should be high, as Stockholm in order to be in cluster 2 and have high characteristics, such as Human Capital, Culture, Finance, Policy, Outputs, Outcomes and Impacts.

Last but not least, the typology revealed that there are not homogeneous ecosystems since there are cases where the regions of some countries are classified in different clusters. This can be due to various reasons, such as for example the structure of the economy of each region whether it is based on agriculture or high-tech sector, how the national programs and initiatives that support entrepreneurship and innovation have been implemented at the regional level as well as the location of a region since it is known that entrepreneurship and innovation are not well developed in rural areas.

6.3 Results for firm level ecosystems

At the micro level, based on the K-means algorithm and the TOPSIS score of the four helices of the QIH model, the 120 companies were grouped into 3 clusters (see Table 6.13). The K-means was tested as regards to the number of clusters 3,4,5,6,7,8,9 and 12 clusters for the companies, for the year 2018 and the average of all years 2013-2018. As well as the K-means was tested at all levels for the variables that were going to be used, which are the following: the helices of the QIH model, the 7 pillars of the new proposed framework and the domains of the 3P framework.

The Quadruple Innovation Helix model, the 3 clusters as well as the average of all years 2013-2018 were chosen due to the fact that they provided better results where all companies are statistically different across all helices. When the number of clusters increased, the clusters were no longer statistically different across all helices.

Table 6.13. K-means per helices 3 clusters results at the micro level.

Clusters	Companies' Activity
Cluster 1	Dairy products 1, Dairy products 2, Dairy products 5, Dairy products 8, Fruits 1, Honey 4, Honey 5, Honey 8, Olive oil 1, Olive oil 11, Olive oil 19, Olive oil 21, Olive oil 23, Other 1, Other 14, Other 15, Other 18, Other 25, Other 26, Other 3, Other 30, Other 32, Other 34, Other 35, Other 36, Other 37, Other 8, Vegetables 5, Vegetables 7, Wine 10, Wine 12, Wine 2, Wine 8
Cluster 2	Dairy products 7, Fruits 3, Honey 1, Honey 7, Olive oil 10, Olive oil 25, Olive oil 26, Olive oil 28, Olive oil 3, Olive oil 31, Olive oil 33, Olive oil 6, Olive oil 8, Other 12, Other 16, Other 2, Other 20, Other 28, Other 31, Other 33, Other 7, Wine 15, Wine 6, Wine 9
Cluster 3	Dairy products 3, Dairy products 4, Dairy products 6, Dairy products 9, Fruits 2, Fruits 4, Honey 10, Honey 2, Honey 3, Honey 6, Honey 9, Olive oil 12, Olive oil 13, Olive oil 14, Olive oil 15, Olive oil 16, Olive oil 17, Olive oil 18, Olive oil 2, Olive oil 20, Olive oil 22, Olive oil 24, Olive oil 27, Olive oil 29, Olive oil 30, Olive oil 32, Olive oil 34, Olive oil 35, Olive oil 4, Olive oil 5, Olive oil 7, Olive oil 9, Other 10, Other 11, Other 13, Other 17, Other 19,

	Other 21, Other 22, Other 23, Other 24, Other 27, Other 29, Other 38, Other 4, Other 5, Other 6, Other 9, Vegetables 1, Vegetables 2, Vegetables 3, Vegetables 4, Vegetables 6, Vegetables 8, Vegetables 9, Wine 1, Wine 11, Wine 13, Wine 14, Wine 3, Wine 4, Wine 5, Wine 7
--	---

Figure 6.3 shows the final clusters centers for the companies. It can be seen that cluster 1 and cluster 2 have the greater distance and cluster 3 with clusters 1 and 2 have the lowest distance (see Table 6.14). This means that cluster 1 is very different from cluster 2 whereas cluster 3 is less different than clusters 1 and 2.

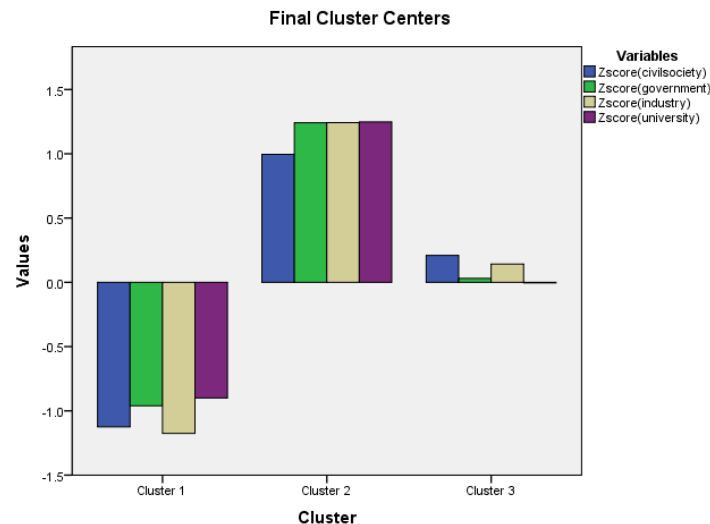


Figure 6.3. Final Cluster Centers for companies.

Table 6.14. Distances between Final Cluster Centers.

Cluster	1	2	3
1		4.450	2.302
2	4.450		2.205
3	2.302	2.205	

Table 6.15 shows the dependent variables which are the four helices, as well as the I column shows the number of the cluster that is being examined to the other two clusters in the J column. Also, the Mean Difference can be seen which shows the mean difference between each pair of clusters that are being examined. The Std. Error is the estimated standard deviation of the sample mean whereas Sig. is the p-value. Last but not least, the 95% Confidence Interval is the test of reliability of the mean difference with lower and upper values.

It can be seen (see Table 6.15) that all clusters are statistically different in all helices since Sig. (p-value)=0≤0,050.

Table 6.15. Post Hoc Tests, Multiple Comparisons, Tukey HSD.

Multiple Comparisons						
Tukey HSD						
Dependent Variable	(I) Cluster	(J) Cluster	Mean Difference	Std. Error	Sig.	95% Confidence Interval

	Number of Case	Number of Case	(I-J)			Lower Bound	Upper Bound
Zscore(civilsociety)	1	2	-2.121	.177	.000	-2.540	-1.701
		3	-1.334	.141	.000	-1.670	-.999
	2	1	2.121	.177	.000	1.701	2.540
		3	.786	.158	.000	.411	1.161
	3	1	1.334	.141	.000	.999	1.670
		2	-.786	.158	.000	-1.161	-.411
Zscore(government)	1	2	-2.202	.178	.000	-2.624	-1.779
		3	-.991	.143	.000	-1.330	-.653
	2	1	2.202	.178	.000	1.779	2.624
		3	1.210	.159	.000	.833	1.588
	3	1	.991	.143	.000	.653	1.330
		2	-1.210	.159	.000	-1.588	-.833
Zscore(industry)	1	2	-2.418	.147	.000	-2.767	-2.069
		3	-1.318	.118	.000	-1.597	-1.039
	2	1	2.418	.147	.000	2.069	2.767
		3	1.100	.131	.000	.788	1.412
	3	1	1.318	.118	.000	1.039	1.597
		2	-1.100	.131	.000	-1.412	-.788
Zscore(university)	1	2	-2.148	.184	.000	-2.584	-1.711
		3	-.895	.147	.000	-1.244	-.545
	2	1	2.148	.184	.000	1.711	2.584
		3	1.253	.164	.000	.863	1.643
	3	1	.895	.147	.000	.545	1.244
		2	-1.253	.164	.000	-1.643	-.863

After having found the clusters for the companies, the profile of each cluster was found by using the 28 variables in order to describe each cluster with specific characteristics. The Compare Means and a One Way ANOVA with a post hoc test Tukey HSD were used. An example will be given here and in the same way the other 27 variables were processed and can be found in Appendix 5. First, the means of the clusters were found for the variable Lifelong Learning which is measured as a number (see Table 6.16).

Table 6.16. Means of clusters for variable Lifelong Learning.

Cluster	Mean	N	Std. Deviation
1	7.288	33	12.705
2	24.500	24	22.163
3	16.984	63	23.655

It can be seen that clusters 1 and 2 are statistically different as regards to the variable lifelong learning (see Table 6.17) since Sig. (p-value) = 0,000 ≤ 0,050. By looking Table 6.33 it can be seen that cluster 2 has the highest mean which shows that cluster 2 has high lifelong learning whereas cluster 1 has the lowest mean which shows that cluster 1 has low lifelong learning.

Table 6.17. Post Hoc Tests, Multiple Comparisons, Tukey HSD.

Multiple Comparisons						
Dependent Variable: Lifelong learning						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-17.212	5.610	.007	-30.529	-3.896
	3	-9.696	4.493	.083	-20.363	.970
2	1	17.212	5.610	.007	3.896	30.529
	3	7.516	5.016	.295	-4.391	19.423
3	1	9.696	4.493	.083	-.970	20.363
	2	-7.516	5.016	.295	-19.423	4.391

The following variables did not have significant differences within the 3 clusters: Quality of education, Startup skills, Risk acceptance, Access to finance, Ease of starting a business, Time to start a business, Turnover per employee.

Cluster 1 has the following characteristics:

1. Low human resources
2. Low corporate governance
3. Low R&D expenditures
4. Low Non-R&D expenditures
5. Low intellectual property rights
6. Low product innovations
7. Low employees in knowledge-intensive activities
8. Low sales
9. Low net investment

Cluster 2 has the following characteristics:

1. High tertiary education
2. High lifelong learning
3. High human resources
4. High opportunity perception
5. High organizational growth
6. High access to information
7. High product innovations
8. High marketing innovations
9. High in-house innovations
10. High employees in knowledge-intensive activities
11. High employees in high-tech
12. High exports
13. High market share
14. High employee retention
15. High employee satisfaction

Cluster 3 has the following characteristics:

1. Low R&D expenditures
2. Low Non-R&D expenditures

3. High access to information
4. Low intellectual property rights
5. High in-house innovations
6. Low sales
7. Low net investment

It can be seen that the way the clusters have been formed is not influenced by the activity of each company. However, neither does the years of operation or the size of the company (see Table 6.18) play a role in the clusters' formation. Perhaps, the exports appear to play an important role in the clusters' formation.

More specifically, cluster 3 has a moderate percentage of exports where 17 companies out of 63 have exports that reach more than 50%. Furthermore, cluster 2 has the greatest percentage of exports where only 1 out of 24 companies have exports less than or equal to 10%. Last but not least, cluster 1 has the lowest percentage of exports where only 5 out of 33 companies have exports that reach above 10%.

Table 6.18. Elements that contributed to clusters' formation.

Activity of company	Cluster	Years of operation	Number of employees	Turnover	Exports
Olive oil 1	1	15+	11-50	Above than 200.000 euros	10% less than 25%
Wine 2	1	15+	11-50	Above than 200.000 euros	5% less than 10%
Other 1	1	15+	50+	Above than 200.000 euros	1% less than 5%
Other 3	1	0-5	1-10	Below than 100.000 euros	0
Olive oil 11	1	15+	11-50	Above than 200.000 euros	0
Other 8	1	15+	11-50	Above than 200.000 euros	0
Dairy products 1	1	0-5	1-10	100.000-200.000 euros	0
Other 14	1	15+	11-50	Above than 200.000 euros	0
Dairy products 2	1	15+	1-10	Above than 200.000 euros	1% less than 5%
Other 15	1	15+	1-10	Above than 200.000 euros	1% less than 5%
Other 18	1	6-15	11-50	Above than 200.000 euros	0
Honey 4	1	6-15	1-10	Below than 100.000 euros	75% or more
Honey 5	1	15+	1-10	Above than 200.000 euros	1% less than 5%
Wine 8	1	6-15	1-10	Below than 100.000 euros	0
Wine 10	1	15+	1-10	Below than 100.000 euros	1% less than 5%
Olive oil 19	1	15+	11-50	Above than 200.000 euros	25% less than 50%
Vegetables 5	1	15+	11-50	Above than 200.000 euros	10% less than 25%

Wine 12	1	6-15	1-10	100.000-200.000 euros	1% less than 5%
Fruits 1	1	0-5	1-10	Below than 100.000 euros	1% less than 5%
Olive oil 21	1	15+	1-10	Above than 200.000 euros	1% less than 5%
Dairy products 5	1	15+	11-50	Above than 200.000 euros	5% less than 10%
Other 25	1	0-5	1-10	Below than 100.000 euros	5% less than 10%
Other 26	1	15+	1-10	Above than 200.000 euros	0
Olive oil 23	1	6-15	1-10	Below than 100.000 euros	50% less than 75%
Other 30	1	15+	11-50	Above than 200.000 euros	5% less than 10%
Other 32	1	15+	11-50	Above than 200.000 euros	1% less than 5%
Vegetables 7	1	6-15	1-10	Below than 100.000 euros	0
Dairy products 8	1	15+	1-10	Above than 200.000 euros	0
Other 34	1	6-15	11-50	Above than 200.000 euros	5% less than 10%
Other 35	1	15+	11-50	Above than 200.000 euros	0
Other 36	1	0-5	1-10	Below than 100.000 euros	1% less than 5%
Honey 8	1	15+	1-10	Above than 200.000 euros	1% less than 5%
Other 37	1	6-15	1-10	100.000-200.000 euros	5% less than 10%
Olive oil 3	2	15+	11-50	Above than 200.000 euros	75% or more
Honey 1	2	15+	1-10	Above than 200.000 euros	50% less than 75%
Other 2	2	6-15	50+	100.000-200.000 euros	10% less than 25%
Olive oil 6	2	15+	11-50	Above than 200.000 euros	75% or more
Olive oil 8	2	15+	1-10	Above than 200.000 euros	75% or more
Olive oil 10	2	15+	11-50	Above than 200.000 euros	50% less than 75%
Other 7	2	0-5	1-10	100.000-200.000 euros	50% less than 75%
Other 16	2	15+	11-50	Above than 200.000 euros	50% less than 75%
Wine 6	2	15+	1-10	Above than 200.000 euros	25% less than 50%
Wine 9	2	15+	1-10	Above than 200.000 euros	10% less than 25%
Fruits 3	2	6-15	1-10	100.000-200.000 euros	50% less than 75%

Other 20	2	6-15	1-10	Above than 200.000 euros	50% less than 75%
Other 12	2	6-15	1-10	Above than 200.000 euros	50% less than 75%
Honey 7	2	15+	1-10	Above than 200.000 euros	25% less than 50%
Other 28	2	15+	11-50	Above than 200.000 euros	75% or more
Olive oil 33	2	0-5	1-10	Below than 100.000 euros	75% or more
Olive oil 31	2	15+	1-10	Above than 200.000 euros	50% less than 75%
Wine 15	2	15+	1-10	100.000-200.000 euros	5% less than 10%
Olive oil 28	2	15+	1-10	Below than 100.000 euros	50% less than 75%
Dairy products 7	2	15+	11-50	Above than 200.000 euros	25% less than 50%
Olive oil 25	2	6-15	1-10	Above than 200.000 euros	75% or more
Other 33	2	6-15	1-10	Above than 200.000 euros	5% less than 10%
Olive oil 26	2	6-15	1-10	Above than 200.000 euros	50% less than 75%
Other 31	2	6-15	1-10	Above than 200.000 euros	25% less than 50%
Wine 1	3	6-15	1-10	Above than 200.000 euros	5% less than 10%
Vegetables 1	3	15+	11-50	Above than 200.000 euros	1% less than 5%
Olive oil 2	3	15+	1-10	Above than 200.000 euros	50% less than 75%
Vegetables 2	3	15+	11-50	Above than 200.000 euros	75% or more
Olive oil 4	3	15+	11-50	Above than 200.000 euros	10% less than 25%
Olive oil 5	3	15+	11-50	Above than 200.000 euros	75% or more
Vegetables 3	3	15+	11-50	Above than 200.000 euros	75% or more
Olive oil 7	3	6-15	1-10	100.000-200.000 euros	10% less than 25%
Olive oil 9	3	15+	1-10	Above than 200.000 euros	50% less than 75%
Other 4	3	15+	50+	Above than 200.000 euros	1% less than 5%
Wine 3	3	0-5	1-10	Below than 100.000 euros	0
Other 5	3	15+	11-50	100.000-200.000 euros	10% less than 25%
Honey 2	3	6-15	1-10	Above than 200.000 euros	10% less than 25%
Olive oil 12	3	15+	11-50	Above than 200.000 euros	75% or more

Other 6	3	0-5	1-10	Below than 100.000 euros	50% less than 75%
Wine 4	3	0-5	1-10	Below than 100.000 euros	1% less than 5%
Vegetables 4	3	6-15	11-50	Above than 200.000 euros	50% less than 75%
Olive oil 13	3	0-5	1-10	100.000-200.000 euros	10% less than 25%
Olive oil 14	3	15+	11-50	Above than 200.000 euros	0
Other 9	3	15+	11-50	Above than 200.000 euros	10% less than 25%
Olive oil 15	3	15+	1-10	Above than 200.000 euros	10% less than 25%
Other 10	3	15+	11-50	Above than 200.000 euros	0
Other 11	3	6-15	1-10	Above than 200.000 euros	1% less than 5%
Olive oil 16	3	15+	11-50	Above than 200.000 euros	5% less than 10%
Other 13	3	15+	50+	Above than 200.000 euros	10% less than 25%
Honey 3	3	15+	1-10	Below than 100.000 euros	10% less than 25%
Olive oil 17	3	15+	1-10	Above than 200.000 euros	50% less than 75%
Other 17	3	6-15	1-10	Above than 200.000 euros	10% less than 25%
Olive oil 18	3	15+	1-10	Above than 200.000 euros	75% or more
Wine 5	3	15+	1-10	Above than 200.000 euros	10% less than 25%
Honey 6	3	15+	1-10	Above than 200.000 euros	25% less than 50%
Dairy products 3	3	6-15	1-10	Above than 200.000 euros	5% less than 10%
Wine 7	3	15+	1-10	Above than 200.000 euros	10% less than 25%
Dairy products 4	3	15+	1-10	Above than 200.000 euros	10% less than 25%
Other 19	3	15+	11-50	Above than 200.000 euros	1% less than 5%
Wine 11	3	15+	11-50	Above than 200.000 euros	1% less than 5%
Fruits 2	3	6-15	11-50	Above than 200.000 euros	25% less than 50%
Olive oil 20	3	6-15	1-10	100.000-200.000 euros	75% or more
Vegetables 6	3	6-15	11-50	Above than 200.000 euros	75% or more
Olive oil 22	3	6-15	11-50	Above than 200.000 euros	10% less than 25%
Other 21	3	15+	1-10	Above than 200.000 euros	10% less than 25%

Other 22	3	15+	50+	Above than 200.000 euros	5% less than 10%
Wine 13	3	15+	1-10	Above than 200.000 euros	10% less than 25%
Fruits 4	3	0-5	1-10	Below than 100.000 euros	5% less than 10%
Other 23	3	0-5	1-10	Below than 100.000 euros	75% or more
Other 24	3	6-15	1-10	Above than 200.000 euros	1% less than 5%
Other 27	3	15+	11-50	Above than 200.000 euros	5% less than 10%
Other 29	3	15+	50+	Above than 200.000 euros	1% less than 5%
Dairy products 6	3	15+	1-10	Above than 200.000 euros	1% less than 5%
Olive oil 24	3	15+	1-10	Above than 200.000 euros	50% less than 75%
Wine 14	3	15+	1-10	100.000-200.000 euros	10% less than 25%
Olive oil 27	3	15+	1-10	Above than 200.000 euros	0
Olive oil 29	3	15+	1-10	Above than 200.000 euros	10% less than 25%
Olive oil 30	3	15+	11-50	Above than 200.000 euros	50% less than 75%
Honey 9	3	15+	1-10	Below than 100.000 euros	10% less than 25%
Vegetables 8	3	15+	1-10	Above than 200.000 euros	50% less than 75%
Olive oil 32	3	15+	11-50	Above than 200.000 euros	25% less than 50%
Honey 10	3	15+	1-10	Below than 100.000 euros	10% less than 25%
Dairy products 9	3	15+	11-50	Above than 200.000 euros	0
Olive oil 34	3	6-15	11-50	Above than 200.000 euros	10% less than 25%
Vegetables 9	3	15+	1-10	Above than 200.000 euros	0
Olive oil 35	3	15+	1-10	Above than 200.000 euros	50% less than 75%
Other 38	3	6-15	1-10	Below than 100.000 euros	5% less than 10%

Cluster 2 presents the highest characteristics in comparison to clusters 1 and 3 and these include high human capital, culture, finance, policy, outputs, outcomes and impacts. This can be explained due to the fact that cluster 2 presents the highest percentages of exports and this could mean that the firms are well developed in various dimensions in order to be able to export their products more successfully.

In addition, these findings are also in line with the findings of Chapter 5. Cluster 2 is constituted mainly by the sectors Olive oil and Wine whereas there is a small number of companies which belong to sectors Other, Dairy products, Honey and Fruits. The results of

the new proposed framework also revealed that the sector Wine performs better than the others sectors on the pillars Human capital and Outcomes and the sector Olive oil has the best performance on the pillars Culture and Policy. Moreover, Fruits perform better on the pillar Finance, Honey performs better on the pillar Impacts whereas Other performs better on the pillar Outputs.

Last but not least, the results of the QIH model revealed that on the helix university the sectors Wine, Olive oil and Dairy products which can be found in cluster 2 have the highest performance. This means that these sectors perform well on the variables that constitute the helix university. These sectors need specialization to create new innovative products and export them, they cooperate with universities and research institutions, they invest more in human capital and therefore they have higher characteristics compared to companies in clusters 1 and 3.

Chapter 7. Conclusions

7.1 Overview of results and findings

In this thesis both the innovation and entrepreneurial ecosystems were studied as well as the ways that the assessment of these ecosystems can be conducted. The new proposed framework showed that it can address the gap that exists in the literature through a multilevel approach and is appropriate for the assessment of the innovative entrepreneurial ecosystems at the macro, meso and micro level. The domains of the new proposed framework follow the 3P framework of Carayannis and Provan (2008) which the authors used for measuring firm innovativeness. The new proposed framework shows a new way that the 3P framework can be applied to the assessment of the innovative entrepreneurial ecosystems.

For the entrepreneurial ecosystems, according to Isenberg (2011a) six are the main elements which interact with each other in complex ways and these are culture, policies and leadership, finance, human capital, markets, institutional and infrastructural supports. For the innovation ecosystem, Jackson (2011) claims that there are different actors or entities that interact in complex ways as well as with the environment whereas elements such as funds which are the material resources, the human capital and the institutional actors such as business firms, are vital.

The pillars of the model are the essential elements of the innovative entrepreneurial ecosystem which can also be found in the innovation ecosystem and according to Isenberg (2011a) they include Human Capital, Culture, Policy and Finance as well as according to Stam (2017) they also include Formal Institutions, Entrepreneurship Culture and Finance whereas Outputs, Outcomes and Impacts are according to Carayannis and Provan (2008) *“the lasting result of innovation”* and entrepreneurship within the ecosystem.

In addition, all the existing frameworks and indexes that assess the entrepreneurial and the innovation ecosystems and were studied in depth in this thesis include some of these elements, a fact that shows the necessity of these within the innovative entrepreneurial ecosystems. For example, frameworks such as the European Innovation Scoreboard, the Global Innovation Index, the Global Entrepreneurship Index include elements such as Human Capital, Finance, Policy, etc, in their measurements. Moreover, the variables of the new proposed framework were chosen carefully from the existing frameworks and indexes as well as from other studies that have used the same variables with the criterion to have as much consistency as possible in all levels.

Two surprises that were identified in this thesis journey are the facts that although there are many and different frameworks and indexes that offer a variety of variables at the macro level, there are only a few frameworks at the meso and micro level. For example, besides the Regional Innovation Scoreboard which is available every two years and measures the performance of innovative regions, other frameworks do not exist besides for example one individual effort which is the Regional REDI that is only available for one year. The same applies to the micro level which besides the Community Innovation Survey which provides useful information as regards to innovation activities in enterprises, other frameworks do not exist besides, for example the Innobarometer or the Eurobarometer that every year explore different themes for enterprises. Therefore, both at the meso and micro levels more frameworks that can provide a variety of variables should be developed and become available.

In the existing literature there are few studies that have used the Multi-Criteria Decision Making methods for the assessment of the innovative entrepreneurial ecosystems at all levels. For example, at the macro level only two studies exist for the measurement of the entrepreneurial ecosystems, the studies of Kitsios and Sitaridis (2017) and Sitaridis and Kitsios (2019) that used the NWM model for the assessment of the Greek entrepreneurial ecosystem.

However, it can be observed from all the studies presented in this thesis that as regards to the assessment of innovation and entrepreneurship either at the macro, meso or micro level among the most widely used Multi-Criteria Decision Making methods is TOPSIS, which was also used in this thesis whereas the use of the NWM showed how well this method can be applied for this kind of assessment. Moreover, strong correlation between these two methods was found at all levels with the use of the Spearman's rank correlation coefficient.

The results of the framework provide significant findings for the two innovative entrepreneurial ecosystems that were studied, Greece and Sweden, presenting their strengths and weaknesses. At the macro level, the low performance of Greece and the high performance of Sweden out of 28 countries, are in line with the results of the existing frameworks such as the European Innovation Scoreboard, the Global Innovation Index, the Global Entrepreneurship Index and the World Economic Forum.

At the macro level, the pillars Outputs and Outcomes can be considered as strengths for Greece whereas the pillars Human Capital, Culture, Policy, Finance and Impacts can be considered as weaknesses and areas that should be improved, especially Impacts. The pillars Human Capital, Finance, Policy, Outcomes and Impacts can be considered as strengths for Sweden whereas the pillars Culture and Outputs can be considered as weaknesses and as areas that should be improved.

At the meso level, the moderate performance of Crete and the high performance of Stockholm out of 212 regions can also be confirmed by the results of the Regional Innovation Scoreboard. At the meso level, the pillars Human Capital, Finance and Outputs can be considered as strengths for Crete whereas the pillars Culture, Policy, Outcomes and Impacts can be considered as weaknesses and as areas that should be improved. For Stockholm, the pillars Human Capital, Finance, Policy, Outcomes and Impacts can be considered as strengths whereas the pillars Culture and Outputs have a slightly lower performance.

At the micro level, the results revealed the average profile of 120 companies in the Cretan Agrofood industry whereas the three case studies that were conducted revealed more information on each pillar of the new proposed framework. The framework revealed that both the Agrofood industry as well as all sectors perform better on the pillars Culture, Policy and Impacts and present a rather low performance on the pillars Human Capital, Finance, Outputs and Outcomes.

In this thesis it was also demonstrated how the domains of the new proposed framework which are based on the 3P framework and are the Enablers, Capabilities and Results can be affected by the performance of each pillar as well as how the new proposed framework can be connected to the QIH model providing again valuable information at each level.

Regarding the 3P framework, although, Greece performs better in Results, many reforms are required in order to improve both Enablers and Capabilities and create a strong entrepreneurship ecosystem. Crete could be characterized as moderate out of 212 regions whereas the improvement of Enablers can lead in the future to the improvement of both Capabilities and Results. Sweden has already a strong entrepreneurship ecosystem, however, the improvement of Capabilities and Enablers can lead in the future to the improvement of Results. As regards to Stockholm, it has also a strong entrepreneurship ecosystem since it has a high performance on all the domains, Enablers, Capabilities and Results. The Agrofood industry has a rather moderate and not a strong entrepreneurship ecosystem, therefore the high performance of Enablers and Capabilities can lead to the future in the improvement of Results. The same applies for the performance of all different sectors.

Regarding the QIH model, at the macro level, the results revealed that Greece has a rather moderate performance on all helices and Sweden has a rather high performance on all helices. At the meso level, Crete has a rather low performance on all helices whereas Stockholm has a rather high performance on all helices, since it has a strong entrepreneurship ecosystem. Last

but not least, as regards to the QIH model at the micro level, the Cretan Agrofood industry as well as all sectors have a rather high performance on all helices except university.

The typology that was developed and applied at each level, macro, meso and micro revealed not only the performance of nations, regions and companies but also provided the characteristics of each cluster and showed that nations which are more innovative have higher characteristics such as higher human capital, culture, etc. On contrary, the other frameworks that exist provide only a classification for nations and regions as regards to their innovation performance such as the European Innovation Scoreboard and the Regional Innovation Scoreboard whereas the Global Entrepreneurship Index provides a classification of countries as regards to their the innovation economic development.

7.2 Limitations and Future Research

This research is acceptable from validity, reliability and generalization set of perspectives. From the validity perspective the design of the new proposed framework has been based on existing theories and studies such as Isenberg (2011a), Stam (2017) and Carayannis and Provan (2008) on how to measure entrepreneurial ecosystems and what pillars and variables should be included.

In addition, different frameworks, indexes, barometers and surveys such as the European Innovation Scoreboard, the Global Innovation Index, the Global Entrepreneurship Index, the World Economic Forum, the Community Innovation Survey etc, have also been studied in order to understand how to measure entrepreneurial ecosystems and the variables of some of these frameworks were used as secondary data on this new proposed framework.

The methodologies that were chosen which are the NWM and the TOPSIS method that belong to the Multi-Criteria Decision Making methods as well as the quantitative research conducted with a questionnaire and the qualitative research through three case studies at the micro level, are appropriate for answering the main research questions of this thesis.

This can be also seen through the correlation of these two methods that were tested through the Spearman's rank correlation coefficient in each pillar where the ranking of the NWM and the TOPSIS method had high values of the Spearman's rho at all levels, macro, meso and micro which shows their high correlation.

The results of the national, regional and firm level ecosystems not only measure the innovative entrepreneurial ecosystems and answer the main research question of this thesis which is how the assessment of the innovative entrepreneurial ecosystem can take place through a multilevel approach but they also have been compared to the existing frameworks that measure entrepreneurial ecosystems and they present great similarity. Moreover, the results of the questionnaire can be found also in the case studies conducted whereas they have been confirmed with other studies.

From the reliability perspective, as stated above not only the results of the NWM and the TOPSIS method at all levels are highly correlated but they also present similarities to the results of the existing frameworks. Another fact is that for example when implementing the methods on the pillar Human Capital for one country across time which is from 2013 to 2018 great differences cannot be observed on the values of the Non-Weighted rank and the TOPSIS rank throughout the years, all these facts show consistency.

Last but not least, from the generalizability perspective the new proposed framework could be applied to a larger number of countries, regions and companies where useful insights could be obtained.

As regards to this thesis some limitations can be identified. First, as regards to the data collection method, the use of secondary data from existing frameworks such as the European Innovation Scoreboard, Global Innovation Index etc, at the national and the regional level could be considered as a limitation, therefore based on the variables of the new proposed

framework one could conduct further research to collect primary data at these two levels. In addition, as limitations can be considered the hypotheses for imputing the values of the data at the meso level. A normalization process was implemented where a weighting was conducted according to the region's contribution to each variable and this contribution was normalised with either GDP or population.

Second, the use of the Multi-Criteria Decision Making methods could be considered as a limitation since two specific methods were used, the NWM and the TOPSIS method which are predefined in the way they can be used. Perhaps simpler models such as the average of the pillars that the World Economic Forum applies or the simple average of the sub-indexes that the Global Innovation Index applies or even other statistical methods could also provide useful results. Moreover, as a limitation can be considered also the fact that in the TOPSIS method the same weights have been applied. This means that the indicators in each pillar have the same weight which is defined to 1, however this approach allowed the successful comparison between the two implemented methods, NWM and TOPSIS.

Third, as regards to the sample size, at the national and regional level a main limitation could be considered the fact that the model is applied to 28 EU countries and 212 EU regions. At the micro level two main limitations could be considered the facts that the model is applied to the Agrofood industry and at the region of Crete.

Future research should focus on different ways of data collection and on exploring different methodologies besides Multi-Criteria Decision Making methods. In addition, future research should focus at the macro and meso level on the expansion of the model to more countries and regions. Perhaps, the framework should include the non-EU countries and non-EU regions whereas at the micro level future research should focus on the expansion of the model to more industries and perhaps include more companies on different regions. Finally, future research should also focus on the flows that exist in the 3P framework of Carayannis and Provan (2008).

References

- Abdulquadri, B., & Ajagbe, M., & Sholanke, A., & Sani, T. (2015). Impact of Employee Turnover in Small and Medium Construction Firms: A Literature Review. *International Journal of Engineering Research & Technology (IJERT)*.
- Acs, Z. J., Autio, E., & Szerb, L. (2014). National systems of entrepreneurship: Measurement issues and policy implications. *Research Policy*, 43(3), 476–494.
- Acs, Z. J., Szerb, L., & Lloyd, A. (2017a). The Global Entrepreneurship Index powered by GEDI. Retrieved from: <http://thegedi.org/downloads/>.
- Acs, Z., & Stam, E., & Audretsch, D., & O'Connor A. (2017b). The lineages of the entrepreneurial ecosystem approach. *Small Bus Econ* 49(1):1–10. <https://doi.org/10.1007/s11187-017-9864-8>.
- Acs, Z.J., Desai, S., Klapper, L.F. (2008). What does “entrepreneurship” data really show? *Small Business Economics* 31 (3), 265–281.
- Adebisi, S., Amole, B., Arikewuyo, K. & Oyenuga, O. (2019). Multi-Criteria Decision Analysis of Entrepreneurial Orientation and Business Performance in Nigeria. *Economics and Business*. 33. 140-151. 10.2478/eb-2019-0010.
- Adner, R. (2006). Match your innovation strategy to your innovation ecosystem. *Harvard Business Review*. 84 (4), 98–107.
- Adner, R., & Kapoor, R. (2010). Value creation in innovation ecosystems: how the structure of technological interdependence affects firm performance in new technology generations. *Strategic Management Journal*. 31 (3), 306–333.
- Ahlgren, L., and Engel, L. (2011). Lifelong learning through SMEs: Exploring workplace learning in the UK. *Journal of Workplace Learning*. 23. 331-348. 10.1108/13665621111141920.
- Ahmad N., & Hoffman A. (2007). A Framework for Addressing and Measuring Entrepreneurship, *Entrepreneurship Indicators Steering Group*, available at: <https://www.oecd.org/std/business-stats/39629644.pdf>.
- Ajayi, O. & Morton, S. (2015). Exploring the Enablers of Organizational and Marketing Innovations in SMEs: Findings From South-Western Nigeria. *SAGE Open*. 5. 10.1177/2158244015571487.
- Akehurst, G., & Comeche, J., M., & Galindo, M., A. (2009). Job satisfaction and commitment in the entrepreneurial SME. *Small Business Economics*. 32. 277-289. 10.1007/s11187-008-9116-z.
- Alvedalen, J. & Boschma, R. (2017). A critical review of entrepreneurial ecosystems research: towards a future research agenda. *European Planning Studies*, 25:6, 887-903, DOI: 10.1080/09654313.2017.1299694.
- Anagnosti, A., Zampetakis, L. A., & Rozakis, S. (2014, August 26 to 29). Understanding entrepreneurial intentions of students in agriculture and related sciences. *EAAE 2014 Congress ‘Agri-Food and Rural Innovations for Healthier Societies’*, Ljubljana, Slovenia.
- Anderson, P. (1999). Complexity theory and organization science. *Organ. Sci.* 10 (3), 216–232.
- Andersson, D., & Tell, F. (2018). The market for patents in Sweden: Past and present. *Stockholm Intellectual Property Law Review*, 1(2), 6–17. Retrieved from <http://urn.kb.se/resolve?urn=urn:nbn:se:uu:diva-377051>.

- Anokhin, S. & Schulze, W. S. (2009). Entrepreneurship, innovation, and corruption, *Journal of Business Venturing*, 24, issue 5, p. 465-476, Available at: <https://EconPapers.repec.org/RePEc:eee:jbvent:v:24:y:2009:i:5:p:465-476>.
- Añón Higón, D., & Driffield, N. (2011). Exporting and innovation performance: Analysis of the annual Small Business Survey in the UK. *International Small Business Journal*, 29(1), 4–24. <https://doi.org/10.1177/0266242610369742>.
- Apak, S. & Atay, E. (2014). Global Innovation and Knowledge Management Practice in Small and Medium Enterprises (SMEs) in Turkey and the Balkans, *Procedia - Social and Behavioral Sciences*, Volume 150, Pages 1260-1266, ISSN 1877-0428, <https://doi.org/10.1016/j.sbspro.2014.09.142>.
- Armstrong, J. (2017). What is an Air Ecosystem? Available at: <https://www.lifepersona.com/what-is-an-air-ecosystem-with-examples>.
- Arrington, D. (n.d.). What is a Terrestrial Ecosystem? - Definition, Examples & Types. Available at: <https://study.com/academy/lesson/what-is-a-terrestrial-ecosystem-definition-examples-types.html>.
- Arruda C., Nogueira V.S., Cozzi A., & Costa V. (2015). The Brazilian Entrepreneurial Ecosystem of Startups: An Analysis of Entrepreneurship Determinants in Brazil and the Perceptions Around the Brazilian Regulatory Framework. In: Lèbre La Rovere R., de Magalhães Ozório L., de Jesus Melo L. (eds) *Entrepreneurship in BRICS*. Springer, Cham.
- Aspen Network of Development Entrepreneurs (ANDE), UK Department for International Development. (2013). Entrepreneurial Ecosystem Diagnostic Toolkit, available at: https://assets.aspeninstitute.org/content/uploads/files/content/docs/pubs/FINAL%20Ecosystem%20Toolkit%20Draft_print%20version.pdf.
- Athanasoglou, P., & Backinezos, C. & Georgiou, E., A. (2010). Export Performance, Competitiveness, and Commodity Composition. Bank of Greece Working Paper, No. 114.
- Audretsch, D. B., & Belitski, M. (2017). Entrepreneurial ecosystems in cities: establishing the framework conditions. *Journal of Technology Transfer*, 42 (5), 1030–1051. <http://doi.org/10.1007/s10961-016-9473-8>.
- Audretsch, D. B., & Link, A. N. (2017). Embracing an entrepreneurial ecosystem: an analysis of the governance of research joint ventures. *Small Business Economics*, 1–8.
- Auerswald, P., E. (2015). Enabling entrepreneurial ecosystems: Insights from ecology to inform effective entrepreneurship policy, Kauffman Foundation Research Series on City, Metro, and Regional Entrepreneurship, available at: http://www.kauffman.org/~media/kauffman.org/research%20reports%20and%20covers/2015/10/enabling_entrepreneurial_ecosystems.pdf.
- Autio, E., Nambisan, S., Thomas, L. D. W., & Wright, M. (2018a). Digital affordances, spatial affordances, and the genesis of entrepreneurial ecosystems. *Strategic Entrepreneurship Journal*, 12(1): 72-95.
- Autio, E., & Szerb, L., & Komlósi, E., & Tiszberger, M. (2018b). The European Index of Digital Entrepreneurship Systems, EUR 29309 EN, Publications Office of the European Union, Luxembourg, ISBN 978-92-79-91303-7, doi:10.2760/39256, JRC112439.
- Autio, E., Kenney, M., Mustar, P., Siegel, D., & Wright, M. (2014). Entrepreneurial innovation: the importance of context. *Research Policy*. 43 (7), 1097–1108.
- Aylward, B., Bandyopadhyay, J., Belausteguigotia, J. C., Borkey, P., Cassar, A. Z., Meadors, L., Saade, L., Siebentritt, M., Stein, R., Tognetti, S., & Tortajada, C. (2005). Freshwater ecosystem services. *Ecosystems and Human Well-being: Policy Responses*, 3, 213–256.
- Babson College. (n.d.). Babson Entrepreneurship Ecosystem Project. Available at: <http://entrepreneurial-revolution.com/lessons/>.

- Badescu, M., & Saisana, M. (2008). Participation in Lifelong Learning in Europe: What can be measured and compared. 10.2788/97081.
- Bahrami, H., & Evans, S. (1995). Flexible re-cycling and high-technology entrepreneurship. *California Management Review* 37:3.
- Bainée, J. (2013). Entrepreneurship education, in: E.G. Carayannis (ed.), *Encyclopedia of Creativity, Invention, Innovation, and Entrepreneurship*, Springer, New York, 649-654.
- Basole, R., C. (2009). Visualization of interfirm relations in a converging mobile ecosystem. *Journal of Information Technology*, 24(2): 144-159.
- Bates, T. (2005). Analysis of young, small firms that have closed: delineating successful from unsuccessful closures. *Journal of Business Venturing*, Vol. 20, No. 3, pp.343–358.
- Bayarcelik, E., Taşel, F., & Apak, S. (2014). A Research on Determining Innovation Factors for SMEs. *Procedia - Social and Behavioral Sciences*. 150. 202-211. 10.1016/j.sbspro.2014.09.032.
- Bear, R., Rintoul, D., Snyder, B., Smith-Caldas, M., Herren, C., & Horne, E. (2013). Principles of Biology. OpenStax CNX. Available at: https://cnx.org/contents/24nI-KJ8@24.18:6Fi_eQmy@8/Ecology-of-Ecosystems.
- Belton, V., & Stewart, T. (2002). Multiple Criteria Decision Analysis. Springer. DOI: 10.1007/978-1-4615-1495-4.
- Beneki, C., & Giannias, D., & Moustakas, G. (2012). Innovation and economic performance: the case of Greek SMEs. *Regional and Sectoral Economic Studies*. 12. 43-54.
- Berrone, P., & Gertel, H., & Giuliodori, R., & Bernard, L., & Meiners, E. (2014). Determinants of Performance in Microenterprises: Preliminary Evidence from Argentina. *Journal of Small Business Management*. 52. 10.1111/jsbm.12045.
- Bhawe, N., & Zahra, S. A. (2017). Inducing heterogeneity in local entrepreneurial ecosystems: the role of MNEs. *Small Business Economics*, 1–18.
- Bilbao-Terol, A., Arenas-Parra, M. & Onopko-Onopko, V. (2019). Measuring regional sustainable competitiveness: a multi-criteria approach. *Operational Research International Journal* 19, 637–660. <https://doi.org/10.1007/s12351-017-0367-9>.
- Birley, S. (1984). Finding the new firm. *Proceedings of the Academy of Management*, Vol. 47, pp.64–68.
- Bitzenis, A., & Marangos, J., & Vlachos, V., A., & Astroulakis, N., & Meramveliotakis, G., & Tsitouras, A. (2011). Competitiveness, Entrepreneurship, and the Business Environment in Greece: Aspects from the EU South. Retrieved from: <https://johnmarangos.eu/wp-content/uploads/2014/10/LexingtonCompetitivenessChapt14.pdf>.
- Blenker, P., & Dreisler, P., & Faergemann, H., M., & Kjeldsen, J., I. (2004). Entrepreneurship education and university context. Available at: https://www.researchgate.net/publication/311457373_Entrepreneurship_education_and_university_context.
- Bloomberg Innovation Index. (2015). Available at: <https://www.bloomberg.com/graphics/2015-innovative-countries/>.
- Bölükbaş, U. and Güneri, A.F. (2017). A fuzzy multi-criteria decision approach for measuring technology competency performance of SMEs. *Sigma Journal of Engineering & Natural Sciences*.
- Bonini, S. ,& Capizzi, V. (2019). The role of venture capital in the emerging entrepreneurial finance ecosystem: future threats and opportunities, *Venture Capital*, 21:2-3, 137-175, DOI: 10.1080/13691066.2019.1608697.

- Bosma, N., & Kelley, D. (2018). *Global Entrepreneurship Monitor: 2018/2019 Global Report*. GEM.
- Bosma, N., & Wennekers, S., & Hessels, J. & Hunt, S. (2005). Early-stage entrepreneurial activity in the European Union: some issues and challenges. EIM Business and Policy Research, Scales Research Reports.
- Bosma, N., Wennekers, S., & Amorós, J-E. (2011). *2011 Extended Report: Entrepreneurs and Entrepreneurial Employees Across the Globe*. GEM.
- Branko, M., & Nikola, P. (2014). Measuring the quality of corporate governance in the banking sector of Bosnia and Herzegovina, *Economic Research-Ekonomska Istraživanja*, 27:1, 784-798, DOI: 10.1080/1331677X.2014.974338.
- Braunerhjelm, P. & Henrekson, M. (2012). Entrepreneurship, Institutions and Economic Dynamism: Lessons from a Comparison of the United States and Sweden. *Industrial and Corporate Change*, Volume 22, Number 1, pp. 107–130. doi:10.1093/icc/dts048.
- Bris, A. (2014). IMD releases its 2014 World Competitiveness Yearbook ranking, The US leads, Europe recovers, and big emerging markets struggle. Available at: <https://www.imd.org/research-knowledge/articles/com-may-2014/>.
- Brodo, J. A. (2002). Today's Ecosystem of E-Learning, Vice President, Marketing.
- Caliendo, M. & Kritikos, A. (2011). Searching for the Entrepreneurial Personality, IZA Discussion Paper, No. 5790, Bonn.
- Canare, T. (2018). The Effect of Ease of Doing Business on Firm Creation. *Annals of Economics and Finance*. 19. 555-584.
- Carayannis, E. G. & Bakouros, I., L. (2010). *Innovation and Entrepreneurship-Theory and Practice*. Athens, Greece: SOFIA.
- Carayannis, E. G. & Campbell, D. F. J. (2010). Triple helix, quadruple helix and quintuple helix and how do knowledge, innovation and the environment relate to each other? A proposed framework for a trans-disciplinary analysis of sustainable development and social ecology. *International Journal of Social Ecology Sustainable Development*, vol. 1, no. 1, pp. 41–69.
- Carayannis, E. G. (2001). *The Strategic Management of Technological Learning: Learning to Learn and Learning to Learn How-To-Learn As Drivers of Strategic Choice and Firm Performance in Global, Technology-Driven Markets*, Boca Raton, FL, USA: CRC Press.
- Carayannis, E. G. (2014a). Strategic Knowledge Arbitrage and Serendipity (SKARSE™) in Action, *Journal of the Knowledge Economy*, 5 (2), 203-211. Available at: <https://link.springer.com/article/10.1007/s13132-012-0142-3>.
- Carayannis, E. G., & Rakhmatullin, R. (2014b). The Quadruple/Quintuple Innovation Helixes and smart specialisation strategies for sustainable and inclusive growth in Europe and beyond, *Journal of the Knowledge Economy*, 5(2), 212-239.
- Carayannis, E. G., & Campbell, D. F. (2009). 'Mode 3' and 'Quadruple Helix': toward a 21st century fractal innovation ecosystem. *International Journal of Technology Management* 46 (3–4), 201–234.
- Carayannis, E. G., & Campbell, D. F. J. (2006). 'Mode 3': meaning and implications from a knowledge systems perspective', in Carayannis, E. G., & Campbell, D. F. J. (Eds): *Knowledge creation, diffusion and use in innovation networks and knowledge clusters: a comparative systems approach across the United States, Europe and Asia*, Praeger, Westport, Connecticut, pp. 1-25.
- Carayannis, E. G., & Campbell, D. F. J. (2011). Open Innovation Diplomacy and a 21st Century Fractal Research, Education and Innovation (FREIE) Ecosystem: Building on the

Quadruple and Quintuple Helix Innovation Concepts and the “Mode 3” Knowledge Production System. *Journal of the Knowledge Economy*, 2, 327 (2011). <https://doi.org/10.1007/s13132-011-0058-3>.

Carayannis, E.G., Sindakis, S. & Walter, C. (2015a). Business Model Innovation as Lever of Organizational Sustainability. *Journal of Technology Transfer*, 40, 85–104. <https://doi.org/10.1007/s10961-013-9330-y>.

Carayannis, E. G., Grigoroudis, E., & Pirounakis, D. (2015b). Quadruple Innovation Helix and Smart Specialization Knowledge Production and National Competitiveness. *Asia Pacific Tech-Monitor*, Vol. 33, No. 3, Jul-Sep 2015, Retrieved from: http://www.techmonitor.net/tm/images/d/d7/15jul_sep_sf2.pdf.

Carayannis, E. G., Grigoroudis, E., Campbell, D., Meissner, D., & Stamati, D. (2017). The ecosystem as helix: an exploratory theory-building study of regional co-opetitive entrepreneurial ecosystems as Quadruple/Quintuple Helix Innovation Models: The ecosystem as helix. *R&D Management*. 48(1), 148-162.

Carayannis, E. G., Grigoroudis, E., Stamati, D., & Valvi, T. (2019). Social Business Model Innovation: A Quadruple/Quintuple Helix-Based Social Innovation Ecosystem. *IEEE Transactions on Engineering Management*, 1-14.

Carayannis, E., & Grigoroudis, E. (2016). Quadruple Innovation Helix and Smart Specialization: Knowledge Production and National Competitiveness. *Foresight and STI Governance*, vol. 10, no 1, pp. 31–42. DOI: 10.17323/1995-459x.2016.1.31.42.

Carayannis, E.G. & Provance, M. (2008). Measuring firm innovativeness: towards a composite innovation index built on firm innovative posture, propensity and performance attributes. *International Journal of Innovation and Regional Development*, Vol. 1, No. 1, pp.90–107.

Carayannis, E.G., & Campbell, D. F. J. (2012). Mode 3 knowledge production in quadruple helix innovation systems: 21st-century democracy, innovation, and entrepreneurship for development, *SpringerBriefs in Business*, Springer, New York, NY.

Carayannis, E.G., & Provance, M. (2008). Measuring firm innovativeness: towards a composite innovation index built on firm innovative posture, propensity and performance attributes. *International Journal of Innovation and Regional Development*, Vol. 1, No. 1, pp.90–107.

Carayannis, E.G., Grigoroudis, E., Campbell, D.F.J., Meissner, D., & Stamati D. (2018). Mode 3 Universities and Academic Firms: Thinking Beyond the Box Trans-Disciplinarity and Non-Linear Innovation Dynamics within Co-opetitive Entrepreneurial Ecosystems. *International Journal of Technology Management* 77 (1-3), 145-185.

Cardoso da Silva, J. M., & Wheeler, E. (2017). Ecosystems as infrastructure, Perspectives in Ecology and Conservation, 15 (1), 32-35. Retrieved from: <https://www.sciencedirect.com/science/article/pii/S1679007316300767>.

Castañó-Martínez, M., S., & Méndez-Picazo, M., T. & Galindo-Martín, M., A. (2015). Policies to promote entrepreneurial activity and economic performance, *Management Decision*, Vol. 53 No. 9, pp. 2073-2087. <https://doi.org/10.1108/MD-06-2014-0393>.

Cavallo, A., Ghezzi, A. & Balocco, R. (2018). Entrepreneurial ecosystem research: present debates and future directions. *International Entrepreneurship and Management Journal*. 10.1007/s11365-018-0526-3.

Cavazza, F. (2012). An overview of the social media ecosystem. Available at: <https://www.forbes.com/sites/fredcavazza/2012/03/12/an-overview-of-the-social-media-ecosystem/#4f093e185e7d>.

- Centre of Entrepreneurial and Technological Development of Crete (CETD). (2004). Development Profile of the Region of Crete (in Greek).
- Ceresia, F., & Mendola, C. (2019). The Effects of Corruption in Entrepreneurial Ecosystems on Entrepreneurial Intentions. *Administrative Sciences*, 9, 88. 10.3390/admsci9040088.
- Chaharbaghi, K., Willis R., (1998). Strategy: The missing link between continuous revolution and constant evolution, *International Journal of Operations and Production Management*, 18(9/10), 1017-1027.
- Chant, J. (2008). Bank Lending and Entrepreneurial Finance: The Performance of Canadian Banks. Fraser Institute.
- Charron, N., & Lapuente, V. (2018). Quality of Government in EU Regions: Spatial and Temporal Patters. QoG Working Paper Series, 2018 (1), 1.
- Charron, N., & Lewis D., & Lapuente, V. (2015). Mapping the Regional Divide in Europe: A Measure for Assessing Quality of Government in 206 European Regions. *Social Indicators Research*. vol 122 (2): 315-346.
- Charron, N., & Lewis, D., & Lapuente, V. (2014). Regional Governance Matters: Quality of Government within European Union Member States, *Regional Studies*, 48(1): 68-90.
- Chinta, R., & Sussan, F. (2018). A Triple-Helix Ecosystem for Entrepreneurship: A Case Review. In O'Connor, A., Stam, E., Sussan, F., & Audretsch, D. B. (Eds). *Entrepreneurial ecosystems. Place-Based Transformations and Transitions* (pp. 45-66). NY: Springer. DOI: <https://doi.org/10.1007/978-3-319-63531-6>.
- Chowdhury, G., & Koya, K., & Philipson, P. (2016). Measuring the Impact of Research: Lessons from the UK's Research Excellence Framework 2014. *PLoS ONE* 11(6): e0156978. <https://doi.org/10.1371/journal.pone.0156978>.
- Clarysse, B., Wright, M., Bruneel, J., & Mahajan, A. (2014). Creating value in ecosystems: Crossing the chasm between knowledge and business ecosystems, *Research Policy*, 43 (7), 1164-1176, Retrieved from: <https://www.sciencedirect.com/science/article/pii/S0048733314000766>.
- Colombo, M. G., & Murtinu, S. (2017). Venture capital investments in Europe and portfolio firms' economic performance: Independent versus corporate investors. *Journal of Economics and Management Strategy*, 26(1), 35–66.
- Conte, A. & Schweizer, P. & Dierx, A. & Ilzkovitz, F. (2009). An analysis of the efficiency of public spending and national policies in the area of R&D. University Library of Munich, Germany, MPRA Paper.
- Cooke P. (2007). Regional Innovation, Entrepreneurship and Talent Systems. *International Journal of Entrepreneurship and Innovation Management* 7(2):117-139.
- Cooke, P. (2001). Regional Innovation Systems, Clusters, and the Knowledge Economy. *Industrial and Corporate Change* 10: 945-974.
- Cooke, P., Uranga, M. G., & Etxebarria, G. (1997). Regional innovation systems: Institutional and organisational dimensions. *Research policy*, 26(4-5), 475–491.
- Cornell University, INSEAD, & WIPO. (2018). The Global Innovation Index 2018: Energizing the World with Innovation. Ithaca, Fontainebleau, and Geneva.
- Corrente, S., Greco, S., Nicotra, M., Romano, M. & Schillaci, C. (2018). Evaluating and comparing entrepreneurial ecosystems using SMAA and SMAA-S. *The Journal of Technology Transfer*. 10.1007/s10961-018-9684-2.
- Coughlan, T. (2014). Enhancing Innovation through Virtual Proximity. *Technology Innovation Management Review*, 4(2), 17–22. <http://timreview.ca/article/765>.

Council on Competitiveness. (2007). Asset Mapping Roadmap: A Guide to Assessing Regional Development Resources. Retrieved from: <https://www.compete.org/storage/Illuminate3.pdf>.

Cox, P. & Khan, R. (2017). Country Culture and National Innovation. Archives of Business Research. 5. 85-101. 10.14738/abr.52.2768.

Crudu, R. (2019). The Role of Innovative Entrepreneurship in the Economic Development of EU Member Countries. Journal of Entrepreneurship, Management and Innovation. 15. 35-60. 10.7341/20191512.

Daniel, L., Medlin, C., J, O'Connor, A., Statsenko, L., Vnuk, R., & Hancock, G. (2018). Deconstructing the Entrepreneurial Ecosystem Concept. In O'Connor, A., Stam, E., Sussan, F., & Audretsch, D. B. (Eds). *Entrepreneurial ecosystems. Place-Based Transformations and Transitions* (pp. 45-66). NY: Springer. DOI: <https://doi.org/10.1007/978-3-319-63531-6>.

Davey, T. & Galan-Muros, V. (2016). The importance of an entrepreneurial ecosystem for creating systemic entrepreneurship. Entrepreneurship Ecosystem Research Network. DOI: 10.13140/RG.2.2.12641.92001.

Davidsson, P. (1995). Culture, structure and regional levels of entrepreneurship, Entrepreneurship & Regional Development: An International Journal, 7:1, 41-62, <http://dx.doi.org/10.1080/08985629500000003>.

Davidsson, P. (2004). Researching Entrepreneurship. New York: Springer Verlag.

Dedehayir, O., Mäkinen, S. J. & Roland O, J. (2018). Roles during innovation ecosystem genesis: A literature review. Technological Forecasting and Social Change, Elsevier, Vol. 136(C), pages 18-29.

DeFries, R., Nagendra, H. (2017). Ecosystem management as a wicked problem. Science 356 (6335), 265–270. <http://doi.org/10.1126/science.aal1950>.

Del Monte-Luna, P., Brook, B. W., Zetina-Rejón, M. J., & Cruz-Escalona, V., H. (2004). The carrying capacity of ecosystems. Global Ecology and Biogeography, 13, 485-495. Retrieved from: <https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.1466-822X.2004.00131.x>.

Dennis, W. J., Jr. (1997). More than you think: an inclusive estimate of business entries. Journal of Business Venturing, Vol. 12, May, pp.175–196.

Dennis, W. J., Jr. (1999). Business starts and stops. Wells Fargo/NFIB Series, Washington, DC: The NFIB Education Foundation, November.

Di Cintio, M., & Ghosh, S., & Grassi, E. (2017). Firm growth, R&D expenditures and exports: An empirical analysis of italian SMEs. Research Policy. 46. 836-852. 10.1016/j.respol.2017.02.006.

Doğan, E. (2016). The effect of innovation on competitiveness. Ekonometri ve İstatistik Sayı:24 2016 60-81.

doingbusiness.org. (n.d.). Doing Business - World Bank Group Entrepreneurship Survey <http://www.doingbusiness.org/data/exploretopics/entrepreneurship>.

Dubina, I. N., Campbell, D. F., Carayannis, E. G., Chub, A. A., Grigoroudis, E., & Kozhevina, O. V. (2017). The Balanced Development of the Spatial Innovation and Entrepreneurial Ecosystem Based on Principles of the Systems Compromise: A Conceptual Framework. Journal of the Knowledge Economy, 8(2), 438–455.

Dybas, C. (2007). Stability and Diversity in Ecosystems. National Science Foundation - Where Discoveries Begin. Available at: https://www.nsf.gov/discoveries/disc_summ.jsp?org=NSF&cntn_id=109766&preview=false.

- Dzienis, A.M., & Kowalski, A., & Lachowicz, M., & Maćkiewicz, M., & Napiórkowski, T.M., & Weresa, M. A. (2019). A Study on Structural Reform in Poland 2013-2018. Competitiveness Report.
- Efthymoulou, G., & Vahter, P. (2016). Financial Constraints, Innovation Performance and Sectoral Disaggregation. *Manchester School*, University of Manchester, vol. 84(2), pages 125-158.
- Eisenhardt, K. M., & Galunic, D. C. (2000). Coevolving: at last, a way to make synergies work. *Harvard Business Review*. 78 (1), 91–102.
- Ellis, E. (2008). “Ecosystem”. In: *Encyclopedia of Earth*. Eds. Cutler J. Cleveland. Washington, D.C.: Environmental Information Coalition, National Council for Science and the Environment. Retrieved from: <http://www.eoearth.org/article/Ecosystem>.
- Eniscuola.net. (2013). The agricultural ecosystem. Available at: <http://www.eniscuola.net/en/argomento/what-is-an-ecosystem/the-agroecosystem/the-agricultural-ecosystem/>.
- Esser, F. C. (2007). The Link Between Innovation Performance and Governance. Office for Official Publications of the European Communities, Luxembourg.
- Ester, P., & Román, A. I. (2017). A generational approach to female entrepreneurship in Europe. *Journal of Women’s Entrepreneurship and Education*. No. 3-4, 1-27.
- Etzkowitz, H., & Leydesdorff, L. (2000). The dynamics of innovation: from national systems and ‘Mode 2’ to a triple helix of university-industry-government relations. *Research Policy*. 29 (2), 109–123.
- European Commission. (2015). Open Innovation 2.0, European Union, Brussels, available at: <https://ec.europa.eu/digital-single-market/en/open-innovation-20>.
- European Commission. (2012a). Effects and impact of entrepreneurship programmes in higher education. Available at: https://ec.europa.eu/growth/content/effects-and-impact-entrepreneurship-programmes-higher-education-0_en.
- European Commission. (2012b). Flash Eurobarometer 354 ENTREPRENEURSHIP IN THE EU AND BEYOND Report. Retrieved from: http://ec.europa.eu/commfrontoffice/publicopinion/flash/fl_354_en.pdf.
- European Commission. (2013a). Mapping and Assessment of Ecosystems and their Services. Retrieved from http://ec.europa.eu/environment/nature/knowledge/ecosystem_assessment/pdf/MAESWorkingPaper2013.pdf.
- European Commission. (2013b). REDI: The Regional Entrepreneurship and Development Index – Measuring regional entrepreneurship Final report. Retrieved from: http://ec.europa.eu/regional_policy/el/information/publications/studies/2014/redi-the-regional-entrepreneurship-and-development-index-measuring-regional-entrepreneurship.
- European Commission. (2017). Annual Report on European SMEs 2016/2017 Focus on self-employment SME Performance Review 2016/2017. Retrieved from: <https://www.ggb.gr/sites/default/files/basic-page-files/Annual%20Report%20-%20EU%20SMEs%202016-2017.pdf>.
- European Commission. (2018a). European Innovation Scoreboard. Available at: http://ec.europa.eu/growth/industry/innovation/facts-figures/scoreboards_el.
- European Commission. (2018b). Regional Innovation Scoreboard. Available at: http://ec.europa.eu/growth/industry/innovation/facts-figures/regional_en.
- European Commission. (2018c). Innobarometer. Available at: http://ec.europa.eu/growth/industry/innovation/facts-figures/innobarometer_en.

- European Commission. (2018d). SME Performance Review. Available at: https://ec.europa.eu/growth/smes/business-friendly-environment/performance-review_en.
- European Commission. (2019). ANNUAL REPORT ON EUROPEAN SMEs 2018/2019 Research & Development and Innovation by SMEs SME Performance Review 2018/2019. Available at: https://ec.europa.eu/growth/smes/business-friendly-environment/performance-review_en.
- European Commission. (2021). Labour market information: Kriti. Available at: <https://ec.europa.eu/eures/main.jsp?catId=378&countryId=GR&acro=Imi&lang=en®ionId=GR4&nuts2Code=GR43&nuts3Code=®ionName=Kriti>.
- European Commission. (n.d.). Internal Market, Industry, Entrepreneurship and SMEs: Stockholm. Available at: <https://ec.europa.eu/growth/tools-databases/regional-innovation-monitor/base-profile/stockholm>.
- European Commission/EACEA/Eurydice/Cedefop. (2014). Tackling Early Leaving from Education and Training in Europe: Strategies, Policies and Measures. Eurydice and Cedefop Report. Luxembourg: Publications Office of the European Union. Retrieved from: https://eacea.ec.europa.eu/national-policies/eurydice/content/tackling-early-leaving-education-and-training-europe-strategies-policies-and-measures_en.
- Eurostat. (2019). Quality of life indicators - material living conditions. Available at: https://ec.europa.eu/eurostat/statistics-explained/index.php/Quality_of_life_indicators_-_material_living_conditions#Risk_of_poverty.
- eurostat. (n.d.). Community Innovation Survey. Available at: <http://ec.europa.eu/eurostat/web/microdata/community-innovation-survey>.
- Exporters' Association of Crete. (n.d.). Export activity of Crete. Available at: <https://www.crete-exporters.com/en/category/actions/>.
- Fadel, J. & Qazi, R. (2015). Improving the Business Regulatory Environment for Entrepreneurs and SMEs in Qatar. Retrieved from: <https://freit.org/WorkingPapers/Papers/PoliticalEconomy/FREIT914.pdf>.
- Feld, B. (2012). Startup Communities: Building an Entrepreneurial Ecosystem in Your City (New York, NY: Wiley).
- Fernández-Serrano, J., Martínez-Román, J., A. & Romero, I. (2019). The entrepreneur in the regional innovation system. A comparative study for high and low-income regions, *Entrepreneurship & Regional Development*, 31:5-6, 337-356, doi:10.1080/08985626.2018.1513079.
- Fetters, M. L., Greene, P. G., Rice, M. P., & Butler, J. S. (2010). The Development of University-Based Entrepreneurship Ecosystems. Edward Elgar, Cheltenham UK.
- Figueira, J., R., & Greco, S., & Matthias, E. (2016). Introduction. In Figueira, J., R. & Greco, S., & Matthias, E. (Eds.). *Multiple Criteria Decision Analysis*. DOI: 10.1007/978-1-4939-3094-4.
- Florida, R. (2004). The Rise of the Creative Class: And how it's Transforming Work, Leisure, Community, and Everyday Life, Basic Books, Cambridge, MA.
- Frenken, K., Saviotti, P. P., & Trommetter, M. (1999). Variety and niche creation in aircraft, helicopters, motorcycles and mini computers. *Research Policy*. 28, 469–488.
- Frenz, M. & Ietto-Gillies, G. (2009). The impact on innovation performance of different sources of knowledge: Evidence from the UK Community Innovation Survey. *Research Policy*. 38. 1125-1135. 10.1016/j.respol.2009.05.002.

- Friedman, B.A. (2011). The Relationship between Governance Effectiveness and Entrepreneurship. *International Journal of Humanities and Social Science* Vol. 1 No. 17, p. 221.
- Fuchs, K., & Werner, A., & Wallau, F. (2008). Entrepreneurship education in Germany and Sweden: what role do different school systems play? *Journal of Small Business and Enterprise Development*. 15:2, 365–38, <http://dx.doi.org/10.1108/14626000810871736>.
- Fuentelsaz, L., Maícas, J. P., & Mata, P. (2018). Institutional Dynamism in Entrepreneurial Ecosystems. In O'Connor, A., Stam, E., Sussan, F., & Audretsch, D. B. (Eds). *Entrepreneurial ecosystems. Place-Based Transformations and Transitions* (pp. 45-66). NY: Springer. DOI: <https://doi.org/10.1007/978-3-319-63531-6>.
- Galvão, A., R., Mascarenhas, C., Rodrigues, R., Marques, C., S., & Leal, C. T. (2017). A quadruple helix model of entrepreneurship, innovation and stages of economic development. *Review of International Business and Strategy*, Vol. 27 Issue: 2, doi: 10.1108/RIBS-01-2017-0003.
- Ganaie, Maryam, & Murchant, H. & Akram, S. & Khan, M. (2011). IMPACT OF SME ENTREPRENEUR'S EDUCATION ON QUALITY OF DOING BUSINESS IN PAKISTAN. Retrieved from: https://www.researchgate.net/publication/330135451_IMPACT_OF_SME_ENTREPRENEUR'S_EDUCATION_ON_QUALITY_OF_DOING_BUSINESS_IN_PAKISTAN.
- Garcia-Bernabeu, A., Cabello, J. & Ruiz, F. (2020). A Multi-Criteria Reference Point Based Approach for Assessing Regional Innovation Performance in Spain. *Mathematics*. 8. 797. 10.3390/math8050797.
- Gartner, W. B. (1985). A conceptual framework for describing the phenomenon of new venture creation. *Academy of Management Review*, 10(4), 696–706.
- Geller, G., & Glücklich, D. (eds.) (2012). *Sustainable Rural and Urban Ecosystems: Design, Implementation and Operation*, doi: 10.1007/978-3-642-28261-4_2.
- Gleick, J. (1987). *Chaos: Making a New Science*, Viking Press, New York.
- Gonçalves, J. M., Ferreira, F. A. F., Ferreira, J. J. M. & Farinha, L. M. C. (2018). A multiple criteria group decision-making approach for the assessment of small and medium-sized enterprise competitiveness, *Management Decision*, <https://doi.org/10.1108/MD-02-2018-0203>.
- González-Rodríguez, D., & Vieira, M., J., & Vidal, J. (2019). Factors that influence early school leaving: a comprehensive model, *Educational Research*, 61:2, 214-230, DOI: 10.1080/00131881.2019.1596034. Retrieved from: <https://www.tandfonline.com/doi/full/10.1080/00131881.2019.1596034>.
- Gössling, T. & Rutten, R. (2007). Innovation in Regions, *European Planning Studies*, 15:2, 253-270, DOI: 10.1080/09654310601078788.
- Goudriaan, T.C. (2016). *Startups and Funding A comparative analysis of Amsterdam and Stockholm*. Available at: <http://dspace.library.uu.nl/handle/1874/337349>.
- Granstrand, O., & Holgersson, M. (2020). Innovation ecosystems: A conceptual review and a new definition, *Technovation*, Volumes 90–91, 102098, ISSN 0166-4972, <https://doi.org/10.1016/j.technovation.2019.102098>.
- Grumbine, R. E., (1994). What is ecosystem management? *Conservation Biology*, 8 (1), 27–38. <https://doi.org/10.1046/j.1523-1739.1994.08010027.x>.
- Gupta, H. & Barua, M. (2016). Identifying enablers of technological innovation for Indian MSMEs using best–worst multi criteria decision making method. *Technological Forecasting and Social Change*. 107. 10.1016/j.techfore.2016.03.028.

- Gupta, H. & Barua, M. (2017). A novel hybrid multi-criteria method for supplier selection among SMEs on the basis of innovation ability, *International Journal of Logistics Research and Applications*, DOI: 10.1080/13675567.2017.1382457.
- Hadzic, M., & Sidhu, A. (2008). Digital health ecosystems, in: *Second IEEE International Conference on Digital Ecosystems and Technologies*, Thailand, pp. cv–cvii. Retrieved from: <http://ieeexplore.ieee.org/abstract/document/4635233/>.
- Halinen, A., & Törnroos, J. Å. (2005). Using Case Methods in the Study of Contemporary Business Networks. *Journal of Business Research*, 58(9), 1285–1297. <http://dx.doi.org/10.1016/j.jbusres.2004.02.001>.
- Harel, R., & Schwartz, D., & Kaufmann, D. (2019). Small businesses are promoting innovation!! Do we know this? *Small Enterprise Research*, 26:1, 18-35, <https://doi.org/10.1080/13215906.2019.1569552>.
- Harris, A. (2017). Types of Environmental Ecosystems. Available at: <https://sciencing.com/types-environmental-ecosystems-8640.html>.
- Harrison, T. M. Pardo, T. A. Cook, M. (2012). Creating Open Government Ecosystems: A Research and Development Agenda. *Future Internet*, 4, 900-928. Retrieved from: https://www.ctg.albany.edu/publications/journals/og_ecosystems_2012/og_ecosystems_2012.pdf.
- Hasgall, A., & Saenen, B., & Borrell-Damian, L. (2019). Doctoral education in Europe today: approaches and institutional structures. Available at: <https://eua.eu/resources/publications/809:doctoral-education-in-europe-today-approaches-and-institutional-structures.html>.
- Hechavarría, D. M., & Ingram, A. E. (2019). Entrepreneurial ecosystem conditions and gendered national-level entrepreneurial activity: A 14-year panel study of GEM. *Small Business Economics*, 53(2), 431–458. <https://doi.org/10.1177/1042258721998948>.
- Herman, E. (2018). Innovation and entrepreneurship for competitiveness in the EU: an empirical analysis, *Proceedings of the International Conference on Business Excellence*, Sciendo, vol. 12(1), pages 425-435.
- Heyman, F., & Norbäck, P., J., & Persson, L., & Andersson, F. (2019). Has the Swedish business sector become more entrepreneurial than the US business sector? *Research Policy*, Elsevier, vol. 48(7), pages 1809-1822. doi: 10.1016/j.respol.2019.04.007.
- Hogeforster, M. (2014). Future Challenges for Innovations in SMEs in the Baltic Sea Region, *Procedia - Social and Behavioral Sciences*, Volume 110, Pages 241-250, ISSN 1877-0428, <https://doi.org/10.1016/j.sbspro.2013.12.867>.
- Hollanders, H. (2009). Measuring Innovation: The European Innovation Scoreboard. In E. Villalba (Ed.). *Measuring creativity: Proceedings for the conference, “Can creativity be measured?”* Brussels, May 28-29.
- Hözl, W. (2016). High growth firms in Europe. Retrieved from: https://www.researchgate.net/publication/320831020_High_growth_firms_in_Europe.
- Hsiao, P. & Li, D. (2012). What is a good investment measure?. *Investment Management and Financial Innovations*. 9. 8-19.
- Hu, M. W. & Schive, C. (1996). The Market Shares of Small and Medium Scale Enterprises in Taiwan Manufacturing. *Asian Economic Journal*, 9: 117-131. doi:10.1111/j.1467-8381.1995.tb00027.x.
- Huang, C., & Arundel, A. & Hollanders, H. (2010). How Firms Innovate: R&D, Non-R&D, and Technology Adoption, MERIT Working Papers 2010-027, United Nations University - Maastricht Economic and Social Research Institute on Innovation and Technology (MERIT).

- Huang, P. H., & Moh, T. Tsieng. (2016). A non-linear non-weight method for multi-criteria decision making. *Annals of Operations Research*, 1–13. doi:10.1007/s10479-016-2208-2.
- Hung, C.C., & Chen, L.H. (2009). A Fuzzy TOPSIS Decision Making Model with Entropy Weight under Intuitionistic Fuzzy Environment. *Proceedings of the International Multi-Conference of Engineers and Computer Scientists IMECS*, Hong Kong.
- Hwang C. L., & Yoon K. (1981). *Multiple Attribute Decision Making: Methods and Applications*. Springer-Verlag, Berlin.
- Iansiti, M., & Levien, R. (2004). Strategy as ecology. *Harvard Business Review*, 82 (3), 68–81.
- IMF Data. (n.d.). Available at: <http://www.imf.org/en/Data>.
- Isenberg, D. J. (2011a). Introducing the Entrepreneurship Ecosystem: Four Defining Characteristics. Available at: <http://www.forbes.com/sites/danisenberg/2011/05/25/introducing-the-entrepreneurship-ecosystem-four-defining-characteristics/#5ee0b6f438c4>.
- Isenberg, D. (2011b). The entrepreneurship ecosystem strategy as a new paradigm for economy policy: principles for cultivating entrepreneurship. Babson Entrepreneurship Ecosystem Project. Babson College, Babson Park.
- Isenberg, D. (2014). What an Entrepreneurship Ecosystem Actually Is. *Harvard Business Review*. Available at: <https://hbr.org/2014/05/what-an-entrepreneurial-ecosystem-actually-is>.
- Isenberg, D. J. (2010). How to start an entrepreneurial revolution. *Harvard Business Review*. 88 (6), 40–50.
- Ivanová E., & Masárová J. (2016). Assessment of innovation performance of Slovak regions, *Journal of International Studies*, Vol. 9, No 2, pp. 207-218. DOI: 10.14254/2071-8330.2016/9-2/16.
- Jackson, D. J. (2011). What is an Innovation Ecosystem? National Science Foundation, Arlington, VA. Retrieved from: http://erc-assoc.org/sites/default/files/topics/policy_studies/DJackson_Innovation%20Ecosystem_03-15-11.pdf.
- Janićijević, N. & Bogićević Milikić, B. (2010). Organizational growth of SMEs in Serbia: Governance as a built-in limiting growth factor. *Sociologija*. 52. 10.2298/SOC1002167J.
- Jankowska, B., Matysek-Jędrych, A., & Mroczek-Dąbrowska, K. (2017). Efficiency of National Innovation Systems – Poland and Bulgaria in The Context of the Global Innovation Index. *Comparative Economic Research*. 20. 10.1515/cer-2017-0021.
- Jones, C., Lawton, J., & Shachak, M. (1994). Organisms as Ecosystem Engineers. *Oikos*, 69(3), 373-386. Retrieved from: http://webpages.fc.ul.pt/~vlamaral/EXPL_MAR-EST_1226_2013_files/7-Jones%201994.pdf.
- Joueid, A. & Coenders, G. (2018). Marketing Innovation and New Product Portfolios. A Compositional Approach. *Journal of Open Innovation: Technology, Market, and Complexity*. 4. 10.3390/joitmc4020019.
- Justo, R., De Castro, J. O. & Maydeu-Olivares, A. (2008). Indicators of entrepreneurship activity: some methodological contributions. *International Journal of Entrepreneurship and Small Business*, Vol. 6, No. 4, pp.604–621.
- Kabadurmus, O. & Kabadurmus, F. N. K. (2019). Innovation in Eastern Europe & Central Asia: A Multi-Criteria Decision-Making Approach, *BMIJ*, (2019), 7(3): 1-22 doi: <http://dx.doi.org/10.15295/bmij.v7i3.1234>.
- Kakouris, A. (2007). On a Distance-Learning Approach on ‘Train the Trainers’ in Entrepreneurial Education in Greece. *Theoretical Considerations Supported by Students’*

Response as Observed from the Career Office of the University of Athens. 2nd European Conference on Entrepreneurship and Innovation, Academic Conferences Limited., Reading, UK, November, pp 75-80.

Kakouris, A., & Apostolopoulos, N., & Dermatis, Z., & Komninos, D., & Liargovas, P. (2017, 31 August- 1 September). Exploring the gender gap in the entrepreneurial efficacy and intention in Greece. International Conference for Entrepreneurship, Innovation and Regional Development. University-Industry Links: Coproducing Knowledge, Innovation & Growth. Thessaloniki, Greece. Retrieved from: https://www.researchgate.net/publication/339458585_Inclusive_Business_Phenomenon.

Kamariotou, M., Kitsios, F. & Grigoroudis, E. (2018). Strategic Decision Making using Multicriteria Analysis: Information Systems Performance Evaluation in Greek SMEs, 7th International Symposium and 29th National Conference on Operational Research, Chania, Crete, Greece, pp. 184-188.

Kanellos, N., S. (2013). Exploring the Characteristics of Knowledge-based Entrepreneurs in Greece, Procedia - Social and Behavioral Sciences, doi: <https://doi.org/10.1016/j.sbspro.2013.02.060>.

Kang, Q., & Li, H., Cheng, Y., & Kraus, S. (2019). Entrepreneurial ecosystems: analyzing the status quo, Knowledge Management Research & Practice, DOI: 10.1080/14778238.2019.1701964.

Kansheba, J. M. P. & Wald, A. E. (2020). Entrepreneurial ecosystems: a systematic literature review and research agenda, Journal of Small Business and Enterprise Development, Vol. 27 No. 6, pp. 943-964. <https://doi.org/10.1108/JSBED-11-2019-0364>.

Kanter, R. M. (2012). Enriching the ecosystem. Harvard Business Review. 90 (3), 140–147.

Kaplanoglou, G., Rapanos, V. T., & Daskalakis, N. (2016). Tax compliance behaviour during the crisis: The case of Greek SMEs. European Journal of Law and Economics, 42(3), 405–444.

Karanassios, N., Pazarskis, M., Mitsopoulos, K., & Christodoulou, P. (2006). EU Strategies to Encourage Youth Entrepreneurship: Evidence from Higher Education in Greece. Industry and Higher Education, 20(1), 43–50. <https://doi.org/10.5367/000000006776150747>.

Karlsson, C., & Olsson, O. (1998). Product Innovation in Small and Large Enterprises. Small Business Economics, 10(1), 31-46. Retrieved July 24, 2020, from www.jstor.org/stable/40228568.

Kaynak, S., Altuntas, S. & Dereli, T. (2017). Comparing the innovation performance of EU candidate countries: an entropy-based TOPSIS approach, Economic Research-Ekonomska Istraživanja, 30:1, 31-54, DOI: 10.1080/1331677X.2016.1265895.

Kelessidis VC. (2013). Enabling engineering students to become successful innovators and entrepreneurs, QScience Proceedings (World Congress on Engineering Education 2013) 2014:13 <http://dx.doi.org/10.5339/qproc.2014.wcee2013.13>.

Kelessidis, V., C., & Samoladas, V., Grigoroudis, E., & Matsatsinis, N., & Moustakis, V., & Zopounidis, K., & Mpanani, N. (2012, 17-19 May). Training University students on entrepreneurship via virtual platforms: The case of Technical University of Crete. International Conference on International Business 2012 Proceedings. Thessaloniki, Greece.

Kitsios, F., & Sitaridis, I. (2017). An application of non-weight MCDM for the evaluation of GEM entrepreneurial ecosystems. Proceedings of 6th International Symposium and 28th National Conference on Operational Research, Thessaloniki, Greece, pp. 35-39.

Klapper, L., Amit, R. & Guillén, M. F. (2010). Entrepreneurship and Firm Formation across Countries in NBER book International Differences in Entrepreneurship, Josh Lerner and

Antoinette Schoar, editors (p. 129 - 158) Conference held February 1-2, 2008 Published in May 2010 by University of Chicago Press, by the National Bureau of Economic Research.

Klimas, P., & Czakon, W. (2021). Species in the wild: a typology of innovation ecosystems. Review of Managerial Science. DOI: <https://doi.org/10.1007/s11846-020-00439-4>.

Klinka, K. (2008). Ecosystem (Site) Classification: Principles, Concepts, Rationale, System, And Its Development; Application in Forest Resources Management. Retrieved from: <http://www.coford.ie/media/coford/content/eventspresentations/events2008/siteclassification/Ecosystem%20site%20classification.pdf>.

Koening, G. (2012). Business Ecosystems Revisited. Management, 15(2): 208–224.

Koltai & Co. LLC. (n.d.). International entrepreneurship ecosystem development. Available at: <https://www.koltai.co/>.

Kuckertz, A. (2019). Let's take the entrepreneurial ecosystem metaphor seriously!, Journal of Business Venturing Insights, Volume 11, <https://doi.org/10.1016/j.jbvi.2019.e00124>.

Lassithiotaki, A. (2011). Rural Women And Entrepreneurship: A Case Study In Heraklion Crete Prefecture, Greece. Journal of Developmental Entrepreneurship (JDE), World Scientific Publishing Co. Pte. Ltd., vol. 16(02), pages 269-284. doi: 10.1142/S1084946711001835.

Latuszynska, A. (2014). Multiple-Criteria Decision Analysis Using TOPSIS Method For Interval Data In Research Into The Level Of Information Society Development, Folia Oeconomica Stetinensia, 13(2), 63-76. doi: <https://doi.org/10.2478/fofi-2013-0015>.

Lee, N. (2011). Are Innovative Regions More Unequal? Evidence from Europe. Environment and Planning C: Government and Policy, 29(1), 2–23. <https://doi.org/10.1068/c1046r>.

Levin, S.A. (1998). Ecosystems and the biosphere as complex adaptive systems. Ecosystems 1, 431–436. Retrieved from: <https://link.springer.com/article/10.1007%2Fs100219900037>.

Lewin, A. Y., & Volberda, H. W. (1999). Prolegomena on coevolution: A framework for research on strategy and new organizational forms. Organization Science, 10(5): 519-534.

Li, J.F., & Garnsey, E., (2014). Policy-driven ecosystems for new vaccine development. Technovation. 34 (12), 762–772.

Li, Y. R. (2009). The technological roadmap of Cisco's business ecosystem, Technovation, 29 (5), 379-386, Retrieved from: <https://www.sciencedirect.com/science/article/pii/S0166497209000157>.

Lindberg, E., & Bohman, H., & Hulten, P. (2017). Methods to enhance students' entrepreneurial mindset: a Swedish example. European Journal of Training and Development, <https://doi.org/10.1108/EJTD-10-2016-0078>.

Lindeman, R. (1942). The Trophic-Dynamic Aspect of Ecology. Ecology, 23(4), 399-417. doi:10.2307/1930126.

Lindholm Dahlstrand, Å. (2007). Technology-based entrepreneurship and regional development: The case of Sweden. European Business Review. 19. 373-386. 10.1108/09555340710818969.

Lindholm Dahlstrand, Å., & Cetindamar, D. (2000). The dynamics of innovation financing in Sweden, Venture Capital, 2:3, 203-221, doi:10.1080/13691060050135082.

Lindqvist, M. & Baltzopoulos, A. (2011). Regional Innovation Monitor: Regional Innovation Report (Stockholm). Retrieved from: <https://archive.nordregio.se/en/Publications/index.html>.

Long, R. D., Charles, A., & Stephenson, R. L. (2015). Key principles of marine ecosystem-based management. Marine Policy. 57, 53–60. <http://doi.org/10.1016/j.marpol.2015.01.013>.

Lugo, A. E., Brown, S., Dodson, R., Smith, T. S., & Shugart. H. H. (1999). The Holdridge Life Zones of the Conterminous United States in Relation to Ecosystem Mapping. Journal of

Biogeography 26:1025-1038. Retrieved from:
https://www.fs.fed.us/global/iitf/pubs/ja_iitf_1999_lugo002.pdf.

MacQueen, J. (1967). Some Methods for Classification and Analysis of Multivariate Observations. In *Proceedings Fifth Berkeley Symposium Mathematics Statistics and Probability*. Vol. 1. Berkeley, CA 281-297.

Malecki, E. J. (2018). Entrepreneurship and Entrepreneurial Ecosystems. *Geography Compass*, 12 (3), e12359, 2018, DOI: 10.1111/gec3.12359.

Mañez, J., A., & Rochina-Barrachina, M., E., & Sanchis-Llopis, J., A. & Sanchis-Llopis, A. (2011). On The Role Of Process Innovations On Smes Productivity Growth?, Working Papers 1125, Department of Applied Economics II, Universidad de Valencia.

Maradana, R.P., Pradhan, R.P., Dash, S. et al. (2017). Does innovation promote economic growth? Evidence from European countries. *Journal of Innovation and Entrepreneurship* 6, 1 <https://doi.org/10.1186/s13731-016-0061-9>.

Markatou, M. (2011). Innovation and Knowledge Creation in Greece: An Analysis Based on Patent Data. *Journal of Innovation and Business Best Practice*. 10.5171/2011.205033.

Markatou, M. (2012). The Role and the Importance of the Greek SMEs in the Production of Innovation. *Journal of Innovation and Business Best Practice*. 10.5171/2012.268692.

Markman, A. (2012). How to Create an Innovation Ecosystem. Available at: <https://hbr.org/2012/12/how-to-create-an-innovation-ec>.

Mason, C., & Brown, R. (2014). Entrepreneurial ecosystems and growth oriented entrepreneurship, OECD LEED Programme, available at: <http://www.oecd.org/cfe/leed/entrepreneurial-ecosystems.pdf>.

Matthews, R. S., Chalmers, D. M., & Fraser, S. S. (2018). “The intersection of entrepreneurship and selling: an interdisciplinary review, framework, and future research agenda”, *Journal of Business Venturing*, Vol. 33 No. 6, pp. 691-719.

Mazzarol, T., & Clark, D., N., & Reboud, S. (2014). Strategy in action: Case studies of strategy, planning and innovation in Australian SMEs, *Small Enterprise Research*, 21:1, 54-71, <https://doi.org/10.1080/13215906.2014.11082076>.

Meng, Y., Y. & Ma, Y., T. (2018). Innovation Ecosystem Analysis 1986-2017: A Citation-Based Literature Survey. *American Journal of Industrial and Business Management* , 8, 2231-2255. <https://doi.org/10.4236/ajibm.2018.811149>.

Merry, U. (1999). Organizational strategy on different landscapes: A new science approach. *Systemic Practice and Action Research*, 12(3): 257-278.

Messerschmitt, D., & Szyperski, C. (2003). *Software ecosystem: understanding an indispensable technology and industry*. MIT Press Books. Retrieved from: <https://mitpress.mit.edu/books/software-ecosystem>.

Micheels, E., T. & Gow, H., R. (2012). The value of a positional advantage for agricultural SMEs, *Small Enterprise Research*, 19:2, 54-73, <https://doi.org/10.5172/ser.2012.19.2.54>.

Milinkovich, M. (2008). TIM Lecture Series: A Practitioners Guide to Ecosystem Development. Open Source Business Resource, October 2008: 40–42. <http://timreview.ca/article/200>.

Miller, D. J., & Acs, Z. J. (2017). The campus as entrepreneurial ecosystem: the University of Chicago. *Small Business Economics*, 1–21.

Montresor, S. & Vezzani, A. (2016). Intangible investments and innovation propensity: Evidence from the Innobarometer 2013, *Industry and Innovation*, DOI: 10.1080/13662716.2016.1151770.

- Moore, J. F. (1993). Predators and prey: a new ecology of competition. *Harvard Business Review*, 71 (3), 75–86. Retrieved from: https://www.researchgate.net/publication/13172133_Predators_and_Prey_A_New_Ecology_of_Competition.
- Moore, J. F. (1996). *The Death of Competition: Leadership and Strategy in the Age of Business Ecosystems*. Harper Business, New York, NY.
- Mujahid, S., Mubarik, S. & Naghavi, N. (2019). Prioritizing dimensions of entrepreneurial ecosystem: a proposed framework. *Journal of Global Entrepreneurship Research* 9, 51, <https://doi.org/10.1186/s40497-019-0176-0>.
- Munda, G. (2008). *Social multi-criteria evaluation for a sustainable economy*. Springer, Berlin.
- Nählinder, J. (2005). Innovation and Employment in Services: The case of Knowledge Intensive Business Services in Sweden. Available at: https://www.researchgate.net/publication/279439819_Innovation_and_Employment_in_Services_The_case_of_Knowledge_Intensive_Business_Services_in_Sweden.
- Nambisan, S., & Baron, R. A. (2013). Entrepreneurship in innovation ecosystems: entrepreneurs' self-regulatory processes and their implications for new venture success. *Entrepreneurship: Theory Practice*, 37 (5), 1071–1097.
- Nassr, I. K., & Robano, V., & Wehinger, G. (2016). Unleashing the Export Potential of SMEs in Greece", *OECD Working Papers on Finance, Insurance and Private Pensions*, No. 41, OECD Publishing, Paris, <https://doi.org/10.1787/5jm0qgt464f6-en>.
- Neck, H. M, Meyer, G. D, Cohen, B., & Corbett, A. C. (2004). An entrepreneurial system view of new venture creation. *Journal of Small Business Management*, 42(2):190–208.
- Newman, J., King, E., M., & Abdul-Hamid, H. (2016). The Quality of Education Systems and Education Outcomes. Available at: http://report.educationcommission.org/wp-content/uploads/dlm_uploads/2016/11/Quality-of-Education-Systems.pdf.
- Nikolaïdis, Y., & Bakouros, I. (2009). Innovation penetration into a region with specific features: The case of Crete, Greece. *International Journal of Entrepreneurship and Innovation Management*, 9. 10.1504/IJEIM.2009.023848.
- O'Connor, A., Stam, E., Sussan, F. & Audretsch, D. B. (2018). Entrepreneurial Ecosystems: The Foundations of Place-based Renewal. In O'Connor, A., Stam, E., Sussan, F., & Audretsch, D. B. (Eds). *Entrepreneurial ecosystems. Place-Based Transformations and Transitions* (pp. 1-22). NY: Springer. DOI: <https://doi.org/10.1007/978-3-319-63531-6>.
- Odum, E. P. (1953). *Fundamentals of Ecology*, 1st edn. W.B. Saunders, Philadelphia.
- Odum, E. P. (1969). The Strategy of Ecosystem Development. *Science*, New Series, 164 (3877), 262-270. Retrieved from: <http://www.biol.wvu.edu/hooper/odumscience1969.pdf>.
- OECD. (1999). Regulatory reform for smaller firms. Retrieved from: <https://www.oecd.org/cfe/smes/2090708.pdf>.
- OECD. (2005). Place-Based policies for rural development Crete, Greece (Case study). Retrieved from: http://www.stepc.gr/docs/library_docs/OECD_CRETE.pdf.
- OECD. (2006). *OECD Territorial Reviews Stockholm, Sweden*. Available at: http://www.regionplanekontoret.sll.se/Global/Dokument/publ/2010/2010_r_oecd_uppfoljning.pdf.
- OECD. (2012). *Measuring Entrepreneurial Finance: A European Survey of SMEs*. Retrieved from: https://www.oecd-ilibrary.org/docserver/entrepreneur_aag-2012-5-en.pdf?expires=1595603960&id=id&accname=guest&checksum=EE7187CF7D588893A490D5E014E7D23F.

- OECD. (2013). OECD Reviews of Innovation Policy: Sweden 2012, OECD Publishing, Paris. Retrieved from: <https://www.oecd.org/sti/inno/oecd-reviews-of-innovation-policy-sweden-2012-9789264184893-en.htm>.
- OECD. (2016). OECD Economic Surveys Greece. Available at: https://read.oecd-ilibrary.org/economics/oecd-economic-surveys-greece-2016_eco_surveys-grc-2016-en#page1.
- OECD. (2017). Employment and Skills Strategies in Slovenia, OECD Reviews on Local Job Creation, OECD Publishing, Paris, <https://doi.org/10.1787/9789264278929-en>.
- OECD. (2018a). Promoting innovation in established SMEs. Retrieved from: <https://www.oecd.org/cfe/smes/ministerial/documents/2018-SME-Ministerial-Conference-Parallel-Session-4.pdf>.
- OECD. (2018b). OECD Economic Surveys Greece. Retrieved from: <http://www.oecd.org/economy/greece-economic-snapshot/>.
- OECD. (2018c). Inclusive Entrepreneurship Policies: Country Assessment Notes. Retrieved from: <https://www.oecd.org/cfe/smes/SWEDEN-IE-Country-Note-2018.pdf>.
- OECD. (2018d). OECD Regional Statistics (database), <http://dx.doi.org/10.1787/region-data-en>.
- OECD. (n.d.a). OECD Better Life Index: Greece. Available at: <https://www.oecdbetterlifeindex.org/countries/greece/>.
- OECD. (n.d.b). OECD Better Life Index: Sweden. Available at: <https://www.oecdbetterlifeindex.org/countries/sweden/>.
- Oh, D., S., & Phillips, F., & Park, S. & Lee, E. (2016). Innovation ecosystems: A critical examination, *Technovation*, 54, 1-6, Retrieved from: <https://www.sciencedirect.com/science/article/pii/S0166497216300062>.
- Oliveira Trindade, J. M. & Almeida, M. F. L. (2017). Measurement and Evaluation of Innovative Capacity and Innovation Performance of Small and Medium-Sized Enterprises. IN Delener, N., Schweikert, C. (Ed.) *Changing Business Environment: Gamechangers, Opportunities and Risks*, (pp.937-948). Global Business and Technology Association.
- Ortega, J. & Rocío, Ma & Rojas, B. & García, M. (2009). Research issues on K-means Algorithm: An Experimental Trial Using Matlab. *CEUR Workshop Proceedings*. 534.
- Osborne, H. (2017). The Research Funding Landscape. Context It is always better to match the idea to the right source of funding than the other way round Aston pays for specialist. Available at: <http://slideplayer.com/slide/10246042/>.
- Papadakis, N., & Lavdas, K. A., & Kotroyannos, D., & Tzagkarakis, S. I., & Kamekis, A., & Drakaki, M. (2018). Regional Governance and Sustainability: Research towards evidence-based policy making, at the Region of Crete. *Advances in Social Sciences Research Journal*, 5(8) 280-293. doi: 10.14738/assrj.58.4914.
- Pappa, E., & Kontodimopoulos, N. & Papadopoulos, A., & Niakas, D. (2009). Assessing the socio-economic and demographic impact on health-related quality of life: Evidence from Greece. *International journal of public health*. 54. 241-9. 10.1007/s00038-009-8057-x.
- Pérez J., & Rodolfo Pazos R., & Laura Cruz R., & Gerardo Reyes S. & Rosy Basave T. & Héctor Fraire H. (2007). Improvement the Efficiency and Efficacy of the K-means Clustering Algorithm through a New Convergence Condition. *Computational Science and Its Applications – ICCSA 2007 – International Conference Proceedings*. Springer Verlag.
- Phillips, M., & Ritala, P. (2019). A complex adaptive systems agenda for ecosystem research methodology. *Technological Forecasting and Social Change*. 148. 119739. 10.1016/j.techfore.2019.119739.

- Phillis, Y. & Grigoroudis, E. & Kouikoglou, V. (2011). Sustainability ranking and improvement of countries. *Ecological Economics*. 70. 542-553. 10.1016/j.ecolecon.2010.09.037.
- Pilinkienė, V. & Mačiulis, P. (2014). Comparison of Different Ecosystem Analogies: The Main Economic Determinants and Levels of Impact. *Procedia - Social and Behavioral Sciences*. DOI: 156. 10.1016/j.sbspro.2014.11.204.
- Piperopoulos, P. (2012). Could higher education programmes, culture and structure stifle the entrepreneurial intentions of students? *Journal of Small Business and Enterprise Development*, Vol. 19 No. 3, pp. 461-483. <https://doi.org/10.1108/14626001211250162>.
- Pita, M., Costa, J., & Moreira, A., C. (2021). Entrepreneurial Ecosystems and Entrepreneurial Initiative: Building a Multi-Country Taxonomy. *Sustainability*, 13, 4065. <https://doi.org/10.3390/su13074065>.
- Podrug, N., & Vrdoljak Raguž, I. i Dedić, M. (2015). Comparative analysis of entrepreneurial orientation of Croatian and Sweden students. *DIEM*, 2 (1), 186-201. Preuzeto s <https://hrcak.srce.hr/161599>.
- Poledníková, E. (2014). Comparing regions ranking by MCDM methods: The case of Visegrad countries. *WSEAS Transactions on Business and Economics*. 11. 496-507.
- Porter M. (1998). Clusters and the New Economics of Competition. *Harvard Business Review* November-December:77-90.
- Prahalad, C. K. (2005). *The Fortune at the Bottom of the Pyramid*. Pearson Education India, New Delhi.
- Quinn, J. B., Anderson, P., & Finkelstein, S. (1998). New Forms of Organizing. In H. Mintzberg & J.B. Quinn (Eds.), *Readings in the Strategic Process*: 362–374. Upper Saddle River, NJ: Prentice Hall.
- Rabelo, R. & Bernus, P. (2015). A Holistic Model of Building Innovation Ecosystems. *IFAC-PapersOnLine*. 48. 10.1016/j.ifacol.2015.06.423.
- Ramík, J. & Hančlová, J. (2012). Multicriteria Methods for Evaluating Competitiveness of Regions in V4 Countries. In: *Multi Criteria Decision Making'12*. Katowice: The University of Economics in Katowice, p. 169-178. ISBN 978-83-7875-042-0.
- Raven, R. P. J. M. (2005). *Strategic Niche Management for Biomass*. Eindhoven University, The Netherlands.
- Relly, J. & Sabharwal, M. (2009). Perceptions of Transparency of Government Policy Making: A Cross-National Study. *Government Information Quarterly*. 26. 148-157. 10.1016/j.giq.2008.04.002.
- Rezaei, J., Ortt, R., & Scholten, V. (2013). An improved fuzzy preference programming to evaluate entrepreneurship orientation. *Applied Soft Computing*. 13. 2749–2758. 10.1016/j.asoc.2012.11.012.
- ris3.crete. (2015). Smart Specialization strategy of Crete region. Available at: <http://www.pepkritis.gr/wp-content/uploads/2016/02/RIS-Crete-Translation-ENG.pdf>.
- Ritala, P., & Almpanopoulou, A. (2017). In defense of 'eco' in innovation ecosystem. *Technovation*, 60–61 (February), 39–42. <https://doi.org/10.1016/j.technovation.2017.01.004>.
- Rogers, E. (1962). *Diffusion of Innovations*, 1st ed. Free Press, New York.
- Röhl, K., H. (2016). Entrepreneurial culture and startups: Could a cultural shift in favour of entrepreneurship lead to more innovative startups? IW policy papers 2/2016E, Institut der deutschen Wirtschaft (IW) / German Economic Institute. Retrieved from: <https://www.econstor.eu/bitstream/10419/127449/1/847452425.pdf>.

- Rojas-Mendizabal, V. A., Serrano-Santoyo, A., Conte-Galvan, R., & Gomez-Gonzalez, A. (2013). Toward a Model for Quality of Experience and Quality of Service in e-health Ecosystems, *Procedia Technology*, 9, 968-974, Retrieved from: <https://www.sciencedirect.com/science/article/pii/S2212017313002624>.
- Romanainen, J. & Angelis, J. & Fikkers, D., J. et al. (2016). Nordic Entrepreneurship Check 2016. Nordic Innovation. Retrieved from: <https://www.nordicinnovation.org/2017/nordic-entrepreneurship-check-2016#:~:text=The%20Nordic%20Entrepreneurship%20Check%202016,in%20London%2C%20Amsterdam%20and%20Berlin>.
- Rostamzadeh, R., Ismail, K., & Noubar, H. (2014). An Application of a Hybrid MCDM Method for the Evaluation of Entrepreneurial Intensity among the SMEs: A Case Study. *The Scientific World Journal*. 2014. 1-16. 10.1155/2014/703650.
- Roszkowska, E. (2011). Multi-criteria Decision Making Models by Applying the TOPSIS Method to Crisp and Interval Data.
- Rothschild, M. (1990). *Bionomics: economy as ecosystem*. New York, Henry Holt and Company.
- Roy, B. (1996). *Multicriteria methodology for decision aiding*. Springer Science & Business Media. DOI: 10.1007/978-1-4757-2500-1.
- Roy, B. (2016). Paradigms and Challenges. In Figueira, J., R. & Greco, S., & Matthias, E. (Eds.). *Multiple Criteria Decision Analysis*. DOI: 10.1007/978-1-4939-3094-4.
- Ruzzier, M., & Antoncic, B., & Hisrich, R., D. (2007). The internationalization of SMEs: developing and testing a multi-dimensional measure on Slovenian firms, *Entrepreneurship and Regional Development*, 19:2, 161-183, <https://doi.org/10.1080/08985620601137646>.
- s3platform. (n.d.). Innovation Stockholm. Available at: <https://s3platform-legacy.jrc.ec.europa.eu/documents/20182/92826/Innovation+Stockholm.pdf/80804b58-1f20-4968-9256-973de91471a6>.
- Sadeghi, A., Azar, A. & Sepehrirad, R. (2012). Developing a Fuzzy Group AHP Model for Prioritizing the Factors Affecting Success of High-Tech SME's in Iran: A Case Study. *Procedia - Social and Behavioral Sciences*. 62. 957-961. 10.1016/j.sbspro.2012.09.163.
- Sanandaji, N. (2020a). Intellectual Property, Jobs & Prosperity in the Nordic Region. ECEPR. Retrieved from: <https://www.ecepr.org/wp-content/uploads/2020/01/Immaterial-Value-Creation-in-the-Nordic-Region.pdf>.
- Sanandaji, N. (2020b). The Geography of Europe's Brain Business Jobs: 2020 Index. ECEPR. Retrieved from: <https://www.ecepr.org/wp-content/uploads/2020/01/Brain-Business-Jobs-2020-Index.pdf>.
- Sanda, A. & Ntsiful, A. (2013). Dynamics of Employee Retention Among SMEs in a Developing Economy. *Proceedings of the 2013 International Conference on Business Administration, Marketing and Economics*. Retrieved from: <http://www.inase.org/library/2013/venice/bypaper/BAME/BAME-16.pdf>.
- Scaringella, L. & Radziwon, A. (2017). Innovation, entrepreneurial, knowledge, and business ecosystems: Old wine in new bottles?, *Technological Forecasting and Social Change*, Retrieved from: <https://doi.org/10.1016/j.techfore.2017.09.023>.
- Schumpeter, J. A. (1934). *The Theory of Economic Development* (Cambridge, MA: Harvard University Press).
- Schwab, K. (2016). *The Global Competitiveness Report*, World Economic Forum. Retrieved from: http://www3.weforum.org/docs/GCR2016-2017/05FullReport/TheGlobalCompetitivenessReport2016-2017_FINAL.pdf.

- Schwab, K. (2017). The Global Competiveness Report, World Economic Forum. Retrieved from: http://www3.weforum.org/docs/WEF_TheGlobalCompetitivenessReport2019.pdf.
- Schwab, K. (2019). The Global Competiveness Report, World Economic Forum. Retrieved from: http://www3.weforum.org/docs/WEF_TheGlobalCompetitivenessReport2019.pdf.
- Sepúlveda, J. & Vasquez, E. (2014). Multicriteria Analysis for Improving the Innovation Capability in Small and Medium Enterprises in Emerging Countries. *American Journal of Industrial and Business Management*. 04. 199-208. 10.4236/ajibm.2014.44027.
- Shaw, D., & Allen, T. (2016). Studying innovation ecosystems using ecology theory. *Technological Forecasting and Social Change*. 136. 10.1016/j.techfore.2016.11.030.
- Shrivastava, P. (n.d.). Knowledge Ecology: Knowledge Ecosystems for Business Education and Training. Available at: <http://www.facstaff.bucknell.edu/shrivast/KnowledgeEcology.html>.
- Silva, M., Gavião, L. O., Gomes, C. F. & Lima, G. B. A. (2017). A proposal for the application of multicriteria analysis to rank countries according to innovation using the indicators provided by the World Intellectual Property Organization. *Revista de Administração e Inovação*, 14(3), 188-198. <https://doi.org/10.1016/j.rai.2017.05.003>.
- Silva, M., Gomes, C. F. & Junior, C. L., C. (2019). The use of topsis for Ranking wipo's Innovation Indicators. *Innovar*, 29(73), 133-148. <https://doi.org/10.15446/innovar.v29n73.78027>.
- Singh, V. & Mirsa, A., K. (2014). A Genetic Algorithm for K-Mean Clustering. *International Journal of Emerging Technologies in Computational and Applied Sciences (IJETCAS)*. Available at: <http://iasir.net/IJETCASpapers/IJETCAS14-179.pdf>.
- Sitaridis, I., & Kitsios, F. (2019). Competitiveness analysis and evaluation of entrepreneurial ecosystems: a multi-criteria approach. *Annals of Operations Research*. 10.1007/s10479-019-03404-x.
- Sjölundh, T., & Wahlbin, C. (2008). Entrepreneurial Students: The Case of Students Starting up Companies in Parallel with Their Studies at Jönköping University, Sweden. *Industry and Higher Education*. 22. 441-452. 10.5367/000000008787225902.
- Smart Specialisation Strategy of the region of Crete. (2015). Retrieved from: <http://www.pepkritis.gr/wp-content/uploads/2016/02/RIS-Crete-Translation-ENG.pdf>.
- Snieska, V., & Bruneckienė, J. (2009). Measurement of Lithuanian Regions by Regional Competitiveness Index. *ISSN 1392-2785 Engineering Economics*, No. 1 (61). The economic conditions of enterprise functioning.
- Song, M. (2010). A study on platform's new strategy in media 2.0 era – based on “keystone” concept & Google case. In 21st European Regional its Conference, Copenhagen 2010.
- Spigel B. (2017). The Relational Organization of Entrepreneurial Ecosystems. *Entrepreneurship Theory and Practice* 41(1):49-72.
- Spigel, B., & Harrison, R. (2017). Towards a Process Theory of Entrepreneurial Ecosystems. *Strategic Entrepreneurship Journal*. 10.1002/sej.1268.
- Srinivas, H. (n.d.). Sustainability Concepts - Urban Ecosystems. Retrieved from: <https://www.gdrc.org/sustdev/concepts/23-u-eco.html>.
- Stam, E. (2015). Entrepreneurial Ecosystems and Regional Policy: A Sympathetic Critique. *European Planning Studies* 23(9): 1759-1769.
- Stam, E. (2017) Measuring Entrepreneurial Ecosystems. Available at: <http://www.uu.nl/organisatie/utrecht-university-school-of-economics-use/onderzoek/publicaties/discussion-papers/2017>.

Stam, E., & Spigel, B. (2016). Entrepreneurial Ecosystems. Retrieved from: <https://www.uu.nl/organisatie/utrecht-university-school-of-economics-use/onderzoek/publicaties/discussion-papers/2016>.

Stangler, D. & Bell-Masterson, J. (2015). *Measuring an Entrepreneurial Ecosystem*, Kauffman Foundation Research Series on City, Metro, and Regional Entrepreneurship, available at: http://www.kauffman.org/~media/kauffman_org/research%20reports%20and%20covers/2015/03/measuring_an_entrepreneurial_ecosystem.pdf.

Statistics Department of the African Development Bank. (2018). GDP Compilation in African Countries: A step-by-step manual. Retrieved from: https://www.afdb.org/fileadmin/uploads/afdb/Documents/Publications/GDP_compilation_in_African_Countries.pdf.

statsamerica.org (n.d.). Innovation Index by the Indiana Business Research Center. Available at: http://www.statsamerica.org/innovation/innovation_index/broad_index.html.

Stenholm, P., Acs, Z. J., & Wuebker, R. (2013). Exploring country-level institutional arrangements on the rate and type of entrepreneurial activity. *Journal of Business Venturing*, 28(1), 176–193. <http://doi.org/10.1016/j.jbusvent.2011.11.002>.

Stuetzer, M., Obschonka, M., Brixy, U., & Sternberg, R. & Cantner, U. (2014). Regional characteristics, opportunity perception and entrepreneurial activities. *Small Business Economics*. 42. 221-244. 10.1007/s11187-013-9488-6.

Suddle, K., & Beugelsdijk, S. & Wennekers, S. (2007). Entrepreneurial Culture and its Effect on the Rate of Nascent Entrepreneurship. EIM Business and Policy Research, Scales Research Reports. 10.1007/978-3-540-87910-7_11.

Sukarmijan, S., S. & Sapong, O. (2014). The Importance of Intellectual Property for SMEs; Challenges and Moving Forward. *UMK Procedia*. 1. 74-81. 10.1016/j.umkpro.2014.07.010.

Suresh, J., & Ramraj, R. (2012). Entrepreneurial ecosystem: case study on the influence of environmental factors on entrepreneurial success. *European Journal Business Management*. 4 (16), 95–101.

Suseno, Y., Standing, C., Kiani-Mavi, R. & Jackson, P. (2018). National innovation performance: the role of human capital and social capital, *Innovation: The European Journal of Social Science Research*, DOI: 10.1080/13511610.2018.1536536.

Szerb, L. & Trumbull, W. N. (2015). Entrepreneurship and entrepreneurial ecosystem in the V4 countries: The Global Entrepreneurship Index perspective. In: *Proceedings of the 5th International Conference on Management 2015. Management, leadership and strategy for SMEs' competitiveness*. Szent István University Publishing House, Gödöllő, pp. 2-7. ISBN 978-963-269-492-4.

Szerb, L., Komlósi, E., Ács, Z. J., & Ortega-Argilés, R. (2013). Measuring Regional Entrepreneurship in Hungary, *Proceedings- 11th International Conference on Management, Enterprise and Benchmarking (MEB 2013)*, Óbuda University, Keleti Faculty of Business and Management.

Tansley, A.G. (1935). The use and abuse of vegetational concepts and terms. *Ecology*, 16 (3), Retrieved from: http://www.esf.edu/cue/documents/Tansley_Use-Abuse-VegConcepts_1935.pdf.

Taskinsoy, J. (2019). The Global Competitiveness Index: A Comparative Analysis between Turkey and G8 Nations. *SSRN Electronic Journal*. 1-. 10.2139/ssrn.3500542.

theredi.org. (n.d.). Regional GEDI. Available at: <https://thegedi.org/regional-gedi/>.

Thomas, L. & Autio, E. (2020). Innovation ecosystems in management: An organizing typology. 10.1093/acrefore/9780190224851.013.203.

- Thomas, L., & Autio, E. (2019). Innovation Ecosystems. SSRN Electronic Journal. 10.2139/ssrn.3476925.
- Tsoukatos, E., & Tabouratzi, E., & Lemonakis, C., & Vassakis, K. (2018). Determinants of technological and non-technological Innovation in SMEs: the case of Crete. *Global Business and Economics Review*. 20: 5/6, 544-557. doi: 10.1504/GBER.2018.10009290.
- Uden, L., Wangsa, I. T., & Damiani, E. (2007). The future of E-learning: E-learning ecosystem. Inaugural IEEE-IES Digital EcoSystems and Technologies Conference, Cairns, 2007, pp. 113-117. doi: 10.1109/DEST.2007.371955. Retrieved from: https://www.researchgate.net/publication/4253636_The_future_of_E-learning_E-Learning_ecosystem.
- UK Department for Business Innovation and Skill. (2011). Innovation and research strategy for growth - refers extensively to the innovation ecosystems of 'Global Innovation Leaders'. Retrieved from: <https://www.gov.uk/government/publications/innovation-and-research-strategy-for-growth--2>.
- Ukpabio, M., G., Oyeibisi, T., O., & Siyanbola, O., W. (2017). Effects of Innovation on Performance of Manufacturing SMEs in Nigeria: An empirical study. Retrieved from: <http://liee.ntua.gr/wp-content/uploads/2018/02/879-Effects-of-Innovation-on-Performance-of-Manufacturing-SMEs-.pdf.2018>.
- Up Global. (2014). Fostering a Startup and Innovation Ecosystem. Available at: <https://publicpolicy.googleblog.com/2014/09/up-global-white-paper-announcing-5.html>.
- Valkokari, K. (2015). Business, Innovation, and Knowledge Ecosystems: How They Differ and How to Survive and Thrive within Them. *Technology Innovation Management Review*, 5, 17–24. Retrieved from: <http://timreview.ca/article/919>.
- Van De Ven, A. H., & Garud, R. (1994). The coevolution of technical and institutional events in the development of an innovation. In J. A. C. Baum, & J. Singh (Eds.), *Evolutionary dynamics of organizations*: 425-443. Oxford, UK: Oxford University Press.
- van der Borgh, M., Cloudt, M., & Romme, A. G. L. (2012). Value creation by knowledge-based ecosystems: evidence from a field study. *R&D Management*. 42 (2), 150–169.
- van Stel, A. (2004). Compendia: harmonizing business ownership data across countries and over time. Scales Research Reports. EIM Business and Policy Research. Available at: <http://ideas.repec.org/p/eim/papers/n200413.html>.
- Vassiliadis, S., & Chatzichristos, C. (2006, September 6-8). Entrepreneurial education and training in the tertiary level institutions of Greece. EISB International Conference on Integrating Business Education in a United Europe. Southampton, UK.
- Vassiliadis, S., & Vassiliadis, A. (2014). The Greek family businesses and the succession problem. *Procedia Economics and Finance*, 9, 242–247.
- Velimirovic, J., Velimirovic, L., Vranic, P. & Janjic, A. (2019). Assessing the risk of SMEs failure using AHP method. Retrieved from: https://www.researchgate.net/publication/333582717_ASSESSING_THE_RISK_OF_SMES_FAILURE_USING_AHP_METHOD.
- Vértesy, D. The Innovation Output Indicator. (2017). Methodology Report, EUR 28876 EN, Publications Office of the European Union, Luxembourg, 2017, ISBN 978-92-79-76474-5, doi:10.2760/971852, JRC108942.
- Vlados, C. & Deniozos, N. & Chatzinikolaou, D. (2017). Towards a new approach of local development under crisis conditions: Empowering the local business ecosystems in Greece, by adopting a new local development policy. 5. 1. 10.5296/ijrd.v5i1.11955.

- Vlados, C., & Chatzinikolaou, D. (2019). Crisis and Entrepreneurship in Greece: Present, Past and Evolving Trends, DUTH Research Papers in Economics 8-2019, Democritus University of Thrace, Department of Economics.
- Vliamos, S., & Tzeremes, N. (2011). Factors Influencing Entrepreneurial Process and Firm Startups: Evidence from Central Greece. *Journal of The Knowledge Economy*. 3. 1-15. 10.1007/s13132-011-0043-x.
- von Bertalanffy, L. (1956). General systems theory. *Gen. Syst.* 1, 1–10.
- Vyas, V. & Jain, P. (2020). Prioritization of Financial Performance Determinants in Indian SMEs. *Journal of Indian Business Research*. 12 (2). 169-190. Doi: 10.1108/JIBR-03-2018-0088.
- Walrave, B., & Talmar, M., & Podoynitsyna, K. S., & Romme, A. G. L., & Verbong, G. P., (2018). A multi-level perspective on innovation ecosystems for path-breaking innovation. *Technol. Forecast. Soc. Chang.* 136, 103–113.
- Weresa, M., A. (2020). Chapter 3 - Innovation, human capital and competitiveness in Central and Eastern Europe with regard to the challenges of a digital economy. In ETUI, The European Trade Union Institute. *Condemned to be left behind? Can Central and Eastern Europe emerge from its low-wage model?* Retrieved from: <https://www.etui.org/publications/books/condemned-to-be-left-behind-can-central-and-eastern-europe-emerge-from-its-low-wage-model>.
- West, J., & Bogers, M. (2014). Leveraging external sources of innovation: a review of research on open innovation. *Journal of Product Innovation Management*. 31 (7), 814–831.
- Whitman, W. (2017). The Ecosystem and how it relates to Sustainability. Retrieved from: <https://globalchange.umich.edu/globalchange1/current/lectures/klings/ecosystem/ecosystem.html>.
- Williams, M. L. (1993). Measuring business starts, success and survival: some database considerations. *Journal of Business Venturing*, Vol. 8, pp.295–299.
- Williams, N., & Vorley, T. (2015). The impact of institutional change on entrepreneurship in a crisis-hit economy: the case of Greece, *Entrepreneurship & Regional Development: An International Journal*, doi: 10.1080/08985626.2014.995723.
- Willis, A. (1997). The Ecosystem: An Evolving Concept Viewed Historically. *Functional Ecology*, 11(2), 268-271. Retrieved from <http://www.jstor.org/stable/2390328>.
- Wolniak, R. & Grebski, M. E. (2018). The Bloomberg Innovation Index as a tool to measure economic growth. *Science notebooks. Organization and Management / Silesian University of Technology*. Volume 119 pages 351—359.
- World Economic Forum. (2013). The Future Role of Civil Society. Retrieved from: http://www3.weforum.org/docs/WEF_FutureRoleCivilSociety_Report_2013.pdf.
- Wright, M. (2014). Academic entrepreneurship, technology transfer and society: where next? *Journal of Technology Transfer*. 39 (3), 322–334.
- Wurth, B., Stam, E., & Spigel, B. (2021). Toward an Entrepreneurial Ecosystem Research Program. *Entrepreneurship Theory and Practice*. <https://doi.org/10.1177/1042258721998948>.
- Yaghmaie, P. & Vanhaverbeke, W. (2019). Identifying and describing constituents of innovation ecosystems: A systematic review of the literature. *EuroMed Journal of Business*. ahead-of-print. 10.1108/EMJB-03-2019-0042.
- Yang, S. H., Nam, C., Kim, S. (2018). The effects of M&As within the mobile ecosystem on the rival's shareholder value: The case of Google and Apple, *Telecommunications Policy*, 42 (1), 15-23, Retrieved from: <https://www.sciencedirect.com/science/article/pii/S030859611630283X>.

Yin, R., K. (2014). How to know whether and when to use the case study as a research method. Available at: https://edisciplinas.usp.br/pluginfile.php/1742025/mod_resource/content/1/How%20to%20know%20whether%20and%20when%20to%20use%20the%20case%20study%20as%20a%20research%20method.pdf.

Zheng, G. & Liu, F. & Xu, F. (2012). Non-R&D innovation: A neglected innovation approach for Chinese SMEs. 2012 International Symposium on Management of Technology, ISMOT 2012. 460-464. 10.1109/ISMOT.2012.6679513.

Zollo, G., Autorino, G., Crescenzo, E.D., Iandoli, L., Imperiale, E., Liguori, V. Y., & Ponsiglione, C. (2011). A gap analysis of Regional Innovation Systems (RIS) with medium-low innovative capabilities: the case of Campania Region (Italy). En 8th ESU Conference on Entrepreneurship (1-21), Sevilla: Universidad de Sevilla.

Zvirblis, A. & Buracas, A. (2011). Multicriteria Evaluation of National Entrepreneurship In Newly EU Countries. International Journal of Economic Sciences and Applied Research (IJESAR). 4. 79-94.

Zvirblis, A. & Buracas, A. (2012). Backgrounds of Aggregated Assessment of SMEs Competitive Advantage Determinants. TEM Journal -Technology, Education, Management, Informatics, Serbia. 1. 213-220.

Zymek, R., & Jones, B. (2020). UK Regional Productivity Differences: An Evidence Review Industrial Strategy Council, Research Paper, Retrieved from: <https://industrialstrategycouncil.org/uk-regional-productivity-differences-evidence-review>.

Appendices

Appendix 1. NWM and TOPSIS method

Non-weighted model

In this thesis the steps that were followed for the Non-Weighted model were as described in Kitsios and Sitaridis (2017). In the general case of the evaluation table of m alternatives, $P1, P2, \dots, P_m$, according to the performance scores on t criteria, $c1, c2, \dots, c_t$, is illustrated in Table 1.

Table 1. The table with the performance scores of the alternatives

Criteria	C1	C2	C3	C4	Ct
Alternatives						
P1	P11	P12	P13	P14		P1t
P2	P21	P22	P23	P24		P2t
P3	P31	P32	P33	P34		P3t
....						
Pm	Pm1	Pm2	Pm3	Pm4		Pmt

A comparison matrix $A_{m \times m} = (a_{rs})_{m \times m}$ of the alternatives $P1, P2, \dots, P_m$, over the criteria $c1, c2, \dots, c_t$, is calculated, with a_{rs} defined as :

$$a_{rs} = \left(g_{rs} + \frac{1}{2} e_{rs} \right) / t, \text{ where } r, s = 1, 2, \dots, m, (1)$$

is calculated, where g_{rs} is the count of wins ($p_{rk} > p_{sk}$) and e_{rs} is the count of ties ($p_{rk} = p_{sk}$) of alternative r over alternative s , respectively, with $k = 1, 2, \dots, t$. Considering all p_{rk} , ($r = 1, 2, \dots, m$ $k=1, 2, \dots, t$) values are available for comparison, then all $a_{rs} \in R^+$. The resulting comparison matrix $A_{m \times m}$ is a primitive matrix (Huang and Moh 2016; Langville and Meyer 2006).

The Perron-Frobenius theorem suggests that every primitive matrix $A_{m \times m}$ has a positive real maximum eigenvalue λ , also called its spectral radius, which is used to calculate the corresponding eigenvector of the matrix (Gantmacher 1959; Saaty 1987). The process is similar to the computation of weights in the original AHP method, as the elements of the eigenvector, by Saaty (1990). Furthermore, λ has an algebraic and geometric multiplicity of 1 and a positive eigenvector $v > 0$, such that all positive eigenvectors of A are multiples of v . Given the comparison matrix $A_{m \times m}$, its spectral radius λ and a vector $v_0 = [1, 1, 1, \dots, 1]^T$, the

the $\lim_{n \rightarrow \infty} \left(\frac{A}{\lambda} \right)^n \cdot v_0 = cv$, where $c = u \cdot v_0 > 0$, given u is some positive row vector, which is a multiple of the eigenvector v . Let $d = cv$, be the ultimate ranking vector (Huang and Moh 2016). The ranking vector based on the comparison matrix $A_{m \times m}$, given its spectral radius λ and a vector $v_0 = [1, 1, 1, \dots, 1]^T$, is calculated using the expression:

$$d = \lim_{n \rightarrow \infty} \left(\frac{A}{\lambda} \right)^n \cdot v_0, (2)$$

where d is the ranking vector: $d = [d_1, d_2, d_3, \dots, d_m]^T$, and each d_n is the ranking of the n -th alternative. Since the required ranking vector is a multiple of the eigenvector, it is adequate to use the eigenvector itself, as the ranking vector d (Huang and Moh 2016).

TOPSIS

In this thesis the steps that were followed for the TOPSIS method were as described in Roszkowska (2011) for a single decision maker.

Step 1. Construct the decision matrix and determine the weight of criteria.

Let $X = (x_{ij})$ be a decision matrix and $W = [w_1, w_2, \dots, w_n]$ a weight vector, where $x_{ij} \in \mathcal{R}$, $w_j \in \mathcal{R}$ and $1 \leq j \leq n$. $w_1 + w_2 + \dots + w_n = 1$.

Criteria of the functions can be: benefit functions (more is better) or cost functions (less is better).

Step 2. Calculate the normalized decision matrix.

This step transforms various attribute dimensions into non-dimensional attributes which allows comparisons across criteria. Because various criteria are usually measured in various units, the scores in the evaluation matrix X have to be transformed to a normalized scale. The normalization of values can be carried out by one of the several known standardized formulas. Some of the most frequently used methods of calculating the normalized value n_{ij} are the following:

$$n_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^m x_{ij}^2}}, \quad (2.1)$$

$$n_{ij} = \frac{x_{ij}}{\max_i x_{ij}}, \quad (2.1^*)$$

$$n_{ij} = \begin{cases} \frac{x_{ij} - \min_i x_{ij}}{\max_i x_{ij} - \min_i x_{ij}} & \text{if } C_i \text{ is a benefit criterion} \\ \frac{\max_i x_{ij} - x_{ij}}{\max_i x_{ij} - \min_i x_{ij}} & \text{if } C_i \text{ is a cost criterion} \end{cases} \quad (2.1)$$

for $i = 1, \dots, m; j = 1, \dots, n$.

Step 3. Calculate the weighted normalized decision matrix.

The weighted normalized value v_{ij} is calculated in the following way:

$$v_{ij} = w_j n_{ij} \text{ for } i = 1, \dots, m; j = 1, \dots, n. \quad (2.2)$$

where w_j is the weight of the j -th criterion, $\sum_{j=1}^n w_j = 1$.

Step 4. Determine the positive ideal and negative ideal solutions.

Identify the positive ideal alternative (extreme performance on each criterion) and identify the negative ideal alternative (reverse extreme performance on each criterion). The ideal positive solution is the solution that maximizes the benefit criteria and minimizes the cost criteria whereas the negative ideal solution maximizes the cost criteria and minimizes the benefit criteria.

Positive ideal solution A^+ has the form:

$$A^+ = (v_1^+, v_2^+, \dots, v_n^+) = \left(\left(\max_i v_{ij} \mid j \in I \right), \left(\min_i v_{ij} \mid j \in J \right) \right) \quad (2.3)$$

Negative ideal solution A^- has the form:

$$A^- = (v_1^-, v_2^-, \dots, v_n^-) = \left(\left(\min_i v_{ij} \mid j \in I \right), \left(\max_i v_{ij} \mid j \in J \right) \right) \quad (2.4)$$

where I is associated with benefit criteria and J with the cost criteria, $i = 1, \dots, m; j = 1, \dots, n$.

Step 5. Calculate the separation measures from the positive ideal solution and the negative ideal solution.

In the TOPSIS method a number of distance metrics can be applied. The separation of each alternative from the positive ideal solution is given as

$$d_i^+ = \left(\sum_{j=1}^n (v_{ij} - v_j^+)^p \right)^{1/p}, \quad i = 1, 2, \dots, m. \quad (2.5)$$

$$d_i^- = \left(\sum_{j=1}^n (v_{ij} - v_j^-)^p \right)^{1/p}, \quad i = 1, 2, \dots, m. \quad (2.6)$$

Where $p \geq 1$. For $p = 2$ we have the most used traditional n -dimensional Euclidean metric.

$$d_i^+ = \sqrt{\sum_{j=1}^n (v_{ij} - v_j^+)^2}, \quad i = 1, 2, \dots, m. \quad (2.5^*)$$

$$d_i^- = \sqrt{\sum_{j=1}^n (v_{ij} - v_j^-)^2}, \quad i = 1, 2, \dots, m. \quad (2.6^*)$$

Step 6. Calculate the relative closeness to the positive ideal solution.

The relative closeness of the i -th alternative A_j with respect to A^+ is defined as

$$R_i = \frac{d_i^-}{d_i^- + d_i^+}, \quad (2.7)$$

where $0 \leq R_i \leq 1$, $i = 1, 2, \dots, m$.

Step 7. Rank the preference order or select the alternative closest to A^+ .

A set of alternatives now can be ranked by the descending order of the value of R_i .

Appendix 2. Imputation at macro and meso level

Macro level Imputation

VARIABLES	TYPES OF IMPUTATION
Tertiary Education	Complete data - No need for imputation
Quality education system	Complete data - No need for imputation
Lifelong learning	Complete data - No need for imputation
Foreign doctorate	Imputation for the country Greece for the years 2013-2017 the values were imputed with the method of the Euclidean distance, where the average values of countries Spain, Italy and Portugal were calculated and used as the values of Greece
Researchers	Complete data - No need for imputation
New business entry density	Imputation for all countries for the year 2017 with the imputation method of linear interpolation
Corruption perception index	Complete data - No need for imputation
Oppurtunity Perception	Imputation for the country Malta for the years 2013-2017 the values were imputed with the method of the Euclidean distance, where the minimum distance was the country Austria and its values were used as the values of Malta
Startup skills	Imputation for the country Malta for the years 2013-2017 the values were imputed with the method of the Euclidean distance, where the minimum distance was the country Austria and its values were used as the values of Malta
Risk acceptance	Imputation for the country Malta for the years 2013-2017 the values were imputed with the method of the Euclidean distance, where the minimum distance was the country Austria and its values were used as the values of Malta
R&D expenditure in the public sector	Imputation for all countries for the year 2017 with the imputation method of linear interpolation
Venture capital expenditures	Complete data - No need for imputation
R&D expenditure in the business sector	Imputation for all countries for the year 2017 with the imputation method of linear interpolation
Non-R&D innovation expenditures	Imputation for all countries for years 2016 and 2017 with the imputation method of linear interpolation the European Innovation Scorecard
Ease of access to loans	Complete data - No need for imputation
Government effectiveness	Complete data - No need for imputation
Ease of starting a business	Complete data - No need for imputation
Rule of law	Complete data - No need for imputation

Time to start a business days	Complete data - No need for imputation
Effectiveness of anti-monopoly policy	Complete data - No need for imputation
Transparency of government policymaking	Complete data - No need for imputation
PCT patents	Imputation for all countries for years 2016 and 2017 with the imputation method of linear interpolation
Trademark applications	Complete data - No need for imputation
Design applications	Complete data - No need for imputation
TEA	<p>Imputation for:</p> <ol style="list-style-type: none"> 1. Countries Belgium, Romania for the years 2016 and 2017 the values were imputed with the imputation method of linear interpolation 2. Country Bulgaria for the years 2013 and 2014 the values were imputed with the imputation method of linear interpolation 3. Country Czech Republic given that the only available value was for the year 2013, it was used for the years 2014-2017 4. Country Denmark given that the only available value was for the year 2013, it was used for the years 2014-2017 5. Country France for the year 2015 with the imputation method of linear interpolation 6. Country Cyprus for the years 2013-2015 the values were imputed with the imputation method of linear interpolation <p>Country Latvia for the year 2014 the value was imputed with the imputation method of linear interpolation</p> <ol style="list-style-type: none"> 7. Country Lithuania for the years 2015-2017 the values were imputed with the imputation method of linear interpolation 8. Countries Hungary, Portugal, Finland, for the year 2017 the values were imputed with the imputation method of linear interpolation 9. Country Malta for the years 2013-2017 the values were imputed with the method of the Euclidean distance, where the minimum distance was the country Austria and its values were used as the values of Malta 10. Country Austria for the years 2013, 2015, 2017 the values were imputed with the imputation method of linear interpolation
SMEs with product or process innovations	Imputation for all countries for the years 2016 and 2017 the values were imputed with the imputation method of linear interpolation
SMEs with marketing or organisational innovations	Imputation for all countries for the years 2016 and 2017 the values were imputed with the imputation method of linear interpolation
SMEs innovating in-house	Imputation for all countries for the years 2016 and 2017 the values were imputed with the imputation method of linear interpolation
Employment in knowledge-intensive activities	Complete data - No need for imputation

Employment fast-growing enterprises of innovative sectors	<p>Imputation for:</p> <ol style="list-style-type: none"> 1. All countries for the years 2016 and 2017 the values were imputed with the imputation method of linear interpolation 2. For country Greece for the years 2013-2017 the values were imputed with the method of the Euclidean distance, where the average values of countries Spain, Italy and Portugal were calculated and used as the values of Greece
Medium and high-tech product exports	Complete data - No need for imputation
Knowledge-intensive services exports	Imputation for all countries for the year 2017 the value was imputed with the imputation method of linear interpolation
Sales of new-to-market and new-to-firm product innovations	Imputation for all countries for the years 2016 and 2017 the values were imputed with the imputation method of linear interpolation
Global Competitiveness Index	Complete data - No need for imputation
GDP per capita	Complete data - No need for imputation
Unemployment	Complete data - No need for imputation
Quality of life Index	<p>Imputation for:</p> <ol style="list-style-type: none"> 1. Country Cyprus, for the years 2013-2017 the values were imputed with the method of the Euclidean distance, where the minimum distance was the country Spain and its values were used as the values of Cyprus 2. Country Luxembourg for the years 2013-2017 the values were imputed with the method of the Euclidean distance, where the minimum distance was the country Ireland and its values were used as the values of Luxembourg 3. Country Malta for the years 2013-2017 the values were imputed with the method of the Euclidean distance, where the minimum distance was the country Cyprus and its values were used as the values of Malta 4. Country Estonia for the year 2016 the value was imputed with the imputation method of linear interpolation 5. Country Spain for the year 2017 the value was imputed with the imputation method of linear interpolation 3. Country Latvia given that the only available value was for the year 2015, it was used for the years 2013, 2014, 2016 and 2017 6. Country Slovenia for the year 2015 with the imputation method of linear interpolation 7. Country Slovakia for the year 2016 with the imputation method of linear interpolation
Rate of High-Growth Enterprises	<p>Imputation for:</p> <ol style="list-style-type: none"> 1. All countries for the year 2013 with the imputation method of linear interpolation 2. Country Malta for the years 2013-2017 with the method of linear interpolation

	<p>3. Country Luxembourg for the year 2014 with the imputation method of linear interpolation</p> <p>4. Countries Bulgaria, Czech Republic, Estonia, Greece, Spain, Croatia, Italy, Cyprus, Latvia, Lithuania, Hungary, Poland, Portugal, Romania, Slovenia for the year 2017 the value was imputed with the imputation method of linear interpolation</p>
--	--

Meso level Imputation

VARIABLES	TYPES OF IMPUTATION
Percentage population aged 30-34 having completed tertiary education	<p>Imputation for:</p> <ol style="list-style-type: none"> For all countries except Estonia, Cyprus, Latvia, Lithuania, Luxembourg and Malta given the values for the years 2007, 2009, 2011 the values for the year 2013 were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y=y1+(x-x1)*(y2-y1)/(x2-x1)$), when the value of the variable was $x_i > 1$ the value was blocked to 1, for example for country United Kingdom, region London, for the year 2013 given that the imputation of the linear interpolation gave a value greater than 1, it was 1,07 the value was blocked to 1 whereas when the value of the variable was $x_i < 0$ the value of the previous year was used such as for example in country Finland, region Aland for the year 2013 For all countries except Estonia, Cyprus, Latvia, Lithuania, Luxembourg and Malta for the year 2015 the values were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y=y1+(x-x1)*(y2-y1)/(x2-x1)$) Country Germany top down imputation for the years 2013 and 2014 where the values of the NUTS 1 regions were imputed as the values of the NUTS 2 regions and also for region Brandenburg the values for the years 2013-2016 were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y=y1+(x-x1)*(y2-y1)/(x2-x1)$) Country Greece top down imputation for the years 2013 and 2014 where the values of the NUTS 1 regions were imputed as the values of the NUTS 2 regions For countries Estonia, Cyprus, Latvia, Lithuania, Luxembourg and Malta, the normalized scores from the macro level were used since these countries have only one region which is themselves For the year 2017 countries Spain, two regions Ciudad Autónoma de Ceuta and Ciudad Autónoma de Melilla, France one region French overseas departments and Finland, one region Aland the values were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y=y1+(x-x1)*(y2-y1)/(x2-x1)$)
R&D expenditures in the public sector	<p>Imputation for:</p> <ol style="list-style-type: none"> For all countries given the values for the years 2007, 2009, 2011 the values for the year 2013 were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y=y1+(x-x1)*(y2-y1)/(x2-x1)$)

	$x1)*(y2-y1)/(x2-x1))$ <ol style="list-style-type: none"> For all countries except Estonia, Cyprus, Latvia, Lithuania, Luxembourg and Malta the values for the year 2015 were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y=y1+(x-x1)*(y2-y1)/(x2-x1)$) Country Germany top down imputation for the years 2013 and 2014 where the values of the NUTS 1 regions were imputed as the values of the NUTS 2 regions and also for region Brandenburg the values for the years 2013-2016 were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y=y1+(x-x1)*(y2-y1)/(x2-x1)$) Country Greece top down imputation for the year 2013 where the values of the NUTS 1 regions were imputed as the values of the NUTS 2 regions whereas for the year 2014 the values were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y=y1+(x-x1)*(y2-y1)/(x2-x1)$) For the countries Estonia, Cyprus, Latvia, Lithuania, Luxembourg and Malta, the normalized scores from the macro level were used since these countries have only one region which is themselves For the year 2017 countries Spain, two regions Ciudad Autónoma de Ceuta and Ciudad Autónoma de Melilla, France one region French overseas departments and Finland, one region Aland the values were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y=y1+(x-x1)*(y2-y1)/(x2-x1)$)
R&D expenditures in the business sector	<p>Imputation for:</p> <ol style="list-style-type: none"> For all countries given the values for the years 2007, 2009, 2011 the values for the year 2013 were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y=y1+(x-x1)*(y2-y1)/(x2-x1)$). When the imputed value of the variable was $x_i > 1$ the value was blocked to 1, for example for country Finland, region Pohjois-ja Itä-Suomi, for the year 2013 given that the imputation of the linear interpolation gave a value greater than 1, it was blocked to 1. When the imputed value of the variable was $x_i < 0$ the value was negative, the value of the previous year was used, for example for country Poland, region Lubelskie and country Spain, region Ciudad Autónoma de Melilla for the year 2013 given that the imputation of the linear interpolation gave a negative, the value of the previous year was used Country Germany top down imputation for the years 2013 and 2014 where the values of the NUTS 1 regions were imputed as the values of the NUTS 2 regions and also for region Brandenburg the values for the years 2013-2016 were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y=y1+(x-x1)*(y2-y1)/(x2-x1)$) Country Greece top down imputation for the year 2013 where the values of the NUTS 1 regions were imputed as the values of the NUTS 2 regions whereas for the year 2014 the values were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y=y1+(x-x1)*(y2-y1)/(x2-x1)$) For the countries Estonia, Cyprus, Latvia, Lithuania, Luxembourg

	<p>and Malta, the normalized scores from the macro level were used since these countries have only one region which is themselves</p> <p>5. For the year 2017 countries Spain, two regions Ciudad Autónoma de Ceuta and Ciudad Autónoma de Melilla, France one region French overseas departments and Finland, one region Aland the values were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y=y1+(x-x1)*(y2-y1)/(x2-x1)$)</p>
Non-R&D innovation expenditures in SMEs	<p>Imputation for:</p> <ol style="list-style-type: none"> For all countries given the values for the years 2007, 2009, 2011 the values for the year 2013 were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y=y1+(x-x1)*(y2-y1)/(x2-x1)$). When the imputed value of the variable was $x_i < 0$ the value was negative, the value of the previous year was used, for example for country Spain, region Ciudad Autónoma de Ceuta for the year 2013 given that the imputation of the linear interpolation gave a negative, the value of the previous year was used. When the imputed value of the variable was $x_i > 1$ the value was blocked to 1, for example for the year 2013 the values were blocked for the following countries: <ol style="list-style-type: none"> Country Italy, regions Calabria and Sicilia Country Hungary, region Dél-Dunántúl Country Austria, region Südösterreich Country Poland, region Mazowieckie Country Germany top down imputation for the years 2013 and 2014 where the values of the NUTS 1 regions were imputed as the values of the NUTS 2 regions and also for region Brandenburg the values for the years 2013-2016 were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y=y1+(x-x1)*(y2-y1)/(x2-x1)$) Country Greece top down imputation for the years 2013 and 2014 where the values of the NUTS 1 regions were imputed as the values of the NUTS 2 regions For the countries Estonia, Cyprus, Latvia, Lithuania, Luxembourg and Malta, the normalized scores from the macro level were used since these countries have only one region which is themselves For the year 2017 countries Spain, two regions Ciudad Autónoma de Ceuta and Ciudad Autónoma de Melilla, France one region French overseas departments and Finland, one region Aland the values were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y=y1+(x-x1)*(y2-y1)/(x2-x1)$) For the year 2014 country United Kingdom for all regions the values were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y=y1+(x-x1)*(y2-y1)/(x2-x1)$)
EPO patent applications	<p>Imputation for:</p> <ol style="list-style-type: none"> For all countries given the values for the years 2007, 2009, 2011 the values for the year 2013 were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y=y1+(x-x1)*(y2-y1)/(x2-x1)$)

	<ol style="list-style-type: none"> Country Germany top down imputation for the years 2013 and 2014 where the values of the NUTS 1 regions were imputed as the values of the NUTS 2 regions and also for region Brandenburg the values for the years 2013-2016 were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y=y1+(x-x1)*(y2-y1)/(x2-x1)$) Country Greece top down imputation for the years 2013 and 2014 where the values of the NUTS 1 regions were imputed as the values of the NUTS 2 regions For the countries Estonia, Cyprus, Latvia, Lithuania, Luxembourg and Malta, the normalized scores from the macro level were used since these countries have only one region which is themselves For the year 2017 countries Spain, two regions Ciudad Autónoma de Ceuta and Ciudad Autónoma de Melilla, France one region French overseas departments and Finland, one region Åland the values were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y=y1+(x-x1)*(y2-y1)/(x2-x1)$)
SMEs with product or innovations	<p>Imputation for:</p> <ol style="list-style-type: none"> For all countries given the values for the years 2007, 2009, 2011 the values for the year 2013 were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y=y1+(x-x1)*(y2-y1)/(x2-x1)$). When the imputed value of the variable was $x_i < 0$ the value was negative, the value of the previous year was used, for example for country Spain, region Ciudad Autónoma de Ceuta, for country Poland, region Łódzkie and for country Romania, region Sud-Vest Oltenia for the year 2013 given that the imputation of the linear interpolation gave a negative, the value of the previous year was used. When the imputed value of the variable was $x_i > 1$ the value was blocked to 1, for example for the year 2013 the value was blocked for country Portugal, region Algarve Country Germany top down imputation for the years 2013 and 2014 where the values of the NUTS 1 regions were imputed as the values of the NUTS 2 regions and also for region Brandenburg the values for the years 2013-2016 were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y=y1+(x-x1)*(y2-y1)/(x2-x1)$) Country Greece top down imputation for the years 2013 and 2014 where the values of the NUTS 1 regions were imputed as the values of the NUTS 2 regions For the countries Estonia, Cyprus, Latvia, Lithuania, Luxembourg and Malta, the normalized scores from the macro level were used since these countries have only one region which is themselves For the year 2017 countries Spain, two regions Ciudad Autónoma de Ceuta and Ciudad Autónoma de Melilla, France one region French overseas departments and Finland, one region Åland the values were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y=y1+(x-x1)*(y2-y1)/(x2-x1)$)
SMEs marketing or organisational	<p>Imputation for:</p> <ol style="list-style-type: none"> For all countries given the values for the years 2007, 2009, 2011 the

innovations	<p>values for the year 2013 were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y=y1+(x-x1)*(y2-y1)/(x2-x1)$). When the imputed value of the variable was $x_i < 0$ the value was negative, the value of the previous year was used, for example for country Spain, region Ciudad Autónoma de Ceuta and for country Romania, region Vest for the year 2013 given that the imputation of the linear interpolation gave a negative value, the value of the previous year was used</p> <ol style="list-style-type: none"> 2. Country Germany top down imputation for the years 2013 and 2014 where the values of the NUTS 1 regions were imputed as the values of the NUTS 2 regions and also for region Brandenburg the values for the years 2013-2016 were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y=y1+(x-x1)*(y2-y1)/(x2-x1)$) 3. Country Greece top down imputation for the years 2013 and 2014 where the values of the NUTS 1 regions were imputed as the values of the NUTS 2 regions 4. For the countries Estonia, Cyprus, Latvia, Lithuania, Luxembourg and Malta, the normalized scores from the macro level were used since these countries have only one region which is themselves 5. For the year 2017 countries Spain, two regions Ciudad Autónoma de Ceuta and Ciudad Autónoma de Melilla, France one region French overseas departments and Finland, one region Aland the values were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y=y1+(x-x1)*(y2-y1)/(x2-x1)$)
SMEs innovating in-house	<p>Imputation for:</p> <ol style="list-style-type: none"> 1. For all countries given the values for the years 2007, 2009, 2011 the values for the year 2013 were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y=y1+(x-x1)*(y2-y1)/(x2-x1)$). When the imputed value of the variable was $x_i > 1$ the value was blocked to 1, for example for the year 2013 the value was blocked for country Portugal, region Algarve. When the imputed value of the variable was $x_i < 0$ the value was negative, the value of the previous year was used, for example the following countries gave a negative value: <ol style="list-style-type: none"> 1. Country Poland, regions Łódzkie, Lubelskie, Swietokrzyskie, Zachodniopomorskie, Warminsko-Mazurskie 2. Country Romania, region Sud-Vest Oltenia 2. Country Germany top down imputation for the years 2013 and 2014 where the values of the NUTS 1 regions were imputed as the values of the NUTS 2 regions and also for region Brandenburg the values for the years 2013-2016 were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y=y1+(x-x1)*(y2-y1)/(x2-x1)$) 3. Country Greece top down imputation for the years 2013 and 2014 where the values of the NUTS 1 regions were imputed as the values of the NUTS 2 regions 4. For the countries Estonia, Cyprus, Latvia, Lithuania, Luxembourg and Malta, the normalized scores from the macro level were used since these countries have only one region which is themselves

	<p>5. For the year 2017 countries Spain, two regions Ciudad Autónoma de Ceuta where the imputed value of the variable was negative, the value of the previous year was used and Ciudad Autónoma de Melilla, France one region French overseas departments and Finland, one region Aland the values were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y=y1+(x-x1)*(y2-y1)/(x2-x1)$)</p>
Employment in medium-high/high-tech manufacturing and knowledge-intensive services	<p>Imputation for:</p> <ol style="list-style-type: none"> 1. For all countries given the values for the years 2007, 2009, 2011 the values for the year 2013 were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y=y1+(x-x1)*(y2-y1)/(x2-x1)$). When the imputed value of the variable was $x_i < 0$ the value was negative, the value of the previous year was used, for example for country Spain, region Ciudad Autónoma de Ceuta and for country Romania, region Vest for the year 2013 given that the imputation of the linear interpolation gave a negative value, the value of the previous year was used 2. Country Germany top down imputation for the years 2013 and 2014 where the values of the NUTS 1 regions were imputed as the values of the NUTS 2 regions and also for region Brandenburg the values for the years 2013-2016 were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y=y1+(x-x1)*(y2-y1)/(x2-x1)$) 3. Country Greece top down imputation for the years 2013 and 2014 where the values of the NUTS 1 regions were imputed as the values of the NUTS 2 regions 4. For the countries Estonia, Cyprus, Latvia, Lithuania, Luxembourg and Malta, the normalized scores from the macro level were used since these countries have only one region which is themselves 5. For the year 2017 countries Spain, two regions Ciudad Autónoma de Ceuta and Ciudad Autónoma de Melilla where the imputed value of the variable was negative, the value of the previous year was used, France one region French overseas departments and Finland, one region Aland the values were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y=y1+(x-x1)*(y2-y1)/(x2-x1)$)
Sales of new-to-market and new-to-firm innovations	<p>Imputation for:</p> <ol style="list-style-type: none"> 1. For all countries given the values for the years 2007, 2009, 2011 the values for the year 2013 were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y=y1+(x-x1)*(y2-y1)/(x2-x1)$). When the imputed value of the variable was $x_i > 1$ the value was blocked to 1, for example for the year 2013 the value was blocked for country Spain, regions Principado de Asturias, País Vasco, Comunidad de Madrid. When the imputed value of the variable was $x_i < 0$ the value was negative, the value of the previous year was used, for example the following countries gave a negative value: <ol style="list-style-type: none"> 1. Country France, region French overseas departments 2. Country Poland, regions Lubelskie, Podlaskie, Zachodniopomorskie 3. Country Romania, region Sud-Vest Oltenia 2. Country Germany top down imputation for the years 2013 and 2014

	<p>where the values of the NUTS 1 regions were imputed as the values of the NUTS 2 regions and also for region Brandenburg the values for the years 2013-2016 were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y=y1+(x-x1)*(y2-y1)/(x2-x1)$)</p> <ol style="list-style-type: none"> Country Greece top down imputation for the years 2013 and 2014 where the values of the NUTS 1 regions were imputed as the values of the NUTS 2 regions For the countries Estonia, Cyprus, Latvia, Lithuania, Luxembourg and Malta, the normalized scores from the macro level were used since these countries have only one region which is themselves For the year 2017 countries Spain, two regions Ciudad Autónoma de Ceuta and Ciudad Autónoma de Melilla where the imputed value of the variable was negative, the value of the previous year was used, France one region French overseas departments and Finland, one region Aland the values were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y=y1+(x-x1)*(y2-y1)/(x2-x1)$)
Exports medium and high-tech manufacturing	<p>Imputation for:</p> <ol style="list-style-type: none"> For all countries, except the countries Estonia, Cyprus, Latvia, Lithuania, Luxembourg and Malta, given the values for the years 2016 and 2017 the values for the years 2013, 2014 and 2015 were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y=y1+(x-x1)*(y2-y1)/(x2-x1)$) For countries Spain two regions Ciudad Autónoma de Ceuta and Ciudad Autónoma de Melilla, France region French overseas departments, Finland two regions Helsinki-Uusimaa and Etelä-Suomi given that only one value was available for the year 2016, this value was also imputed for the years 2013, 2014, 2015 and 2017 For the countries Estonia, Cyprus, Latvia, Lithuania, Luxembourg and Malta, the normalized scores from the macro level were used since these countries have only one region which is themselves For all countries, when the imputed value of the variable was $x_i > 1$ the value was blocked to 1 and when the imputed value of the variable was $x_i < 0$ the value was negative, the value of the next year was used because it was the only available, since this variable has data only for the years 2016 and 2017: <ol style="list-style-type: none"> Country Belgium Région Wallonne for the year 2013, due to the fact the value was negative, the value of the next year was imputed Country Czech Republic regions Jihozápad for the year and Severozápad for the years 2013 and 2014, due to the fact the value was negative, the value of the next year was imputed Country Germany: <ol style="list-style-type: none"> region Stuttgart for the years 2013 and 2014 due to the fact that the imputed value of the variable was $x_i > 1$ the value was blocked to 1 regions Berlin, Weser-Ems, Gießen, Kassel, Dresden

	<p>for the year 2013, due to the fact the value was negative, the value of the next year was imputed</p> <ol style="list-style-type: none"> 3. regions Bremen, Münster, Koblenz, Trier, Sachsen-Anhalt, Schleswig-Holstein, Thüringen for the years 2013 and 2014, due to the fact the value was negative, the value of the next year was imputed 4. region Mecklenburg-Vorpommern for the years 2013, 2014 and 2015, due to the fact the value was negative, the value of the next year was imputed 5. regions Hannover and Luneburg for the years 2013 and 2014, due to the fact the value was negative, the value of the next year was imputed <p>4. Country Greece:</p> <ol style="list-style-type: none"> 1. region Thessalia for the years 2013 and 2014, due to the fact the value was negative, the value of the next year was imputed 2. region Sterea Ellada for the years 2013 and 2014, due to the fact the value was negative, the value of the next year was imputed 3. region Attiki for the year 2013 due to the fact that the imputed value of the variable was $x_i > 1$ the value was blocked to 1 <p>5. Country Spain:</p> <ol style="list-style-type: none"> 1. regions Galicia, Cantabria, Castilla y León, Andalucía, Región de Murcia for the years 2013 and 2014, due to the fact the value was negative, the value of the next year was imputed 2. region Aragón for the year 2013 due to the fact the value was negative, the value of the next year was imputed 3. regions Extremadura and Illes Balears for the years 2013, 2014 and 2015 due to the fact the value was negative, the value of the next year was imputed <p>6. Country Croatia regions Jadranska Hrvatska and Kontinentalna Hrvatska for the year 2013, due to the fact the value was negative, the value of the next year was imputed</p> <p>7. Country France regions Bassin Parisien, Nord - Pas-de-Calais, Est, Ouest for the years 2013 and 2014 due to the fact the value was negative, the value of the next year was imputed and Sud-Ouest for the year 2013 due to the fact the value was negative, the value of the next year was imputed</p> <p>8. Country Italy:</p> <ol style="list-style-type: none"> 1. region Valle d'Aosta/Vallée d'Aoste for the year 2013 due to the fact that the imputed value of the variable was $x_i > 1$ the value was blocked to 1 2. regions Liguria, Calabria and Sicilia for the years 2013 and 2014, due to the fact the value was negative, the value of the next year was imputed 3. regions Provincia Autonoma Bolzano/Bozen, Umbria, Molise and Campania for the year 2013 due to the fact the value was negative, the value of the next year was
--	--

	<p>imputed</p> <p>9. Country Hungary:</p> <ol style="list-style-type: none"> 1. regions Dél-Dunántúl, Észak-Alföld and Dél-Alföld for the years 2013, 2014 and 2015 due to the fact the value was negative, the value of the next year was imputed 2. region Észak-Magyarország for the year 2013 due to the fact the value was negative, the value of the next year was imputed <p>10. Country Netherlands:</p> <ol style="list-style-type: none"> 1. region Drenthe for the year 2013 due to the fact the value was negative, the value of the next year was imputed 2. region Noord-Holland for the year 2013 due to the fact that the imputed value of the variable was $x_i > 1$ the value was blocked to 1 3. regions Zeeland and Limburg due to the fact the value was negative, the value of the next year was imputed <p>11. Country Austria region Südbösterreich for the year 2013 due to the fact the value was negative, the value of the next year was imputed</p> <p>12. Country Poland:</p> <ol style="list-style-type: none"> 1. regions Łódzkie, Małopolskie, Śląskie, Wielkopolskie, Dolnośląskie and Opolskie for the year 2013 due to the fact the value was negative, the value of the next year was imputed 2. regions Lubelskie, Podkarpackie, Świętokrzyskie, Podlaskie, Zachodniopomorskie and Kujawsko-Pomorskie for the years 2013, 2014 and 2015 due to the fact the value was negative, the value of the next year was imputed 3. regions Lubuskie, Warmińsko-Mazurskie and Pomorskie for the years 2013 and 2014 due to the fact the value was negative, the value of the next year was imputed <p>13. Country Portugal:</p> <ol style="list-style-type: none"> 1. regions Centro and Alentejo for the years 2013 and 2014 due to the fact the value was negative, the value of the next year was imputed 2. regions Região Autónoma dos Açores and Região Autónoma da Madeira due to the fact that the imputed value of the variable was $x_i > 1$ the value was blocked to 1 <p>14. Country Romania:</p> <ol style="list-style-type: none"> 1. region Centru for the year 2013 due to the fact the value was negative, the value of the next year was imputed 2. regions Nord-Vest and Sud - Muntenia for the years 2013 and 2014 due to the fact the value was negative,
--	--

	<p>the value of the next year was imputed</p> <ol style="list-style-type: none"> regions Nord-Est, Sud-Est and Sud-Vest Oltenia for the years 2013, 2014 and 2015 due to the fact the value was negative, the value of the next year was imputed <p>15. Country Slovakia:</p> <ol style="list-style-type: none"> regions Západné Slovensko and Východné Slovensko for the year 2013 due to the fact the value was negative, the value of the next year was imputed <p>16. Country Sweden:</p> <ol style="list-style-type: none"> region Stockholm for the years 2013, 2014 and 2015 due to the fact that the imputed value of the variable was $x_i > 1$ the value was blocked to 1 region Övre Norrland for the years 2013 and 2014 due to the fact the value was negative, the value of the next year was imputed <p>17. Country United Kingdom:</p> <ol style="list-style-type: none"> regions North East, North West, Scotland and Northern Ireland due to the fact the value was negative, the value of the next year was imputed region London for the years 2013 and 2014 due to the fact that the imputed value of the variable was $x_i > 1$ the value was blocked to 1 region Wales for the years 2013 and 2014 due to the fact the value was negative, the value of the next year was imputed
Participation rate in education and training (last 4 weeks) by NUTS 2 regions	<p>Imputation for:</p> <ol style="list-style-type: none"> Country Ireland top down imputation for the years 2013-2017 where the value of the country was used as the values for the regions, due to the fact that there was no clear relationship between this variable and to population or GDP Country France bottom up imputation for the years 2013-2017 weighting with population, given the values of the NUTS 2 regions for the years 2013- 2017 and looking the values of the NUTS 1 regions, specifically it was used the weighted average type where X, Y are positively related: $X = (y_i / Y) * x_i$. Here Y, y_i are numbers that is the population for which $Y = \sum(Y_i)$ and X, x_i is percentage that is the participation rate Country Greece, region Voreio Aigaio, for the years 2015 and 2016 the values were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y = y_1 + (x - x_1) * (y_2 - y_1) / (x_2 - x_1)$)
Total R&D personnel and researchers by sectors of performance, sex and NUTS 2 regions	<p>Imputation for:</p> <ol style="list-style-type: none"> Country Germany for the years 2014 and the 2016 the values were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y = y_1 + (x - x_1) * (y_2 - y_1) / (x_2 - x_1)$) for all regions and for the year 2013 only two regions Niederbayern, Oberpfalz Country Ireland given the values of the 2010 and 2011, for the years 2013 and the 2017 the values were imputed with the method of the

	<p>linear interpolation (excel linear interpolation tool, function $y=y_1+(x-x_1)*(y_2-y_1)/(x_2-x_1)$) for all regions</p> <ol style="list-style-type: none"> Country Greece for the years 2014 and the 2016 the values were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y=y_1+(x-x_1)*(y_2-y_1)/(x_2-x_1)$) for all regions Country Spain for the years 2016 and the 2017 the values were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y=y_1+(x-x_1)*(y_2-y_1)/(x_2-x_1)$) for two regions Ciudad Autónoma de Ceuta, Ciudad Autónoma de Melilla Country France for the years 2014-2017 the values were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y=y_1+(x-x_1)*(y_2-y_1)/(x_2-x_1)$) for all regions Country Italy for the years 2015 and 2016 the values were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y=y_1+(x-x_1)*(y_2-y_1)/(x_2-x_1)$) for three regions Umbria, Molise and Basilicata only for the year 2016 Country Austria for the years 2014 and 2016 the values were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y=y_1+(x-x_1)*(y_2-y_1)/(x_2-x_1)$) for all regions Country Poland for the years 2016 and 2017 the values were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y=y_1+(x-x_1)*(y_2-y_1)/(x_2-x_1)$) for six regions Łódzkie, Lubelskie, Podkarpackie, Świętokrzyskie, Podlaskie and Mazowieckie for the years 2013-2017 given the years 2011 and 2012 Country Finland for the year 2014 the values were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y=y_1+(x-x_1)*(y_2-y_1)/(x_2-x_1)$) for all regions Country Sweden for the years 2014 and 2016 the values were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y=y_1+(x-x_1)*(y_2-y_1)/(x_2-x_1)$) for all regions and for the year 2017 for two regions Småland med öarna and Mellersta Norrland Country United Kingdom for the year 2017 the values were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y=y_1+(x-x_1)*(y_2-y_1)/(x_2-x_1)$) for all regions
<p>Researchers, all sectors by NUTS 2 regions % of total employment</p>	<p>Imputation for:</p> <ol style="list-style-type: none"> All countries for the year 2017 the values were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y=y_1+(x-x_1)*(y_2-y_1)/(x_2-x_1)$) For the year 2014 the values were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y=y_1+(x-x_1)*(y_2-y_1)/(x_2-x_1)$) for the regions of the following countries:

	<ol style="list-style-type: none"> 1. Germany 2. Greece 3. Austria 4. Finland 5. Sweden <p>3. For the year 2016 the values were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y=y1+(x-x1)*(y2-y1)/(x2-x1)$) for the regions of the following countries:</p> <ol style="list-style-type: none"> 1. Germany 2. Greece 3. Italy only three regions Umbria, Molise, Basilicata 4. Poland only six regions Łódzkie, Mazowieckie, Lubelskie, Podkarpackie, Świętokrzyskie, Podlaskie 5. Sweden 6. Lithuania <p>4. For the year 2015 the values were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y=y1+(x-x1)*(y2-y1)/(x2-x1)$) for the regions of the following countries:</p> <ol style="list-style-type: none"> 1. Italy only two regions Umbria, Molise 2. Lithuania <p>5. Country Ireland both regions given the values of the years 2010 and 2011, for the years 2013-2017 the values were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y=y1+(x-x1)*(y2-y1)/(x2-x1)$)</p> <p>6. Country Hungary region Közép-Magyarország given the values for the years 2011 and 2012, for the years 2013-2017 the values were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y=y1+(x-x1)*(y2-y1)/(x2-x1)$)</p> <p>7. Country Poland region Mazowieckie given the values for the years 2011 and 2012, for the years 2013-2017 the values were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y=y1+(x-x1)*(y2-y1)/(x2-x1)$)</p> <p>8. Country Belgium bottom up imputation for the years 2013-2017 weighting with population, given the values of the NUTS 2 regions for the years 2013- 2017 and looking the values of the NUTS 1 regions, specifically it was used the weighted average type where X, Y are positively related: $X=(y_i / Y)*x_i$. Here Y, y_i are numbers that is the population for which $Y=\text{Sum}(Y_i)$ and X, x_i is the percentage that is the researchers as a percentage of total employment</p> <p>9. Country Bulgaria bottom up imputation for the years 2013-2017 weighting with population, given the values of the NUTS 2 regions for the years 2013- 2017 and looking the values of the NUTS 1 regions, specifically it was used the weighted average type where X, Y are positively related: $X=(y_i / Y)*x_i$. Here Y, y_i are numbers that is the population for which $Y=\text{Sum}(Y_i)$ and X, x_i is the percentage that is the researchers as a percentage of total employment</p> <p>10. Country France bottom up imputation for the years 2013-2017 weighting with population, given the values of the NUTS 2 regions</p>
--	--

	<p>for the years 2013- 2017 and looking the values of the NUTS 1 regions, specifically it was used the weighted average type where X, Y are positively related: $X=(y_i/ Y)*x_i$. Here Y, y_i are numbers that is the population for which $Y=\text{Sum}(Y_i)$ and X, x_i is the percentage that is the researchers as a percentage of total employment</p> <p>11. Country Austria bottom up imputation for the years 2013-2017 weighting with population, given the values of the NUTS 2 regions for the years 2013- 2017 and looking the values of the NUTS 1 regions, specifically it was used the weighted average type where X, Y are positively related: $X=(y_i/ Y)*x_i$. Here Y, y_i are numbers that is the population for which $Y=\text{Sum}(Y_i)$ and X, x_i is the percentage that is the researchers as a percentage of total employment</p> <p>12. Country United Kingdom bottom up imputation for the years 2013-2017 weighting with population, given the values of the NUTS 2 regions for the years 2013- 2017 and looking the values of the NUTS 1 regions, specifically it was used the weighted average type where X, Y are positively related: $X=(y_i/ Y)*x_i$. Here Y, y_i are numbers that is the population for which $Y=\text{Sum}(Y_i)$ and X, x_i is the percentage that is the researchers as a percentage of total employment</p>
Human resources in science and technology (HRST) by NUTS 2 regions % of active population	<p>Imputation for:</p> <ol style="list-style-type: none"> 1. Country Belgium bottom up imputation for the years 2013-2017 weighting with population, given the values of the NUTS 2 regions for the years 2013- 2017 and looking the values of the NUTS 1 regions, specifically it was used the weighted average type where X, Y are positively related: $X=(y_i/ Y)*x_i$. Here Y, y_i are numbers that is the population for which $Y=\text{Sum}(Y_i)$ and X, x_i is the percentage that is the human resources in science and technology as a percentage of active population 2. Country Bulgaria bottom up imputation for the years 2013-2017 weighting with population, given the values of the NUTS 2 regions for the years 2013- 2017 and looking the values of the NUTS 1 regions, specifically it was used the weighted average type where X, Y are positively related: $X=(y_i/ Y)*x_i$. Here Y, y_i are numbers that is the population for which $Y=\text{Sum}(Y_i)$ and X, x_i is the percentage that is the human resources in science and technology as a percentage of active population 3. Country France bottom up imputation for the years 2013-2017 weighting with population, given the values of the NUTS 2 regions for the years 2013- 2017 and looking the values of the NUTS 1 regions, specifically it was used the weighted average type where X, Y are positively related: $X=(y_i/ Y)*x_i$. Here Y, y_i are numbers that is the population for which $Y=\text{Sum}(Y_i)$ and X, x_i is the percentage that is the human resources in science and technology as a percentage of active population 4. Country Austria bottom up imputation for the years 2013-2017 weighting with population, given the values of the NUTS 2 regions for the years 2013- 2017 and looking the values of the NUTS 1 regions, specifically it was used the weighted average type where X, Y are positively related: $X=(y_i/ Y)*x_i$. Here Y, y_i are numbers that is the population for which $Y=\text{Sum}(Y_i)$ and X, x_i is the percentage that is the human resources in science and technology as a percentage of active population

	<p>5. Country United Kingdom bottom up imputation for the years 2013-2017 weighting with population, given the values of the NUTS 2 regions for the years 2013- 2017 and looking the values of the NUTS 1 regions, specifically it was used the weighted average type where X, Y are positively related: $X=(y_i/ Y)*x_i$. Here Y, y_i are numbers that is the population for which $Y=Sum(Y_i)$ and X, x_i is the percentage that is the human resources in science and technology as a percentage of active population</p> <p>6. For the countries Ireland for both regions, Hungary only one region Közép-Magyarország and Lithuania, given the years 2010 and 2011 the values for the years 2013-2017 were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y=y_1+(x-x_1)*(y_2-y_1)/(x_2-x_1)$)</p>
Employment in high-tech sectors by NUTS 2 regions % of total employment	<p>Imputation for:</p> <p>1. Country Belgium bottom up imputation for the years 2013-2017 weighting with GDP, given the values of the NUTS 2 regions for the years 2013- 2017 and looking the values of the NUTS 1 regions, specifically it was used the weighted average type where X, Y are positively related: $X=(y_i/ Y)*x_i$. Here Y, y_i are numbers that is the GDP for which $Y=Sum(Y_i)$ and X, x_i is the employment in high-tech sectors</p> <p>2. Country Bulgaria bottom up imputation for the years 2013-2017 weighting with GDP, given the values of the NUTS 2 regions for the years 2013- 2017 and looking the values of the NUTS 1 regions, specifically it was used the weighted average type where X, Y are positively related: $X=(y_i/ Y)*x_i$. Here Y, y_i are numbers that is the GDP for which $Y=Sum(Y_i)$ and X, x_i is the employment in high-tech sectors</p> <p>3. Country France bottom up imputation for the years 2013-2017 weighting with GDP, given the values of the NUTS 2 regions for the years 2013- 2017 and looking the values of the NUTS 1 regions, specifically it was used the weighted average type where X, Y are positively related: $X=(y_i/ Y)*x_i$. Here Y, y_i are numbers that is the GDP for which $Y=Sum(Y_i)$ and X, x_i is the employment in high-tech sectors</p> <p>4. Country Austria bottom up imputation for the years 2013-2017 weighting with GDP, given the values of the NUTS 2 regions for the years 2013- 2017 and looking the values of the NUTS 1 regions, specifically it was used the weighted average type where X, Y are positively related: $X=(y_i/ Y)*x_i$. Here Y, y_i are numbers that is the GDP for which $Y=Sum(Y_i)$ and X, x_i is the employment in high-tech sectors</p> <p>5. Country United Kingdom bottom up imputation for the years 2013-2017 weighting with GDP, given the values of the NUTS 2 regions for the years 2013- 2017 and looking the values of the NUTS 1 regions, specifically it was used the weighted average type where X, Y are positively related: $X=(y_i/ Y)*x_i$. Here Y, y_i are numbers that is the GDP for which $Y=Sum(Y_i)$ and X, x_i is the employment in high-tech sectors</p> <p>6. Country Italy given the value of the country top down up imputation for the years 2013-2017 weighting with GDP for two regions Valle d'Aosta/Vallée d'Aoste and Molise, specifically it was used the weighted average type where X, Y are positively related: $x_i=(y_i/$</p>

	<p>$Y) * X$. Here Y, y_i are numbers that is the GDP for which $Y = \text{Sum}(Y_i)$, but X, x_i is the employment in high-tech sectors. In this case the percentages were converted into numbers with the following process: the population of the country multiplied with the percentage of the country's employment gave the number X of the country's employees, then the y_i/Y, x_i were found with the above formula and the region's employment in percentage was found by dividing the x_i with the region's population</p> <p>7. Country Greece given the value of the country top down up imputation for the years 2013-2017 weighting with GDP for five regions Dytiki Makedonia, Ipeiros, Ionia Nisia, Voreio Aigaio and Notio Aigaio, specifically it was used the weighted average type where X, Y are positively related: $x_i = (y_i / Y) * X$. Here Y, y_i are numbers that is the GDP for which $Y = \text{Sum}(Y_i)$, but X, x_i is the employment in high-tech sectors. In this case the percentages were converted into numbers with the following process: the population of the country multiplied with the percentage of the country's employment gave the number X of the country's employees, then the y_i/Y, x_i were found with the above formula and the region's employment in percentage was found by dividing the x_i with the region's population</p> <p>8. Country Spain given the value of the country top down up imputation for the years 2013-2017 weighting with GDP for two regions Ciudad Autónoma de Ceuta, Ciudad Autónoma de Melilla, specifically it was used the weighted average type where X, Y are positively related: $x_i = (y_i / Y) * X$. Here Y, y_i are numbers that is the GDP for which $Y = \text{Sum}(Y_i)$, but X, x_i is the employment in high-tech sectors. In this case the percentages were converted into numbers with the following process: the population of the country multiplied with the percentage of the country's employment gave the number X of the country's employees, then the y_i/Y, x_i were found with the above formula and the region's employment in percentage was found by dividing the x_i with the region's population</p> <p>9. Country Poland given the value of the country top down up imputation for the years 2013-2017 weighting with GDP for one region Łódzkie, specifically it was used the weighted average type where X, Y are positively related: $x_i = (y_i / Y) * X$. Here Y, y_i are numbers that is the GDP for which $Y = \text{Sum}(Y_i)$, but X, x_i is the employment in high-tech sectors. In this case the percentages were converted into numbers with the following process: the population of the country multiplied with the percentage of the country's employment gave the number X of the country's employees, then the y_i/Y, x_i were found with the above formula and the region's employment in percentage was found by dividing the x_i with the region's population</p> <p>10. Country Portugal given the value of the country top down up imputation for the years 2013-2017 weighting with GDP for three regions Algarve, Região Autónoma dos Açores, Região Autónoma da Madeira, specifically it was used the weighted average type where X, Y are positively related: $x_i = (y_i / Y) * X$. Here Y, y_i are numbers that is the GDP for which $Y = \text{Sum}(Y_i)$, but X, x_i is the employment in high-tech sectors. In this case the percentages were converted into numbers with the following process: the population of the country multiplied with the percentage of the country's employment gave the number X of the country's employees, then</p>
--	--

	<p>the y_i/Y, x_i were found with the above formula and the region's employment in percentage was found by dividing the x_i with the region's population</p> <ol style="list-style-type: none"> Country Finland given the value of the country top down up imputation for the years 2013-2017 weighting with GDP for one region Aland specifically it was used the weighted average type where X, Y are positively related: $x_i = (y_i/Y) * X$. Here Y, y_i are numbers that is the GDP for which $Y = \text{Sum}(Y_i)$, but X, x_i is the employment in high-tech sectors. In this case the percentages were converted into numbers with the following process: the population of the country multiplied with the percentage of the country's employment gave the number X of the country's employees, then the y_i/Y, x_i were found with the above formula and the region's employment in percentage was found by dividing the x_i with the region's population Country Ireland for both regions given the values of the years 2010 and 2011, for the years 2013-2017 the values were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y = y_1 + (x - x_1) * (y_2 - y_1) / (x_2 - x_1)$) Country Hungary for only one region Közép-Magyarország given the values of the years 2010 and 2011, for the years 2013-2017 the values were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y = y_1 + (x - x_1) * (y_2 - y_1) / (x_2 - x_1)$) Country Lithuania given the values of the years 2010 and 2011, for the years 2013-2017 the values were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y = y_1 + (x - x_1) * (y_2 - y_1) / (x_2 - x_1)$)
Oppurtunity Perception	Top down imputation, the value of the country was used as the value of the region due to the fact that there was no clear relationship between this variable and to population or GDP
Startup skills	Top down imputation the value of the country was used as the value of the region due to the fact that there was no clear relationship between this variable and to population or GDP
Risk acceptance	Top down imputation the value of the country was used as the value of the region due to the fact that there was no clear relationship between this variable and to population or GDP
Intramural R&D expenditure (GERD) by sectors of performance and NUTS 2 regions	<p>Imputation for:</p> <ol style="list-style-type: none"> Country Ireland given the value of the country top down imputation for the years 2013-2017 weighting with GDP for both regions, where the data is not percentages and X, Y are positively related, it was used the function $x_i = (y_i/Y) * X$. The x_i, y_i are numbers for which $X = \text{sum}(x_i)$ and $Y = \text{sum}(Y_i)$, where X, x_i is the number of GERD that is euro per inhabitant and Y, y_i is the GDP For all countries for the year 2017, except Ireland and France which had complete data, the values were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y = y_1 + (x - x_1) * (y_2 - y_1) / (x_2 - x_1)$) For the year 2016 the values were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y = y_1 + (x - x_1) * (y_2 - y_1) / (x_2 - x_1)$) for the regions of the following countries:

	<ol style="list-style-type: none"> 1. Belgium 2. Germany 3. Greece 4. Spain only two regions (Ciudad Autónoma de Ceuta, Ciudad Autónoma de Melilla) 5. Italy only five regions (Umbria, Marche, Lazio, Abruzzo, Molise) 6. Austria 7. Poland only six regions (Łódzkie, Mazowieckie, Lubelskie, Podkarpackie, Świętokrzyskie, Podlaskie) 8. Sweden <p>4. For the year 2014 the values were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y=y1+(x-x1)*(y2-y1)/(x2-x1)$) for the regions of the following countries:</p> <ol style="list-style-type: none"> 1. Germany 2. Greece 3. Austria 4. Finland 5. Sweden
European Quality of Government Index	<p>Due to the fact that there was no clear relationship between this variable and to population or GDP the imputation was conducted for:</p> <ol style="list-style-type: none"> 1. Country Austria bottom up imputation for the years 2013-2017 where the average values of the NUTS 2 regions were imputed as the values of the NUTS 1 regions 2. Country Bulgaria bottom up imputation for the years 2013-2017 where the average values of the NUTS 2 regions were imputed as the values of the NUTS 1 regions 3. Country France bottom up imputation for the years 2013-2017 where the average values of the NUTS 2 regions were imputed as the values of the NUTS 1 regions 4. Country Germany top down imputation for the years 2013-2017 where the values of the NUTS 1 regions were imputed as the values of the NUTS 2 regions 5. Country Greece top down imputation for the years 2013-2017 where the values of the NUTS 1 regions were imputed as the values of the NUTS 2 regions 6. Country Sweden top down imputation for the years 2013-2017 where the values of the NUTS 1 regions were imputed as the values of the NUTS 2 regions 7. Country Spain top down imputation for the years 2013-2017 where the value of the country were imputed as the values of the NUTS 2 regions, imputation only for two regions, Ciudad Autónoma de Ceuta and Ciudad Autónoma de Melilla
Quality Pillar of EQI Index	<p>Due to the fact that there was no clear relationship between this variable and to population or GDP the imputation was conducted for:</p> <ol style="list-style-type: none"> 1. Country Austria bottom up imputation for the years 2013-2017 where the average values of the NUTS 2 regions were imputed as the values of the NUTS 1 regions 2. Country Bulgaria bottom up imputation for the years 2013-2017 where the average values of the NUTS 2 regions were imputed as

	<p>the values of the NUTS 1 regions</p> <ol style="list-style-type: none"> Country France bottom up imputation for the years 2013-2017 where the average values of the NUTS 2 regions were imputed as the values of the NUTS 1 regions Country Germany top down imputation for the years 2013-2017 where the values of the NUTS 1 regions were imputed as the values of the NUTS 2 regions Country Greece top down imputation for the years 2013-2017 where the values of the NUTS 1 regions were imputed as the values of the NUTS 2 regions Country Sweden top down imputation for the years 2013-2017 where the values of the NUTS 1 regions were imputed as the values of the NUTS 2 regions Country Spain top down imputation for the years 2013-2017 where the value of the country were imputed as the values of the two NUTS 2 regions, imputation only for two regions, Ciudad Autónoma de Ceuta and Ciudad Autónoma de Melilla
Impartiality Pillar of EQI Index	<p>Due to the fact that there was no clear relationship between this variable and to population or GDP the imputation was conducted for:</p> <ol style="list-style-type: none"> Country Austria bottom up imputation for the years 2013-2017 where the average values of the NUTS 2 regions were imputed as the values of the NUTS 1 regions Country Bulgaria bottom up imputation for the years 2013-2017 where the average values of the NUTS 2 regions were imputed as the values of the NUTS 1 regions Country France bottom up imputation for the years 2013-2017 where the average values of the NUTS 2 regions were imputed as the values of the NUTS 1 regions Country Germany top down imputation for the years 2013-2017 where the values of the NUTS 1 regions were imputed as the values of the NUTS 2 regions Country Greece top down imputation for the years 2013-2017 where the values of the NUTS 1 regions were imputed as the values of the NUTS 2 regions Country Sweden top down imputation for the years 2013-2017 where the values of the NUTS 1 regions were imputed as the values of the NUTS 2 regions Country Spain top down imputation for the years 2013-2017 where the value of the country were imputed as the values of the two NUTS 2 regions, imputation only for two regions, Ciudad Autónoma de Ceuta and Ciudad Autónoma de Melilla
Corruption Pillar of EQI Index	<p>Due to the fact that there was no clear relationship between this variable and to population or GDP the imputation was conducted for:</p> <ol style="list-style-type: none"> Country Austria bottom up imputation for the years 2013-2017 where the average values of the NUTS 2 regions were imputed as the values of the NUTS 1 regions Country Bulgaria bottom up imputation for the years 2013-2017

	<p>where the average values of the NUTS 2 regions were imputed as the values of the NUTS 1 regions</p> <ol style="list-style-type: none"> Country France bottom up imputation for the years 2013-2017 where the average values of the NUTS 2 regions were imputed as the values of the NUTS 1 regions Country Germany top down imputation for the years 2013-2017 where the values of the NUTS 1 regions were imputed as the values of the NUTS 2 regions Country Greece top down imputation for the years 2013-2017 where the values of the NUTS 1 regions were imputed as the values of the NUTS 2 regions Country Sweden top down imputation for the years 2013-2017 where the values of the NUTS 1 regions were imputed as the values of the NUTS 2 regions Country Spain top down imputation for the years 2013-2017 where the value of the country were imputed as the values of the two NUTS 2 regions, imputation only for two regions, Ciudad Autónoma de Ceuta and Ciudad Autónoma de Melilla
Total expenditures	<p>EU</p> <p>Imputation for:</p> <ol style="list-style-type: none"> For all countries given the value of the country, top down imputation for the years 2013-2017 weighting with GDP for all regions, where the data is not percentages and X, Y are positively related, it was used the function $x_i = (y_i/Y) * X$. The x_i, y_i are numbers for which $X = \sum(x_i)$ and $Y = \sum(Y_i)$, where X, x_i is the total EU expenditures in million euro and Y, y_i is the GDP
Employment by full-time/part-time, sex and NUTS 2 regions aged 15 to 64 years	<p>Imputation for:</p> <ol style="list-style-type: none"> Country Ireland given the value of the country top down imputation for the years 2013-2017 weighting with GDP for both regions, where the data is not percentages and X, Y are positively related, it was used the function $x_i = (y_i/Y) * X$. The x_i, y_i are numbers for which $X = \sum(x_i)$ and $Y = \sum(Y_i)$, where X, x_i is the employment in thousand persons and Y, y_i is the GDP Country France top down imputation for the years 2013-2017 weighting with GDP, where the data is not percentages and X, Y are positively related, it was used the function $x_i = (y_i/Y) * X$. The x_i, y_i are numbers for which $X = \sum(x_i)$ and $Y = \sum(Y_i)$, where X, x_i is the employment in thousand persons and Y, y_i is the GDP
Regional Competiveness Index	<p>Imputation for:</p> <ol style="list-style-type: none"> All countries given the values for the years 2013 and 2016, for the years 2014, 2015 and 2017 the values were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y = y_1 + (x - x_1) * (y_2 - y_1) / (x_2 - x_1)$) Country Belgium, given the values of the NUTS 2 regions for the years 2013 and 2016 and looking the values of the NUTS 1 regions, bottom up imputation weighting with GDP was used, specifically it was used the weighted average type where X, Y are positively related: $X = (y_i / Y) * x_i$. Here Y, y_i are numbers that is the GDP for which $Y = \sum(Y_i)$ and X, x_i is the scores of the Regional Competiveness Index

	<p>3. Country Bulgaria, given the values of the NUTS 2 regions for the years 2013 and 2016 and looking the values of the NUTS 1 regions, bottom up imputation weighting with GDP was used, specifically it was used the weighted average type where X, Y are positively related: $X=(y_i/Y)*x_i$. Here Y, y_i are numbers that is the GDP for which $Y=\text{Sum}(Y_i)$ and X, x_i are the scores of the Regional Competitiveness Index</p> <p>4. Country France, given the values of the NUTS 2 regions for the years 2013 and 2016 and looking the values of the NUTS 1 regions, bottom up imputation weighting with GDP was used, specifically it was used the weighted average type where X, Y are positively related: $X=(y_i/Y)*x_i$. Here Y, y_i are numbers that is the GDP for which $Y=\text{Sum}(Y_i)$ and X, x_i are the scores of the Regional Competitiveness Index</p> <p>5. Country Austria, given the values of the NUTS 2 regions for the years 2013 and 2016 and looking the values of the NUTS 1 regions, bottom up imputation weighting with GDP was used, specifically it was used the weighted average type where X, Y are positively related: $X=(y_i/Y)*x_i$. Here Y, y_i are numbers that is the GDP for which $Y=\text{Sum}(Y_i)$ and X, x_i are the scores of the Regional Competitiveness Index</p> <p>6. Country United Kingdom, given the values of the NUTS 2 regions for the years 2013 and 2016 and looking the values of the NUTS 1 regions, bottom up imputation weighting with GDP was used, specifically it was used the weighted average type where X, Y are positively related: $X=(y_i/Y)*x_i$. Here y_i are numbers that is the GDP for which $Y=\text{Sum}(Y_i)$ and X, x_i are the scores of the Regional Competitiveness Index</p>
Unemployment rates by sex, age and NUTS 2 regions (%)	<p>Imputation for:</p> <p>1. Country Ireland given the value of the country top down imputation for the years 2013-2017 weighting with GDP for both regions, where the data is percentages and X, Y are negatively related, it was used the function $x_i=n*[(Y/y_i)/\text{sum}(Y/y_i)]*X$. The Y, y_i are numbers that is the GDP for which $Y=\text{sum}(Y_i)$ and X, x_i is the percentage that is the unemployment rate</p> <p>2. Country France given the values of the NUTS 2 regions for the years 2013-2017 and looking the values of the NUTS 1 regions, bottom up imputation weighting with GDP was used, specifically it was used the weighted average type where X, Y are negatively related, it was used the function $x_i=[(Y/y_i)/\text{sum}(Y/y_i)]*X$. Here Y, y_i are numbers that is the GDP for which $Y=\text{Sum}(Y_i)$ and X, x_i is the percentage that is the unemployment rate</p>
Gross domestic product (GDP) per capita by NUTS 2 regions	<p>Imputation for:</p> <p>1. Country Ireland for both regions by having the GDP in million euro and the population of both the country and regions, the GDP per capita was calculated by multiplying the region's GDP with 1000 and divide it by the region's population</p> <p>2. Country France for all regions by having the GDP in million euro and the population of both the country and regions, the GDP per capita was calculated by multiplying the region's GDP with 1000 and divide it by the region's population</p> <p>In order to find the Gross Domestic Product in million euro for the countries</p>

	<p>the following processes were followed:</p> <ol style="list-style-type: none"> 1. Country Ireland given the value of the country top down imputation for the years 2013-2017 weighting with population for both regions, where the data is not percentages and X, Y are positively related, it was used the function $xi=(y_i/Y)*X$. The xi, y_i are numbers for which $X=\sum(xi)$ and $Y=\sum(Y_i)$, where X, xi is the gross domestic product in million euro and Y, y_i is the population 2. Country France top down imputation for the years 2013-2017 weighting with GDP, where the data is not percentages and X, Y are positively related, it was used the function $xi=(y_i/Y)*X$. The xi, y_i are numbers for which $X=\sum(xi)$ and $Y=\sum(Y_i)$, where X, xi is the GDP of the NUTS 1 regions and Y, y_i is the GDP of the country 3. Country Netherlands for the years 2013 and 2014 the values were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y=y_1+(x-x_1)*(y_2-y_1)/(x_2-x_1)$) for all the regions 4. Country Poland for the year 2013 the values were imputed with the method of the linear interpolation (excel linear interpolation tool, function $y=y_1+(x-x_1)*(y_2-y_1)/(x_2-x_1)$) for all the regions
Gross fixed capital formation by NUTS 2 regions	<p>Imputation for:</p> <ol style="list-style-type: none"> 1. For all countries given their values top down imputation for the years 2013-2017 weighting with GDP for all regions, where the data is not percentages and X, Y are positively related, it was used the function $xi=(y_i/Y)*X$. The xi, y_i are numbers for which $X=\sum(xi)$ and $Y=\sum(Y_i)$, where X, xi is the gross fixed capital formation in million euro and Y, y_i is the GDP
Gross value added at basic prices by NUTS 2 regions	<p>Imputation for:</p> <ol style="list-style-type: none"> 1. For all countries given their values top down imputation for the years 2013-2017 weighting with GDP for all regions, where the data is not percentages and X, Y are positively related, it was used the function $xi=(y_i/Y)*X$. The xi, y_i are numbers for which $X=\sum(xi)$ and $Y=\sum(Y_i)$, where X, xi is the gross fixed capital formation in million euro and Y, y_i is the GDP
People at risk of poverty or social exclusion by NUTS 2 regions % of total population	<p>Imputation for:</p> <ol style="list-style-type: none"> 1. Countries Belgium, France, Greece, Poland, Portugal and United Kingdom top down imputation for the years 2013-2017 weighting with GDP per capita, where the data is not percentages and X, Y are negatively related, it was used the function $xi=n*[(Y/y_i)/\sum(Y/y_i)]*X$. The y_i are numbers that is the GDP for which $Y=\sum(Y_i)$ and X, xi is the percentage of total population that is at risk of poverty or social exclusion 2. Country Austria given the values of the NUTS 2 regions for the years 2013-2017 and looking the values of the NUTS 1 regions, bottom up imputation weighting with GDP was used, specifically it was used the weighted average type where X, Y are negatively related, it was used the function $xi=[(Y/y_i)/\sum(Y/y_i)]*X$. Here Y, y_i are numbers that is the GDP for which $Y=\sum(Y_i)$ and X, xi is the percentage of total population that is at risk of poverty or social exclusion 3. Country Germany the values for the years 2013-2015 were imputed given the years 2016 and 2017 with the method of the linear

	<p>interpolation (excel linear interpolation tool, function $y=y_1+(x-x_1)*(y_2-y_1)/(x_2-x_1)$) whereas for the region Oberfranken top down imputation for the years 2013-2017 weighting with GDP per capita, where the data is not percentages and X, Y are negatively related, it was used the function $x_i=n*[(Y/y_i)/\sum(Y/y_i)]*X$. The Y, y_i are numbers that is the GDP for which $Y=\sum(Y_i)$ and X, x_i is the percentage of total population that is at risk of poverty or social exclusion</p> <p>4. Country Netherlands the values for the years 2013-2015 were imputed given the years 2016 and 2017 with the method of the linear interpolation (excel linear interpolation tool, function $y=y_1+(x-x_1)*(y_2-y_1)/(x_2-x_1)$)</p>
--	--

Appendix 3. Results NWM-TOPSIS

Macro Level Results NWM-TOPSIS

2018	Human Capital	rs = 0.9896	Culture	rs = 0.96866	Finance	rs = 0.96607	Policy	rs = 0.99562
	TOPSIS Rank	NWM RANK	TOPSIS Rank	NWM RANK	TOPSIS Rank	NWM RANK	TOPSIS Rank	NWM Rank
Belgium	9	8	12	16	5	5	7	8
Bulgaria	25	26	27	26	25	26	28	28
Czech Republic	19	19	19	18	14	14	18	18
Denmark	1	2	3	1	6	9	5	4
Germany	12	12	11	14	1	1	11	9
Estonia	11	11	1	6	8	6	9	10
Ireland	6	5	6	5	22	19	6	6
Greece	22	23	22	21	26	23	24	24
Spain	18	18	17	17	17	17	19	19
France	8	9	14	13	7	7	10	11
Croatia	27	27	24	23	20	22	25	26
Italy	23	21	26	27	23	18	21	21
Cyprus	14	14	15	12	27	27	16	17
Latvia	20	20	20	19	19	24	17	16
Lithuania	15	17	23	24	12	16	14	14
Luxembourg	3	6	10	9	9	10	8	7
Hungary	26	24	28	28	15	13	23	22
Malta	17	15	7	8	24	25	20	20
Netherlands	5	3	4	3	11	11	1	1
Austria	10	10	9	11	4	4	12	12
Poland	21	22	18	20	16	15	27	27
Portugal	13	13	16	15	13	12	13	13
Romania	28	28	25	25	28	28	26	25
Slovenia	16	16	13	10	21	20	15	15
Slovakia	24	25	21	22	18	21	22	23
Finland	4	4	5	2	3	3	3	3
Sweden	2	1	8	6	2	2	2	2
United Kingdom	7	7	2	4	10	8	4	5

2018	Outputs	rs = 0.98207	Outcomes	rs = 0.97359	Impacts	rs = 0.96552
	TOPSIS Rank	NWM RANK	TOPSIS Rank	NWM RANK	TOPSIS Rank	NWM Rank
Belgium	9	7	10	13	10	13
Bulgaria	25	25	25	24	25	25
Czech Republic	20	18	8	9	13	11
Denmark	11	10	18	17	4	3
Germany	6	8	3	3	2	2
Estonia	4	4	19	19	12	10

Ireland	17	17	1	1	1	6
Greece	13	16	20	16	28	28
Spain	22	23	16	20	24	20
France	12	12	14	12	11	12
Croatia	19	19	28	28	23	27
Italy	14	14	17	18	27	26
Cyprus	18	21	13	8	22	23
Latvia	21	22	23	23	26	24
Lithuania	15	15	21	21	16	16
Luxembourg	3	3	9	10	5	9
Hungary	27	26	12	10	20	18
Malta	10	11	7	7	14	14
Netherlands	8	6	6	6	3	1
Austria	2	1	15	14	9	8
Poland	26	27	24	25	17	17
Portugal	5	5	27	27	18	19
Romania	28	28	26	26	21	21
Slovenia	23	20	22	22	15	15
Slovakia	24	23	5	5	19	22
Finland	1	2	11	15	7	5
Sweden	7	9	4	4	8	7
United Kingdom	16	13	2	2	6	4

Meso Level Results NWM-TOPSIS

2018	rs =0.98276		rs =0.98736		rs =0.97008			
Human Capital	TOPSIS Rank	NWM RANK	Culture	TOPSIS Rank	NWM RANK	Finance	TOPSIS Rank	NWM RANK
Région de Bruxelles-Capitale / Brussels Hoofdstedelijk Gewest	18	35	Région de Bruxelles-Capitale / Brussels Hoofdstedelijk Gewest	92	117	Région de Bruxelles-Capitale / Brussels Hoofdstedelijk Gewest	68	51
Vlaams Gewest	55	46	Vlaams Gewest	89	109	Vlaams Gewest	24	14
Région Wallonne	100	101	Région Wallonne	88	102	Région Wallonne	42	66
Severna i iztochna Bulgaria	198	205	Severna i iztochna Bulgaria	206	210	Severna i iztochna Bulgaria	201	204
Yugozapadna i yuzhna tsentralna Bulgaria	111	113	Yugozapadna i yuzhna tsentralna Bulgaria	204	208	Yugozapadna i yuzhna tsentralna Bulgaria	144	156
Praha	10	8	Praha	149	149	Praha	22	28
Strední Čechy	122	126	Strední Čechy	151	157	Strední Čechy	67	48
Jihozápad	131	127	Jihozápad	150	151	Jihozápad	44	26
Severozápad	201	204	Severozápad	153	165	Severozápad	190	180
Severovýchod	125	116	Severovýchod	147	147	Severovýchod	45	36
Jihovýchod	47	36	Jihovýchod	146	146	Jihovýchod	8	6
Strední Morava	96	92	Strední Morava	143	143	Strední Morava	51	32

Moravskoslezsko	128	117	Moravskoslezsko	148	148	Moravskoslezsko	100	99
Hovedstaden	1	4	Hovedstaden	20	7	Hovedstaden	13	19
Sjælland	87	111	Sjælland	21	9	Sjælland	149	164
Syddanmark	46	61	Syddanmark	23	11	Syddanmark	115	120
Midtjylland	20	27	Midtjylland	22	10	Midtjylland	33	43
Nordjylland	56	67	Nordjylland	24	13	Nordjylland	120	141
Stuttgart	36	52	Stuttgart	76	78	Stuttgart	12	30
Karlsruhe	48	56	Karlsruhe	76	78	Karlsruhe	7	7
Freiburg	130	133	Freiburg	76	78	Freiburg	29	18
Tübingen	54	43	Tübingen	76	78	Tübingen	10	10
Oberbayern	25	25	Oberbayern	51	52	Oberbayern	9	9
Niederbayern	139	138	Niederbayern	51	52	Niederbayern	191	168
Oberpfalz	132	136	Oberpfalz	51	52	Oberpfalz	180	147
Oberfranken	145	144	Oberfranken	51	52	Oberfranken	93	92
Mittelfranken	92	91	Mittelfranken	51	52	Mittelfranken	4	3
Unterfranken	104	89	Unterfranken	51	52	Unterfranken	43	22
Schwaben	127	130	Schwaben	51	52	Schwaben	162	122
Berlin	74	69	Berlin	64	65	Berlin	5	4
Brandenburg	180	185	Brandenburg	86	90	Brandenburg	53	34
Bremen	80	80	Bremen	63	64	Bremen	25	31
Hamburg	69	63	Hamburg	50	51	Hamburg	52	60
Darmstadt	71	72	Darmstadt	65	67	Darmstadt	38	59
Gießen	121	125	Gießen	65	67	Gießen	49	54
Kassel	141	144	Kassel	65	67	Kassel	116	112
Mecklenburg-Vorpommern	174	180	Mecklenburg-Vorpommern	68	70	Mecklenburg-Vorpommern	39	39
Braunschweig	51	66	Braunschweig	59	60	Braunschweig	3	8
Hannover	137	137	Hannover	59	60	Hannover	46	44
Lüneburg	176	193	Lüneburg	59	60	Lüneburg	177	152
Weser-Ems	177	190	Weser-Ems	59	60	Weser-Ems	171	150
Düsseldorf	158	159	Düsseldorf	71	73	Düsseldorf	97	84
Köln	106	106	Köln	71	73	Köln	15	17
Münster	168	176	Münster	71	73	Münster	154	165
Detmold	154	149	Detmold	71	73	Detmold	87	86
Arnsberg	160	162	Arnsberg	71	73	Arnsberg	76	67
Koblenz	186	195	Koblenz	80	83	Koblenz	184	172
Trier	157	174	Trier	80	83	Trier	27	77
Rheinhausen-Pfalz	117	121	Rheinhausen-Pfalz	80	83	Rheinhausen-Pfalz	50	80
Saarland	172	173	Saarland	58	59	Saarland	77	79
Dresden	59	47	Dresden	83	86	Dresden	11	15
Chemnitz	159	166	Chemnitz	83	86	Chemnitz	61	44
Leipzig	98	90	Leipzig	83	86	Leipzig	47	57
Sachsen-Anhalt	169	167	Sachsen-Anhalt	87	92	Sachsen-Anhalt	70	67
Schleswig-Holstein	165	163	Schleswig-Holstein	69	71	Schleswig-Holstein	82	78
Thüringen	146	140	Thüringen	70	72	Thüringen	36	27
Border. Midland and	33	20	Border. Midland and	18	34	Border. Midland and	135	137

Western Southern and Eastern	23	19	Western Southern and Eastern	19	38	Western Southern and Eastern	136	146
Anatoliki			Anatoliki			Anatoliki		
Makedonia. Thraki	164	168	Makedonia. Thraki	162	158	Makedonia. Thraki	104	87
Kentriki Makedonia	65	50	Kentriki Makedonia	162	158	Kentriki Makedonia	99	85
Dytiki Makedonia	120	112	Dytiki Makedonia	162	158	Dytiki Makedonia	142	125
Ipeiros	67	81	Ipeiros	162	158	Ipeiros	78	62
Thessalia	83	83	Thessalia	156	152	Thessalia	127	108
Ionia Nisia	138	134	Ionia Nisia	156	152	Ionia Nisia	157	144
Dytiki Ellada	91	71	Dytiki Ellada	156	152	Dytiki Ellada	58	42
Stereia Ellada	173	187	Stereia Ellada	156	152	Stereia Ellada	176	142
Peloponnisos	109	95	Peloponnisos	156	152	Peloponnisos	186	189
Attiki	29	21	Attiki	155	150	Attiki	150	160
Voreio Aigaio	179	156	Voreio Aigaio	167	162	Voreio Aigaio	125	118
Notio Aigaio	156	170	Notio Aigaio	167	162	Notio Aigaio	122	132
Kriti	102	93	Kriti	167	162	Kriti	30	21
Galicia	110	102	Galicia	121	125	Galicia	160	171
Principado de Asturias	81	96	Principado de Asturias	104	96	Principado de Asturias	178	192
Cantabria	103	109	Cantabria	100	93	Cantabria	175	189
País Vasco	26	17	País Vasco	93	89	País Vasco	95	107
Comunidad Foral de Navarra	49	48	Comunidad Foral de Navarra	94	91	Comunidad Foral de Navarra	124	133
La Rioja	140	123	La Rioja	106	102	La Rioja	169	182
Aragón	114	99	Aragón	101	94	Aragón	170	185
Comunidad de Madrid	64	55	Comunidad de Madrid	123	128	Comunidad de Madrid	107	116
Castilla y León	123	123	Castilla y León	115	117	Castilla y León	155	163
Castilla-la Mancha	189	177	Castilla-la Mancha	111	112	Castilla-la Mancha	196	199
Extremadura	170	142	Extremadura	105	99	Extremadura	172	184
Cataluña	129	108	Cataluña	113	114	Cataluña	126	142
Comunidad Valenciana	149	120	Comunidad Valenciana	118	122	Comunidad Valenciana	146	161
Illes Balears	199	179	Illes Balears	124	129	Illes Balears	187	191
Andalucía	192	171	Andalucía	119	123	Andalucía	145	159
Región de Murcia	184	139	Región de Murcia	116	120	Región de Murcia	168	187
Ciudad Autónoma de Ceuta	209	194	Ciudad Autónoma de Ceuta	107	106	Ciudad Autónoma de Ceuta	210	201
Ciudad Autónoma de Melilla	187	146	Ciudad Autónoma de Melilla	107	106	Ciudad Autónoma de Melilla	209	200
Canarias	188	172	Canarias	114	116	Canarias	193	205
Jadranska Hrvatska Kontinentalna Hrvatska	119	131	Jadranska Hrvatska Kontinentalna Hrvatska	173	169	Jadranska Hrvatska Kontinentalna Hrvatska	113	114
Île de France	6	6	Île de France	95	95	Île de France	32	37
Bassin Parisien	90	97	Bassin Parisien	98	99	Bassin Parisien	129	130
Nord - Pas-de-Calais	99	115	Nord - Pas-de-Calais	103	105	Nord - Pas-de-Calais	66	58

Est	61	68	Est	102	104	Est	69	65
Ouest	41	40	Ouest	97	98	Ouest	79	71
Sud-Ouest	15	14	Sud-Ouest	96	97	Sud-Ouest	26	24
Centre-Est	12	16	Centre-Est	99	101	Centre-Est	41	47
Méditerranée	39	38	Méditerranée	109	110	Méditerranée	54	61
French overseas departments	203	208	French overseas departments	129	141	French overseas departments	206	193
Piemonte	167	161	Piemonte	188	186	Piemonte	59	56
Valle d'Aosta/Vallée d'Aoste	185	178	Valle d'Aosta/Vallée d'Aoste	178	178	Valle d'Aosta/Vallée d'Aoste	197	197
Liguria	161	158	Liguria	197	195	Liguria	88	102
Lombardia	155	152	Lombardia	183	183	Lombardia	131	127
Provincia Autonoma Bolzano/Bozen	147	149	Provincia Autonoma Bolzano/Bozen	180	180	Provincia Autonoma Bolzano/Bozen	173	178
Provincia Autonoma Trento	72	52	Provincia Autonoma Trento	179	179	Provincia Autonoma Trento	57	70
Veneto	148	151	Veneto	185	184	Veneto	137	128
Friuli-Venezia Giulia	112	110	Friuli-Venezia Giulia	181	182	Friuli-Venezia Giulia	85	92
Emilia-Romagna	126	127	Emilia-Romagna	176	177	Emilia-Romagna	75	64
Toscana	134	135	Toscana	175	175	Toscana	91	96
Umbria	124	129	Umbria	192	192	Umbria	123	113
Marche	144	155	Marche	201	196	Marche	143	134
Lazio	135	140	Lazio	190	187	Lazio	96	114
Abruzzo	153	154	Abruzzo	203	199	Abruzzo	106	88
Molise	150	164	Molise	199	196	Molise	161	165
Campania	197	191	Campania	193	193	Campania	98	102
Puglia	196	197	Puglia	200	196	Puglia	138	154
Basilicata	171	182	Basilicata	202	199	Basilicata	164	167
Calabria	205	199	Calabria	191	187	Calabria	128	124
Sicilia	211	200	Sicilia	186	184	Sicilia	132	155
Sardegna	208	192	Sardegna	194	193	Sardegna	141	157
Közép-Magyarország	42	32	Közép-Magyarország	212	212	Közép-Magyarország	86	97
Közép-Dunántúl	178	189	Közép-Dunántúl	209	207	Közép-Dunántúl	110	91
Nyugat-Dunántúl	166	184	Nyugat-Dunántúl	208	206	Nyugat-Dunántúl	174	158
Dél-Dunántúl	193	202	Dél-Dunántúl	210	208	Dél-Dunántúl	167	180
Észak-Magyarország	207	203	Észak-Magyarország	207	205	Észak-Magyarország	181	173
Észak-Alföld	194	201	Észak-Alföld	211	211	Észak-Alföld	83	76
Dél-Alföld	162	175	Dél-Alföld	205	204	Dél-Alföld	111	92
Groningen	13	10	Groningen	9	13	Groningen	62	106
Friesland	76	82	Friesland	11	16	Friesland	192	188
Drenthe	97	104	Drenthe	12	17	Drenthe	198	203
Overijssel	44	41	Overijssel	7	6	Overijssel	114	118
Gelderland	32	29	Gelderland	3	3	Gelderland	65	75
Flevoland	70	73	Flevoland	4	4	Flevoland	109	126
Utrecht	8	7	Utrecht	13	18	Utrecht	74	104
Noord-Holland	11	11	Noord-Holland	5	5	Noord-Holland	117	129
Zuid-Holland	21	18	Zuid-Holland	8	8	Zuid-Holland	71	82

Zeeland	101	114	Zeeland	10	15	Zeeland	182	179
Noord-Brabant	31	31	Noord-Brabant	15	22	Noord-Brabant	92	123
Limburg	66	70	Limburg	14	19	Limburg	102	109
Ostösterreich	27	23	Ostösterreich	26	44	Ostösterreich	37	38
Südösterreich	37	28	Südösterreich	27	45	Südösterreich	18	35
Westösterreich	68	52	Westösterreich	25	43	Westösterreich	40	46
Lódzkie	75	64	Lódzkie	144	136	Lódzkie	119	101
Mazowieckie	57	51	Mazowieckie	132	115	Mazowieckie	60	63
Malopolskie	52	39	Malopolskie	134	121	Malopolskie	55	40
Slaskie	84	84	Slaskie	131	112	Slaskie	152	139
Lubelskie	88	78	Lubelskie	142	134	Lubelskie	64	48
Podkarpackie	79	74	Podkarpackie	145	139	Podkarpackie	16	25
Swietokrzyskie	85	88	Swietokrzyskie	133	117	Swietokrzyskie	189	194
Podlaskie	136	143	Podlaskie	141	133	Podlaskie	166	183
Wielkopolskie	93	85	Wielkopolskie	128	106	Wielkopolskie	148	135
Zachodniopomorskie	133	147	Zachodniopomorskie	135	123	Zachodniopomorskie	153	130
Lubuskie	142	160	Lubuskie	130	111	Lubuskie	194	177
Dolnoslaskie	77	76	Dolnoslaskie	138	130	Dolnoslaskie	134	110
Opolskie	105	105	Opolskie	140	132	Opolskie	183	186
Kujawsko-Pomorskie	143	157	Kujawsko-Pomorskie	136	126	Kujawsko-Pomorskie	159	136
Warminsko-Mazurskie	163	183	Warminsko-Mazurskie	137	127	Warminsko-Mazurskie	185	168
Pomorskie	86	76	Pomorskie	139	131	Pomorskie	81	71
Norte	113	119	Norte	125	144	Norte	63	52
Algarve	200	186	Algarve	117	138	Algarve	156	140
Centro	115	118	Centro	122	142	Centro	56	41
Lisboa	45	44	Lisboa	112	137	Lisboa	121	120
Alentejo	175	169	Alentejo	110	135	Alentejo	179	162
Região Autónoma dos Açores	202	188	Região Autónoma dos Açores	126	145	Região Autónoma dos Açores	84	117
Região Autónoma da Madeira	195	181	Região Autónoma da Madeira	120	140	Região Autónoma da Madeira	163	148
Nord-Vest	191	205	Nord-Vest	195	201	Nord-Vest	203	209
Centru	204	209	Centru	189	191	Centru	202	201
Nord-Est	210	211	Nord-Est	196	201	Nord-Est	199	208
Sud-Est	212	212	Sud-Est	198	203	Sud-Est	208	209
Sud - Muntenia	206	210	Sud - Muntenia	177	176	Sud - Muntenia	200	196
Bucuresti - Ilfov	78	65	Bucuresti - Ilfov	182	181	Bucuresti - Ilfov	188	198
Sud-Vest Oltenia	190	207	Sud-Vest Oltenia	187	190	Sud-Vest Oltenia	207	212
Vest	181	198	Vest	184	187	Vest	205	207
Vzhodna Slovenija	73	59	Vzhodna Slovenija	90	49	Vzhodna Slovenija	118	105
Zahodna Slovenija	22	12	Zahodna Slovenija	90	49	Zahodna Slovenija	31	29
Bratislavský kraj	28	26	Bratislavský kraj	166	173	Bratislavský kraj	34	20
Západné Slovensko	151	153	Západné Slovensko	171	174	Západné Slovensko	165	176
Stredné Slovensko	152	148	Stredné Slovensko	161	171	Stredné Slovensko	140	151
Východné Slovensko	183	196	Východné Slovensko	154	168	Východné Slovensko	94	81
Helsinki-Uusimaa	3	2	Helsinki-Uusimaa	6	12	Helsinki-Uusimaa	17	15

Etelä-Suomi	40	58	Etelä-Suomi	16	20	Etelä-Suomi	20	23
Länsi-Suomi	14	24	Länsi-Suomi	2	2	Länsi-Suomi	48	32
Pohjois- ja Itä-Suomi	16	30	Pohjois- ja Itä-Suomi	17	21	Pohjois- ja Itä-Suomi	23	13
Åland	24	34	Åland	1	1	Åland	204	195
Stockholm	2	1	Stockholm	42	26	Stockholm	1	2
Östra Mellansverige	4	5	Östra Mellansverige	42	26	Östra Mellansverige	2	1
Småland med öarna	30	45	Småland med öarna	44	29	Småland med öarna	90	73
Sydsverige	7	3	Sydsverige	44	29	Sydsverige	14	11
Västsverige	5	9	Västsverige	44	29	Västsverige	6	4
Norra Mellansverige	35	49	Norra Mellansverige	47	35	Norra Mellansverige	103	83
Mellersta Norrland	60	106	Mellersta Norrland	47	35	Mellersta Norrland	105	95
Övre Norrland	9	13	Övre Norrland	47	35	Övre Norrland	28	50
North East	89	87	North East	38	42	North East	80	74
North West	82	86	North West	41	48	North West	108	90
Yorkshire and The Humber	107	100	Yorkshire and The Humber	37	41	Yorkshire and The Humber	147	152
East Midlands	63	62	East Midlands	30	25	East Midlands	130	145
West Midlands	95	94	West Midlands	32	32	West Midlands	73	69
East of England	62	57	East of England	29	24	East of England	35	52
London	17	22	London	34	38	London	151	170
South East	43	42	South East	35	40	South East	21	12
South West	38	37	South West	28	23	South West	72	54
Wales	94	103	Wales	31	28	Wales	133	137
Scotland	58	79	Scotland	39	45	Scotland	89	111
Northern Ireland	108	98	Northern Ireland	33	33	Northern Ireland	139	149
Estonia	50	59	Estonia	36	66	Estonia	112	100
Cypurs	53	75	Cypurs	152	166	Cypurs	212	211
Latvia	116	132	Latvia	172	167	Latvia	195	174
Lithuania	34	33	Lithuania	170	172	Lithuania	19	97
Luxembourg	19	14	Luxembourg	127	78	Luxembourg	158	175
Malta	182	165	Malta	40	47	Malta	211	206

2018	rs = 0.96557		rs = 0.94922		
Policy	TOPSIS Rank	NWM RANK	Outputs	TOPSIS Rank	NWM RANK
Région de Bruxelles-Capitale / Brussels Hoofdstedelijk Gewest	120	109	Région de Bruxelles-Capitale / Brussels Hoofdstedelijk Gewest	98	105
Vlaams Gewest	1	22	Vlaams Gewest	9	2
Région Wallonne	94	89	Région Wallonne	70	50
Severna i iztochna Bulgaria	204	164	Severna i iztochna Bulgaria	190	176
Yugozapadna i yuzhna tsentralna Bulgaria	192	157	Yugozapadna i yuzhna tsentralna Bulgaria	106	118
Praha	107	94	Praha	92	67

Strední Čechy	153	150	Strední Čechy	176	184
Jihozápad	125	130	Jihozápad	165	172
Severozápad	167	177	Severozápad	173	175
Severovýchod	118	119	Severovýchod	127	95
Jihovýchod	108	101	Jihovýchod	117	91
Strední Morava	115	116	Strední Morava	129	143
Moravskoslezsko	122	127	Moravskoslezsko	131	142
Hovedstaden	19	10	Hovedstaden	44	29
Sjælland	69	67	Sjælland	62	82
Syddanmark	38	30	Syddanmark	72	41
Midtjylland	6	1	Midtjylland	24	16
Nordjylland	48	51	Nordjylland	125	110
Stuttgart	17	17	Stuttgart	2	4
Karlsruhe	47	35	Karlsruhe	20	36
Freiburg	54	47	Freiburg	14	20
Tübingen	55	49	Tübingen	1	1
Oberbayern	5	2	Oberbayern	8	5
Niederbayern	26	32	Niederbayern	97	124
Oberpfalz	27	33	Oberpfalz	39	90
Oberfranken	31	34	Oberfranken	49	41
Mittelfranken	12	17	Mittelfranken	28	66
Unterfranken	25	29	Unterfranken	40	55
Schwaben	13	20	Schwaben	13	12
Berlin	95	87	Berlin	22	17
Brandenburg	84	92	Brandenburg	114	129
Bremen	61	61	Bremen	73	76
Hamburg	9	4	Hamburg	69	44
Darmstadt	16	25	Darmstadt	25	32
Gießen	64	66	Gießen	77	80
Kassel	62	62	Kassel	48	30
Mecklenburg-Vorpommern	40	37	Mecklenburg-Vorpommern	52	61
Braunschweig	28	21	Braunschweig	75	85
Hannover	22	12	Hannover	51	54
Lüneburg	35	31	Lüneburg	56	75
Weser-Ems	18	11	Weser-Ems	80	57
Düsseldorf	76	73	Düsseldorf	54	47
Köln	79	75	Köln	5	6
Münster	87	100	Münster	19	10
Detmold	88	102	Detmold	17	9
Arnsberg	81	88	Arnsberg	15	7
Koblenz	53	53	Koblenz	23	26
Trier	59	60	Trier	126	112
Rhein Hessen-Pfalz	45	39	Rhein Hessen-Pfalz	41	65
Saarland	73	84	Saarland	65	72
Dresden	80	103	Dresden	87	126

Chemnitz	82	104	Chemnitz	104	140
Leipzig	85	110	Leipzig	37	69
Sachsen-Anhalt	96	118	Sachsen-Anhalt	139	160
Schleswig-Holstein	50	44	Schleswig-Holstein	29	24
Thüringen	71	69	Thüringen	57	63
Border. Midland and Western	70	58	Border. Midland and Western	16	28
Southern and Eastern	10	52	Southern and Eastern	18	18
Anatoliki Makedonia. Thraki	209	202	Anatoliki Makedonia. Thraki	136	181
Kentriki Makedonia	206	170	Kentriki Makedonia	100	105
Dytiki Makedonia	211	212	Dytiki Makedonia	89	97
Ipeiros	210	211	Ipeiros	160	173
Thessalia	178	188	Thessalia	71	71
Ionia Nisia	183	206	Ionia Nisia	133	146
Dytiki Ellada	180	192	Dytiki Ellada	74	93
Stereia Ellada	179	190	Stereia Ellada	107	133
Peloponnisos	181	193	Peloponnisos	102	108
Attiki	162	139	Attiki	122	154
Voreio Aigaio	201	210	Voreio Aigaio	130	137
Notio Aigaio	200	200	Notio Aigaio	119	164
Kriti	198	194	Kriti	67	88
Galicia	132	123	Galicia	179	166
Principado de Asturias	106	120	Principado de Asturias	182	201
Cantabria	92	111	Cantabria	183	164
País Vasco	65	56	País Vasco	152	147
Comunidad Foral de Navarra	91	105	Comunidad Foral de Navarra	164	152
La Rioja	103	127	La Rioja	151	167
Aragón	113	111	Aragón	163	174
Comunidad de Madrid	98	91	Comunidad de Madrid	168	162
Castilla y León	137	127	Castilla y León	191	193
Castilla-la Mancha	131	138	Castilla-la Mancha	158	159
Extremadura	117	142	Extremadura	193	205
Cataluña	114	106	Cataluña	154	121
Comunidad Valenciana	129	114	Comunidad Valenciana	153	104
Illes Balears	154	166	Illes Balears	189	155
Andalucía	156	132	Andalucía	174	189
Región de Murcia	121	135	Región de Murcia	145	103
Ciudad Autónoma de Ceuta	143	183	Ciudad Autónoma de Ceuta	202	182
Ciudad Autónoma de Melilla	144	184	Ciudad Autónoma de Melilla	99	83
Canarias	161	161	Canarias	204	202

Jadranska Hrvatska	177	178	Jadranska Hrvatska	175	194
Kontinentalna Hrvatska	184	159	Kontinentalna Hrvatska	155	179
Île de France	2	69	Île de France	64	52
Bassin Parisien	74	76	Bassin Parisien	111	126
Nord - Pas-de-Calais	97	85	Nord - Pas-de-Calais	118	116
Est	101	90	Est	103	101
Ouest	46	64	Ouest	90	95
Sud-Ouest	67	68	Sud-Ouest	91	102
Centre-Est	66	71	Centre-Est	38	57
Méditerranée	93	86	Méditerranée	123	138
French overseas departments	176	181	French overseas departments	143	168
Piemonte	175	158	Piemonte	84	53
Valle d'Aosta/Vallée d'Aoste	169	197	Valle d'Aosta/Vallée d'Aoste	101	114
Liguria	171	182	Liguria	120	134
Lombardia	109	98	Lombardia	82	51
Provincia Autonoma Bolzano/Bozen	157	185	Provincia Autonoma Bolzano/Bozen	85	84
Provincia Autonoma Trento	160	189	Provincia Autonoma Trento	76	70
Veneto	123	108	Veneto	43	22
Friuli-Venezia Giulia	159	180	Friuli-Venezia Giulia	11	8
Emilia-Romagna	141	122	Emilia-Romagna	88	60
Toscana	168	156	Toscana	78	49
Umbria	203	209	Umbria	121	107
Marche	189	191	Marche	142	122
Lazio	188	152	Lazio	150	149
Abruzzo	199	195	Abruzzo	159	186
Molise	164	199	Molise	147	170
Campania	202	169	Campania	177	180
Puglia	187	176	Puglia	161	158
Basilicata	191	207	Basilicata	157	135
Calabria	212	204	Calabria	110	100
Sicilia	197	175	Sicilia	178	195
Sardegna	170	187	Sardegna	170	199
Közép-Magyarország	196	174	Közép-Magyarország	172	150
Közép-Dunántúl	173	198	Közép-Dunántúl	196	200
Nyugat-Dunántúl	185	203	Nyugat-Dunántúl	184	171
Dél-Dunántúl	172	201	Dél-Dunántúl	181	182
Észak-Magyarország	186	205	Észak-Magyarország	188	191
Észak-Alföld	193	208	Észak-Alföld	201	195
Dél-Alföld	163	196	Dél-Alföld	185	190
Groningen	24	15	Groningen	63	73
Friesland	29	24	Friesland	36	19
Drenthe	15	14	Drenthe	33	33

Overijssel	37	36	Overijssel	30	21
Gelderland	14	8	Gelderland	35	40
Flevoland	34	27	Flevoland	45	27
Utrecht	68	65	Utrecht	79	78
Noord-Holland	44	38	Noord-Holland	68	46
Zuid-Holland	49	48	Zuid-Holland	59	48
Zeeland	72	77	Zeeland	60	78
Noord-Brabant	20	13	Noord-Brabant	12	25
Limburg	41	46	Limburg	31	33
Ostösterreich	63	54	Ostösterreich	27	15
Südösterreich	83	82	Südösterreich	32	37
Westösterreich	43	42	Westösterreich	10	2
Lódzkie	150	134	Lódzkie	149	115
Mazowieckie	145	131	Mazowieckie	167	123
Malopolskie	127	113	Malopolskie	140	113
Slaskie	119	107	Slaskie	197	197
Lubelskie	155	145	Lubelskie	156	178
Podkarpackie	148	140	Podkarpackie	115	163
Swietokrzyskie	151	160	Swietokrzyskie	205	208
Podlaskie	146	155	Podlaskie	132	155
Wielkopolskie	133	120	Wielkopolskie	138	151
Zachodniopomorskie	139	126	Zachodniopomorskie	180	152
Lubuskie	147	153	Lubuskie	200	187
Dolnoslaskie	126	114	Dolnoslaskie	169	131
Opolskie	135	144	Opolskie	186	177
Kujawsko-Pomorskie	136	124	Kujawsko-Pomorskie	148	130
Warminsko-Mazurskie	138	141	Warminsko-Mazurskie	162	161
Pomorskie	112	99	Pomorskie	203	185
Norte	102	96	Norte	113	111
Algarve	152	167	Algarve	194	192
Centro	104	95	Centro	55	23
Lisboa	86	83	Lisboa	94	86
Alentejo	116	124	Alentejo	58	64
Região Autónoma dos Açores	124	165	Região Autónoma dos Açores	96	86
Região Autónoma da Madeira	110	137	Região Autónoma da Madeira	83	124
Nord-Vest	207	172	Nord-Vest	209	206
Centru	195	171	Centru	208	204
Nord-Est	194	173	Nord-Est	210	210
Sud-Est	208	179	Sud-Est	206	212
Sud - Muntenia	174	162	Sud - Muntenia	207	207
Bucuresti - Ilfov	190	148	Bucuresti - Ilfov	192	169
Sud-Vest Oltenia	205	186	Sud-Vest Oltenia	212	209
Vest	182	168	Vest	211	211
Vzhodna Slovenija	142	143	Vzhodna Slovenija	50	68

Zahodna Slovenija	140	133	Zahodna Slovenija	95	74
Bratislavský kraj	165	153	Bratislavský kraj	171	143
Západné Slovensko	166	147	Západné Slovensko	198	198
Stredné Slovensko	149	146	Stredné Slovensko	199	203
Východné Slovensko	158	148	Východné Slovensko	166	136
Helsinki-Uusimaa	100	80	Helsinki-Uusimaa	21	13
Etelä-Suomi	89	81	Etelä-Suomi	7	37
Länsi-Suomi	39	28	Länsi-Suomi	46	35
Pohjois- ja Itä-Suomi	90	78	Pohjois- ja Itä-Suomi	53	43
Åland	4	6	Åland	3	31
Stockholm	8	3	Stockholm	6	14
Östra Mellansverige	30	19	Östra Mellansverige	47	45
Småland med öarna	33	23	Småland med öarna	137	138
Sydsverige	21	9	Sydsverige	34	39
Västsverige	11	5	Västsverige	66	55
Norra Mellansverige	57	57	Norra Mellansverige	146	145
Mellersta Norrland	60	63	Mellersta Norrland	135	132
Övre Norrland	58	59	Övre Norrland	116	128
North East	42	40	North East	128	155
North West	78	72	North West	134	148
Yorkshire and The Humber	75	74	Yorkshire and The Humber	61	59
East Midlands	77	79	East Midlands	81	77
West Midlands	23	16	West Midlands	109	99
East of England	52	44	East of England	105	92
London	7	43	London	93	61
South East	32	41	South East	108	98
South West	36	26	South West	144	119
Wales	56	55	Wales	124	109
Scotland	51	49	Scotland	112	120
Northern Ireland	111	135	Northern Ireland	141	117
Estonia	105	97	Estonia	187	188
Cypurs	134	150	Cypurs	42	94
Latvia	130	117	Latvia	195	141
Lithuania	99	93	Lithuania	86	80
Luxembourg	3	7	Luxembourg	4	11
Malta	128	162	Malta	26	89

2018

rs = 0.96702

Outcomes	TOPSIS Rank	NWM RANK
Région de Bruxelles-Capitale / Brussels		
Hoofdstedelijk Gewest	33	37
Vlaams Gewest	87	76
Région Wallonne	82	90
Severna i iztochna	192	199

rs =0.96017

Impacts	TOPSIS Rank	NWM RANK
Région de Bruxelles-Capitale / Brussels		
Hoofdstedelijk Gewest	25	16
Vlaams Gewest	6	12
Région Wallonne	126	108
Severna i iztochna	184	191

Bulgaria			Bulgaria		
Yugozapadna i yuzhna tsentralna Bulgaria	137	117	Yugozapadna i yuzhna tsentralna Bulgaria	159	146
Praha	6	9	Praha	29	13
Strední Čechy	37	33	Strední Čechy	75	52
Jihozápad	27	10	Jihozápad	100	82
Severozápad	84	100	Severozápad	135	137
Severovýchod	14	6	Severovýchod	102	76
Jihovýchod	29	13	Jihovýchod	90	55
Strední Morava	66	57	Strední Morava	106	89
Moravskoslezsko	69	64	Moravskoslezsko	119	120
Hovedstaden	20	48	Hovedstaden	9	15
Sjælland	78	66	Sjælland	59	57
Syddanmark	159	149	Syddanmark	39	28
Midtjylland	135	132	Midtjylland	35	24
Nordjylland	174	173	Nordjylland	76	88
Stuttgart	12	13	Stuttgart	11	3
Karlsruhe	18	22	Karlsruhe	23	14
Freiburg	26	24	Freiburg	37	25
Tübingen	17	8	Tübingen	28	18
Oberbayern	5	5	Oberbayern	7	4
Niederbayern	65	74	Niederbayern	66	79
Oberpfalz	40	36	Oberpfalz	45	43
Oberfranken	102	118	Oberfranken	58	71
Mittelfranken	30	26	Mittelfranken	40	31
Unterfranken	64	68	Unterfranken	43	37
Schwaben	54	59	Schwaben	42	32
Berlin	7	4	Berlin	65	78
Brandenburg	112	115	Brandenburg	74	86
Bremen	61	79	Bremen	93	119
Hamburg	43	31	Hamburg	22	38
Darmstadt	16	23	Darmstadt	14	8
Gießen	59	69	Gießen	71	91
Kassel	88	112	Kassel	54	56
Mecklenburg- Vorpommern	141	153	Mecklenburg- Vorpommern	115	145
Braunschweig	41	48	Braunschweig	55	73
Hannover	77	95	Hannover	57	61
Lüneburg	93	133	Lüneburg	62	60
Weser-Ems	157	172	Weser-Ems	70	58
Düsseldorf	115	135	Düsseldorf	33	39
Köln	34	32	Köln	30	34
Münster	101	92	Münster	64	64
Detmold	97	111	Detmold	52	47
Arnsberg	127	145	Arnsberg	63	66
Koblenz	116	126	Koblenz	79	96

Trier	183	197	Trier	98	122
Rhein Hessen-Pfalz	25	17	Rhein Hessen-Pfalz	46	42
Saarland	156	155	Saarland	91	118
Dresden	47	27	Dresden	83	110
Chemnitz	68	53	Chemnitz	101	123
Leipzig	63	50	Leipzig	84	115
Sachsen-Anhalt	105	94	Sachsen-Anhalt	105	125
Schleswig-Holstein	85	106	Schleswig-Holstein	77	81
Thüringen	70	84	Thüringen	99	116
Border. Midland and Western	79	70	Border. Midland and Western	138	68
Southern and Eastern	13	44	Southern and Eastern	3	16
Anatoliki Makedonia. Thraki	203	198	Anatoliki Makedonia. Thraki	199	204
Kentriki Makedonia	193	170	Kentriki Makedonia	201	181
Dytiki Makedonia	198	163	Dytiki Makedonia	206	209
Ipeiros	212	212	Ipeiros	204	210
Thessalia	205	210	Thessalia	203	200
Ionia Nisia	207	206	Ionia Nisia	190	207
Dytiki Ellada	196	167	Dytiki Ellada	211	205
Stereia Ellada	186	163	Stereia Ellada	202	196
Peloponnisos	208	199	Peloponnisos	193	199
Attiki	98	42	Attiki	183	132
Voreio Aigaio	204	207	Voreio Aigaio	205	212
Notio Aigaio	209	202	Notio Aigaio	198	196
Kriti	200	168	Kriti	195	198
Galicia	126	118	Galicia	168	136
Principado de Asturias	173	183	Principado de Asturias	171	162
Cantabria	118	113	Cantabria	166	173
País Vasco	71	62	País Vasco	94	63
Comunidad Foral de Navarra	100	97	Comunidad Foral de Navarra	121	117
La Rioja	188	166	La Rioja	161	175
Aragón	89	88	Aragón	143	128
Comunidad de Madrid	32	52	Comunidad de Madrid	50	51
Castilla y León	151	141	Castilla y León	155	129
Castilla-la Mancha	182	162	Castilla-la Mancha	192	167
Extremadura	178	160	Extremadura	208	191
Cataluña	28	12	Cataluña	85	75
Comunidad Valenciana	164	150	Comunidad Valenciana	179	131
Illes Balears	169	161	Illes Balears	156	141
Andalucía	167	152	Andalucía	197	133
Región de Murcia	179	178	Región de Murcia	189	170
Ciudad Autónoma de Ceuta	140	128	Ciudad Autónoma de Ceuta	212	211
Ciudad Autónoma de Melilla	191	186	Ciudad Autónoma de Melilla	196	208

Canarias	206	211	Canarias	200	165
Jadranska Hrvatska	170	189	Jadranska Hrvatska	175	188
Kontinentalna Hrvatska	144	146	Kontinentalna Hrvatska	172	166
Île de France	11	16	Île de France	1	2
Bassin Parisien	125	143	Bassin Parisien	24	59
Nord - Pas-de-Calais	143	139	Nord - Pas-de-Calais	123	94
Est	50	39	Est	80	83
Ouest	129	138	Ouest	18	45
Sud-Ouest	91	96	Sud-Ouest	31	44
Centre-Est	67	58	Centre-Est	13	26
Méditerranée	142	156	Méditerranée	38	50
French overseas departments	122	93	French overseas departments	187	157
Piemonte	62	55	Piemonte	122	124
Valle d'Aosta/Vallée d'Aoste	117	53	Valle d'Aosta/Vallée d'Aoste	118	135
Liguria	73	80	Liguria	140	151
Lombardia	56	51	Lombardia	32	53
Provincia Autonoma Bolzano/Bozen	172	169	Provincia Autonoma Bolzano/Bozen	72	67
Provincia Autonoma Trento	119	120	Provincia Autonoma Trento	109	143
Veneto	113	108	Veneto	103	98
Friuli-Venezia Giulia	95	99	Friuli-Venezia Giulia	112	126
Emilia-Romagna	72	75	Emilia-Romagna	88	90
Toscana	145	134	Toscana	130	130
Umbria	133	140	Umbria	147	172
Marche	148	121	Marche	136	154
Lazio	23	29	Lazio	141	134
Abruzzo	99	86	Abruzzo	178	189
Molise	81	72	Molise	180	203
Campania	134	137	Campania	209	181
Puglia	181	177	Puglia	194	185
Basilicata	80	67	Basilicata	188	206
Calabria	190	181	Calabria	207	202
Sicilia	168	176	Sicilia	210	185
Sardegna	195	184	Sardegna	191	195
Közép-Magyarország	8	19	Közép-Magyarország	78	41
Közép-Dunántúl	46	41	Közép-Dunántúl	129	102
Nyugat-Dunántúl	24	20	Nyugat-Dunántúl	124	95
Dél-Dunántúl	94	105	Dél-Dunántúl	170	184
Észak-Magyarország	31	28	Észak-Magyarország	177	174
Észak-Alföld	90	110	Észak-Alföld	173	161
Dél-Alföld	121	124	Dél-Alföld	148	151
Groningen	136	101	Groningen	89	110
Friesland	165	159	Friesland	95	113

Drenthe	108	107	Drenthe	82	104
Overijssel	128	124	Overijssel	53	49
Gelderland	149	122	Gelderland	36	22
Flevoland	124	102	Flevoland	56	84
Utrecht	58	43	Utrecht	16	9
Noord-Holland	123	85	Noord-Holland	10	10
Zuid-Holland	132	109	Zuid-Holland	19	21
Zeeland	139	142	Zeeland	68	74
Noord-Brabant	120	129	Noord-Brabant	17	6
Limburg	106	123	Limburg	51	40
Ostösterreich	38	30	Ostösterreich	21	27
Südösterreich	35	21	Südösterreich	49	36
Westösterreich	83	83	Westösterreich	27	22
Lódzkie	155	171	Lódzkie	133	127
Mazowieckie	158	175	Mazowieckie	134	142
Malopolskie	131	147	Malopolskie	117	100
Slaskie	104	126	Slaskie	110	85
Lubelskie	171	188	Lubelskie	160	176
Podkarpackie	160	180	Podkarpackie	157	171
Swietokrzyskie	202	208	Swietokrzyskie	150	179
Podlaskie	180	195	Podlaskie	146	160
Wielkopolskie	161	179	Wielkopolskie	111	80
Zachodniopomorskie	110	144	Zachodniopomorskie	139	149
Lubuskie	163	182	Lubuskie	137	150
Dolnoslaskie	42	35	Dolnoslaskie	116	92
Opolskie	166	185	Opolskie	142	156
Kujawsko-Pomorskie	175	193	Kujawsko-Pomorskie	144	155
Warminsko-Mazurskie	199	203	Warminsko-Mazurskie	154	180
Pomorskie	60	72	Pomorskie	125	109
Norte	184	194	Norte	164	148
Algarve	197	192	Algarve	145	168
Centro	185	196	Centro	149	153
Lisboa	103	104	Lisboa	107	97
Alentejo	176	191	Alentejo	163	176
Região Autónoma dos Açores	211	205	Região Autónoma dos Açores	176	201
Região Autónoma da Madeira	210	201	Região Autónoma da Madeira	169	194
Nord-Vest	187	190	Nord-Vest	152	140
Centru	150	157	Centru	167	163
Nord-Est	201	208	Nord-Est	181	158
Sud-Est	194	204	Sud-Est	185	187
Sud - Muntenia	162	174	Sud - Muntenia	182	176
Bucuresti - Ilfov	48	78	Bucuresti - Ilfov	114	103
Sud-Vest Oltenia	153	165	Sud-Vest Oltenia	186	193
Vest	21	17	Vest	153	159

Vzhodna Slovenija	51	34	Vzhodna Slovenija	132	144
Zahodna Slovenija	44	47	Zahodna Slovenija	92	101
Bratislavský kraj	2	1	Bratislavský kraj	47	48
Západné Slovensko	49	45	Západné Slovensko	127	121
Stredné Slovensko	96	103	Stredné Slovensko	158	183
Východné Slovensko	92	76	Východné Slovensko	174	190
Helsinki-Uusimaa	4	7	Helsinki-Uusimaa	12	11
Etelä-Suomi	152	153	Etelä-Suomi	96	92
Länsi-Suomi	111	115	Länsi-Suomi	87	87
Pohjois- ja Itä-Suomi	154	129	Pohjois- ja Itä-Suomi	104	106
Åland	147	136	Åland	48	70
Stockholm	3	3	Stockholm	5	5
Östra Mellansverige	76	81	Östra Mellansverige	44	32
Småland med öarna	146	148	Småland med öarna	60	54
Sydsverige	55	56	Sydsverige	86	77
Västsverige	53	38	Västsverige	26	20
Norra Mellansverige	130	129	Norra Mellansverige	97	107
Mellersta Norrland	75	63	Mellersta Norrland	81	105
Övre Norrland	138	151	Övre Norrland	61	71
North East	19	60	North East	120	113
North West	39	61	North West	20	30
Yorkshire and The Humber	45	87	Yorkshire and The Humber	67	65
East Midlands	15	46	East Midlands	69	62
West Midlands	36	65	West Midlands	73	68
East of England	22	11	East of England	15	19
London	9	13	London	2	1
South East	1	2	South East	4	7
South West	10	25	South West	34	29
Wales	52	71	Wales	108	99
Scotland	109	91	Scotland	41	46
Northern Ireland	86	97	Northern Ireland	113	112
Estonia	107	82	Estonia	131	138
Cypurs	114	114	Cypurs	162	169
Latvia	189	186	Latvia	165	164
Lithuania	177	158	Lithuania	151	147
Luxembourg	74	89	Luxembourg	8	35
Malta	57	40	Malta	128	139

Micro Level Results NWM-TOPSIS

2020	Human Capital	rs=0.92429	Culture	rs=0.93958	Finance	rs=0.89735	Policy	rs = 0.91625
	TOPSIS Rank	NWM Rank	TOPSIS Rank	NWM Rank	TOPSIS Rank	NWM Rank	TOPSIS Rank	NWM Rank
Olive oil	36	32	100	104	75	91	6	31

Wine	14	13	70	68	89	69	66	51
Wine	53	89	105	111	28	57	99	106
Other	44	42	17	19	67	72	49	61
Fruits and vegetables	79	49	104	96	114	110	38	53
Olive oil	83	65	44	73	108	97	49	54
Fruits and vegetables	77	57	23	28	13	6	49	61
Olive oil	20	14	44	73	45	64	15	20
Honey	86	74	23	35	32	28	39	13
Olive oil	76	48	44	73	45	64	49	61
Olive oil	46	59	9	7	44	60	15	20
Other	36	31	14	14	5	4	65	46
Other	95	109	78	82	103	111	85	86
Olive oil	13	6	21	21	32	28	68	43
Fruits and vegetables	99	53	84	84	17	18	95	76
Olive oil	60	77	1	5	81	104	15	39
Olive oil	113	114	44	73	13	6	68	43
Olive oil	64	54	88	88	64	53	44	69
Other	22	20	7	8	40	46	49	61
Wine	120	118	87	49	110	100	68	47
Olive oil	17	10	13	13	13	6	10	6
Other	26	40	44	73	9	10	49	54
Honey	73	86	23	28	50	61	15	20
Olive oil	60	81	58	42	37	41	37	73
Olive oil	101	83	105	107	25	15	27	40
Other	75	41	42	28	110	100	114	112
Wine	8	22	35	43	84	42	49	45
Other	54	73	11	10	24	25	3	4
Other	17	10	100	104	120	120	75	92
Fruits and vegetables	109	104	88	88	72	83	85	86
Olive oil	83	65	1	1	57	35	1	1
Olive oil	41	44	23	28	67	72	75	92
Other	107	95	69	46	57	35	85	86
Olive oil	87	86	95	99	64	53	6	31
Dairy products	67	92	95	99	84	42	75	92
Other	100	85	120	120	51	78	99	105
Other	95	109	43	45	62	50	39	10
Other	42	36	14	14	57	35	15	20
Olive oil	24	21	44	62	39	56	49	61
Other	64	54	95	102	17	18	49	61
Other	108	108	70	68	35	32	49	61
Honey	59	60	70	67	95	88	33	41
Dairy	82	90	111	112	89	69	74	74

products								
Olive oil	52	52	33	27	99	107	13	35
Other	49	76	88	88	64	53	112	113
Other	44	45	44	62	88	63	118	117
Other	48	68	116	110	4	11	10	6
Olive oil	98	113	14	14	56	87	35	37
Other	56	69	88	87	119	119	75	97
Honey	60	77	107	103	117	115	117	118
Honey	43	37	117	116	93	85	110	100
Wine	40	39	58	56	110	100	96	75
Honey	119	116	77	23	98	76	6	31
Wine	7	7	44	65	30	23	15	20
Dairy products	67	84	84	81	1	1	15	20
Wine	33	26	58	50	75	91	15	20
Dairy products	95	109	57	46	67	72	49	54
Wine	8	26	70	61	115	113	103	107
Wine	5	4	67	55	30	23	49	61
Wine	116	119	103	86	43	39	119	120
Other	39	35	44	73	40	46	68	49
Wine	38	33	100	104	84	42	75	92
Olive oil	101	82	80	91	99	107	15	20
Fruits and vegetables	50	43	107	107	81	104	85	77
Wine	113	114	95	95	55	51	107	102
Fruits	116	119	58	56	51	78	6	31
Fruits	109	104	1	1	45	64	48	9
Fruits	92	94	44	73	3	3	84	85
Other	12	18	39	24	89	69	66	51
Olive oil	11	5	9	11	92	52	39	10
Fruits and vegetables	32	38	19	17	51	78	68	49
Olive oil	58	75	44	62	45	64	75	83
Olive oil	21	30	95	99	75	91	27	15
Dairy products	106	91	111	117	75	91	115	115
Other	28	34	44	73	35	32	27	15
Other	85	71	93	97	38	45	3	4
Wine	33	26	58	50	75	91	15	20
Fruits	30	25	107	107	10	13	85	91
Other	8	22	118	115	108	97	110	111
Other	31	50	23	35	25	15	44	70
Other	93	97	22	22	105	117	115	116
Other	115	117	107	98	102	85	120	119
Honey	89	101	67	60	107	82	92	79
Other	33	29	23	28	75	91	15	20

Olive oil	60	77	58	50	117	115	44	72
Other	118	100	35	39	57	35	13	35
Other	80	63	44	65	67	72	33	41
Other	55	45	23	35	74	77	75	92
Other	25	16	70	68	81	104	27	15
Other	109	104	80	91	45	64	68	47
Fruits and vegetables	80	61	115	114	110	100	75	83
Dairy products	73	86	80	91	61	31	75	97
Olive oil	101	80	35	43	104	112	97	101
Dairy products	50	47	4	3	16	26	92	79
Olive oil	19	19	58	50	8	27	92	79
Other	15	9	17	19	12	9	27	15
Olive oil	23	17	33	41	2	2	39	10
Dairy products	93	97	88	94	99	107	49	54
Wine	4	7	70	68	87	59	49	54
Other	64	56	58	56	17	18	103	110
Other	16	15	4	4	29	58	106	99
Olive oil	88	96	35	39	17	18	49	54
Olive oil	2	2	84	84	5	4	15	20
Olive oil	89	101	7	8	17	18	35	37
Other	109	104	111	112	95	88	112	113
Wine	2	2	58	50	7	12	103	108
Olive oil	47	50	23	28	22	34	1	3
Honey	104	99	119	119	95	88	109	109
Honey	89	101	70	68	72	83	44	70
Fruits and vegetables	67	92	83	48	23	40	101	90
Other	105	112	94	83	115	113	97	104
Olive oil	70	63	11	12	40	46	85	77
Olive oil	72	72	111	117	105	117	85	86
Honey	27	62	19	17	71	49	10	6
Olive oil	1	1	79	59	63	62	107	102
Dairy products	77	57	39	24	10	13	101	82
Olive oil	29	24	23	28	25	15	49	54
Fruits and vegetables	6	12	23	35	32	28	5	2
Olive oil	56	69	4	6	51	78	39	13
Other	70	67	39	24	94	99	27	15

2020	Outputs TOPSIS Rank	rs = 0.89698 NWM Rank	Outcomes TOPSIS Rank	rs = 0.87813 NWM Rank	Impacts TOPSIS Rank	rs =0.89886 NWM Rank
Olive oil	74	61	79	72	97	101
Wine	94	92	60	40	20	26
Wine	18	30	68	65	102	85
Other	62	35	112	109	81	78
Fruits and vegetables	65	55	69	73	91	98
Olive oil	40	66	51	99	31	53
Fruits and vegetables	80	75	18	28	99	107
Olive oil	63	44	9	7	68	44
Honey	48	48	29	19	44	41
Olive oil	11	18	87	83	88	89
Olive oil	72	71	14	18	78	68
Other	7	3	28	16	26	24
Other	72	72	118	117	116	116
Olive oil	58	20	1	1	95	67
Fruits and vegetables	63	44	7	11	75	64
Olive oil	99	100	85	76	11	10
Olive oil	30	36	20	42	10	20
Olive oil	70	52	37	43	64	103
Other	5	6	58	35	112	110
Wine	80	75	24	55	16	30
Olive oil	29	11	46	74	19	15
Other	27	7	64	61	55	40
Honey	74	61	54	22	20	26
Olive oil	99	107	114	113	103	99
Olive oil	54	88	18	32	56	60
Other	10	12	35	38	86	92
Wine	9	25	5	6	82	82
Other	4	14	8	26	28	22
Other	117	117	119	119	54	96
Fruits and vegetables	23	87	32	54	84	61
Olive oil	65	55	71	30	67	52
Olive oil	38	46	65	62	73	57
Other	2	1	54	23	68	44
Olive oil	80	75	77	60	25	43
Dairy products	105	103	114	113	106	88
Other	57	91	82	69	38	14
Other	30	36	49	85	20	19
Other	25	9	11	9	14	8
Olive oil	80	75	62	58	47	13
Other	44	15	78	56	74	84
Other	71	60	107	107	100	48
Honey	40	66	71	30	105	112
Dairy products	109	111	107	111	51	79

Olive oil	54	88	39	49	23	33
Other	40	66	92	90	31	53
Other	6	13	29	19	43	31
Other	48	48	13	16	44	41
Olive oil	99	100	27	94	94	94
Other	112	112	114	113	88	89
Honey	117	117	23	59	119	119
Honey	92	93	92	88	12	16
Wine	65	55	56	35	48	71
Honey	96	97	62	68	17	28
Wine	47	33	25	13	8	7
Dairy products	80	75	91	89	29	36
Wine	30	36	82	77	31	48
Dairy products	39	10	94	97	12	16
Wine	117	117	67	70	92	105
Wine	58	20	17	12	65	77
Wine	105	103	107	111	114	104
Other	3	1	103	104	68	58
Wine	80	75	35	25	109	109
Olive oil	105	103	74	102	97	101
Fruits and vegetables	53	74	79	66	76	76
Wine	80	75	100	96	62	74
Fruits	80	75	112	109	115	113
Fruits	80	75	69	87	66	38
Fruits	45	19	33	27	53	38
Other	21	53	1	3	23	37
Olive oil	103	95	22	52	113	108
Fruits and vegetables	40	66	21	46	63	75
Olive oil	112	112	107	108	31	53
Olive oil	80	75	85	81	78	68
Dairy products	96	98	99	95	68	58
Other	48	48	56	33	27	35
Other	1	4	87	82	59	65
Wine	30	36	82	77	31	48
Fruits	52	70	33	24	108	97
Other	30	36	16	48	77	80
Other	80	75	94	93	46	63
Other	117	117	89	86	120	120
Other	99	100	119	119	104	106
Honey	56	73	53	53	7	9
Other	21	53	103	105	68	44
Olive oil	105	103	42	71	118	117
Other	19	34	10	29	9	3
Other	26	23	97	92	61	70
Other	96	98	98	84	88	89
Other	13	5	25	8	39	71

Other	30	36	73	80	101	81
Fruits and vegetables	116	116	89	79	110	111
Dairy products	14	26	103	103	50	66
Olive oil	46	16	46	74	80	95
Dairy products	8	22	52	44	52	21
Olive oil	60	31	6	4	2	1
Other	95	108	45	21	31	53
Olive oil	11	17	11	9	5	6
Dairy products	114	115	114	113	39	71
Wine	65	55	39	45	57	47
Other	103	95	60	39	84	61
Other	79	90	111	118	30	11
Olive oil	110	109	65	62	15	25
Olive oil	92	94	4	5	4	5
Olive oil	110	109	79	66	2	1
Other	74	61	103	100	117	118
Wine	48	48	31	34	1	4
Olive oil	60	31	43	57	42	32
Honey	30	36	58	35	6	18
Honey	74	61	96	101	49	23
Fruits and vegetables	74	61	44	64	58	86
Other	14	26	101	106	93	87
Olive oil	30	36	15	15	17	28
Olive oil	14	26	48	41	111	114
Honey	65	55	75	50	82	82
Olive oil	20	47	1	1	86	92
Dairy products	14	26	101	98	41	12
Olive oil	27	7	38	14	60	34
Fruits and vegetables	114	114	76	51	31	48
Olive oil	80	75	49	91	96	100
Other	24	24	39	47	107	115

Appendix 4. Quadruple Innovation Helix model results

Macro level Quadruple Innovation Helix model results

2013-2018	POSTURE	PROPENSITY	OUTPUTS	OUTCOMES	IMPACTS	CIVIL SOCEITY
Belgium	0.579	0.723	0.251	0.398	0.617	0.510
Bulgaria	0.197	0.000	0.027	0.453	0.360	0.210
Czech Republic	0.318	0.549	0.327	0.538	0.513	0.450
Denmark	0.803	0.966	0.178	0.486	0.746	0.640
Germany	0.506	0.843	0.136	0.512	0.731	0.550
Estonia	0.528	0.630	0.921	0.366	0.527	0.590
Ireland	0.568	0.863	0.464	0.860	0.656	0.680
Greece	0.217	0.220	0.241	0.443	0.159	0.260
Spain	0.401	0.526	0.192	0.360	0.373	0.370
France	0.627	0.725	0.147	0.458	0.583	0.510
Croatia	0.169	0.173	0.411	0.277	0.325	0.270
Italy	0.202	0.203	0.083	0.356	0.393	0.250
Cyprus	0.421	0.514	0.570	0.370	0.400	0.460
Latvia	0.316	0.434	0.852	0.392	0.346	0.470
Lithuania	0.437	0.462	0.535	0.276	0.417	0.430
Luxembourg	0.631	0.902	0.467	0.653	0.791	0.690
Hungary	0.251	0.312	0.405	0.572	0.396	0.390
Malta	0.468	0.634	0.462	0.714	0.515	0.560
Netherlands	0.732	0.936	0.514	0.609	0.718	0.700
Austria	0.598	0.919	0.487	0.370	0.693	0.610
Poland	0.364	0.406	0.457	0.400	0.436	0.410
Portugal	0.344	0.558	0.442	0.308	0.435	0.420
Romania	0.143	0.108	0.628	0.151	0.396	0.290
Slovenia	0.426	0.523	0.272	0.360	0.470	0.410
Slovakia	0.274	0.300	0.574	0.533	0.369	0.410
Finland	0.756	0.996	0.253	0.434	0.693	0.630
Sweden	0.867	0.986	0.327	0.711	0.729	0.720
United Kingdom	0.678	0.863	0.411	0.746	0.679	0.680

2013-2018	POSTURE	PROPENSITY	OUTPUTS	OUTCOMES	IMPACTS	INDUSTRY
Belgium	0.461	0.628	0.488	0.504	0.601	0.536
Bulgaria	0.329	0.346	0.207	0.331	0.316	0.306
Czech Republic	0.359	0.406	0.356	0.568	0.567	0.451
Denmark	0.684	0.587	0.478	0.492	0.781	0.605
Germany	0.436	0.604	0.528	0.649	0.826	0.609
Estonia	0.571	0.619	0.441	0.399	0.588	0.524
Ireland	0.467	0.556	0.472	0.802	0.742	0.608
Greece	0.340	0.326	0.412	0.418	0.161	0.331
Spain	0.417	0.356	0.240	0.464	0.412	0.378
France	0.496	0.616	0.436	0.552	0.667	0.553

Croatia	0.253	0.385	0.333	0.250	0.405	0.325
Italy	0.231	0.387	0.425	0.453	0.275	0.354
Cyprus	0.354	0.420	0.465	0.493	0.369	0.420
Latvia	0.344	0.450	0.317	0.347	0.460	0.384
Lithuania	0.319	0.508	0.388	0.303	0.516	0.407
Luxembourg	0.498	0.590	0.627	0.582	0.578	0.575
Hungary	0.281	0.434	0.214	0.562	0.368	0.372
Malta	0.559	0.355	0.531	0.558	0.407	0.482
Netherlands	0.596	0.607	0.512	0.590	0.661	0.593
Austria	0.538	0.499	0.575	0.470	0.583	0.533
Poland	0.354	0.329	0.229	0.380	0.452	0.349
Portugal	0.416	0.483	0.490	0.318	0.436	0.429
Romania	0.230	0.353	0.202	0.325	0.430	0.308
Slovenia	0.477	0.466	0.338	0.423	0.475	0.436
Slovakia	0.328	0.385	0.263	0.595	0.395	0.393
Finland	0.675	0.672	0.568	0.478	0.725	0.624
Sweden	0.706	0.696	0.537	0.608	0.688	0.647
United Kingdom	0.621	0.619	0.415	0.757	0.741	0.631

2013-2018	POSTURE	PROPENSITY	OUTPUTS	OUTCOMES	IMPACTS	GOVERNMENT
Belgium	0.707	0.731	0.223	0.610	0.617	0.578
Bulgaria	0.003	0.299	0.248	0.235	0.360	0.229
Czech Republic	0.264	0.462	0.128	0.587	0.513	0.391
Denmark	1.000	0.674	0.450	0.643	0.746	0.702
Germany	0.794	0.618	0.427	0.831	0.731	0.680
Estonia	0.591	0.652	0.253	0.417	0.527	0.488
Ireland	0.659	0.787	0.128	0.783	0.656	0.603
Greece	0.056	0.381	0.037	0.279	0.159	0.183
Spain	0.344	0.470	0.152	0.383	0.373	0.345
France	0.590	0.657	0.247	0.682	0.583	0.552
Croatia	0.148	0.376	0.034	0.234	0.325	0.223
Italy	0.102	0.414	0.242	0.538	0.393	0.338
Cyprus	0.371	0.590	0.399	0.720	0.400	0.496
Latvia	0.301	0.519	0.088	0.353	0.346	0.322
Lithuania	0.349	0.538	0.072	0.199	0.417	0.315
Luxembourg	0.832	0.696	0.571	0.730	0.791	0.724
Hungary	0.162	0.435	0.076	0.633	0.396	0.340
Malta	0.296	0.418	0.601	0.595	0.515	0.485
Netherlands	0.852	0.751	0.353	0.663	0.718	0.667
Austria	0.667	0.572	0.405	0.543	0.693	0.576
Poland	0.400	0.320	0.178	0.440	0.436	0.355
Portugal	0.442	0.572	0.159	0.323	0.435	0.386
Romania	0.087	0.373	0.010	0.520	0.396	0.277
Slovenia	0.370	0.552	0.203	0.487	0.470	0.416
Slovakia	0.169	0.416	0.050	0.559	0.369	0.313

Finland	0.955	0.716	0.460	0.552	0.693	0.675
Sweden	0.937	0.702	0.496	0.712	0.729	0.715
United Kingdom	0.788	0.776	0.212	0.763	0.679	0.644

2013-2108	POSTURE	PROPENSITY	OUTPUTS	OUTCOMES	IMPACTS	UNIVERSITY
Belgium	0.591	0.635	0.339	0.398	0.713	0.535
Bulgaria	0.284	0.016	0.032	0.177	0.431	0.188
Czech Republic	0.325	0.627	0.075	0.362	0.623	0.403
Denmark	0.628	1.000	0.637	0.514	0.877	0.731
Germany	0.421	0.827	0.662	0.490	0.980	0.676
Estonia	0.448	0.581	0.098	0.356	0.656	0.428
Ireland	0.633	0.162	0.203	0.888	0.696	0.517
Greece	0.416	0.410	0.033	0.322	0.158	0.268
Spain	0.444	0.400	0.135	0.338	0.416	0.347
France	0.493	0.627	0.403	0.461	0.684	0.534
Croatia	0.259	0.244	0.037	0.263	0.383	0.237
Italy	0.208	0.348	0.204	0.422	0.434	0.323
Cyprus	0.464	0.093	0.037	0.628	0.455	0.335
Latvia	0.356	0.215	0.052	0.276	0.405	0.261
Lithuania	0.455	0.495	0.042	0.142	0.501	0.327
Luxembourg	0.562	0.440	0.185	1.000	0.752	0.588
Hungary	0.236	0.155	0.122	0.312	0.463	0.257
Malta	0.434	0.067	0.108	0.759	0.606	0.395
Netherlands	0.614	0.732	0.592	0.655	0.878	0.694
Austria	0.544	0.785	0.492	0.492	0.827	0.628
Poland	0.412	0.237	0.035	0.184	0.529	0.279
Portugal	0.446	0.506	0.063	0.212	0.520	0.350
Romania	0.191	0.014	0.000	0.000	0.466	0.134
Slovenia	0.493	0.343	0.234	0.432	0.552	0.411
Slovakia	0.269	0.331	0.034	0.188	0.431	0.251
Finland	0.636	0.858	0.868	0.572	0.836	0.754
Sweden	0.612	0.903	0.997	0.721	0.866	0.820
United Kingdom	0.577	0.358	0.316	0.724	0.829	0.561

Meso level Quadruple Innovation Helix model results

2013-2018	POSTURE	PROPENSITY	OUTPUTS	OUTCOMES	IMPACTS	CIVIL SOCIETY
Région de Bruxelles-Capitale / Brussels Hoofdstedelijk Gewest	0.577	0.397	0.327	0.582	0.587	0.494
Vlaams Gewest	0.554	0.790	0.518	0.475	0.616	0.590
Région Wallonne	0.520	0.460	0.508	0.432	0.469	0.478
Severna i iztočna Bulgaria	0.220	0.177	0.082	0.220	0.297	0.199

Yugozapadna i yuzhna tsentralna Bulgaria	0.262	0.210	0.128	0.489	0.371	0.292
Praha	0.406	0.439	0.204	0.829	0.568	0.489
Strední Čechy	0.318	0.343	0.246	0.609	0.527	0.408
Jihozápad	0.324	0.384	0.193	0.516	0.499	0.383
Severozápad	0.274	0.281	0.178	0.397	0.443	0.315
Severovýchod	0.338	0.393	0.279	0.582	0.493	0.417
Jihovýchod	0.368	0.425	0.264	0.589	0.501	0.429
Strední Morava	0.336	0.392	0.238	0.473	0.481	0.384
Moravskoslezsko	0.323	0.374	0.168	0.461	0.451	0.356
Hovedstaden	0.836	0.542	0.688	0.790	0.635	0.698
Sjælland	0.694	0.500	0.540	0.471	0.546	0.550
Syddanmark	0.695	0.530	0.554	0.317	0.562	0.531
Midtjylland	0.742	0.552	0.724	0.415	0.568	0.600
Nordjylland	0.697	0.527	0.509	0.334	0.544	0.522
Stuttgart	0.550	0.521	0.898	0.641	0.649	0.652
Karlsruhe	0.552	0.503	0.864	0.685	0.607	0.642
Freiburg	0.537	0.496	0.863	0.659	0.580	0.627
Tübingen	0.545	0.495	0.883	0.655	0.596	0.635
Oberbayern	0.561	0.556	0.818	0.779	0.685	0.680
Niederbayern	0.504	0.511	0.670	0.488	0.542	0.543
Oberpfalz	0.524	0.511	0.862	0.612	0.559	0.614
Oberfranken	0.515	0.510	0.745	0.480	0.547	0.559
Mittelfranken	0.529	0.516	0.899	0.632	0.568	0.629
Unterfranken	0.531	0.512	0.783	0.510	0.555	0.578
Schwaben	0.517	0.516	0.778	0.531	0.569	0.582
Berlin	0.571	0.442	0.616	0.716	0.540	0.577
Brandenburg	0.485	0.449	0.512	0.350	0.532	0.466
Bremen	0.550	0.481	0.357	0.491	0.535	0.483
Hamburg	0.574	0.504	0.489	0.640	0.634	0.568
Darmstadt	0.546	0.515	0.658	0.664	0.651	0.607
Gießen	0.539	0.482	0.674	0.529	0.555	0.556
Kassel	0.521	0.484	0.581	0.458	0.563	0.521
Mecklenburg- Vorpommern	0.492	0.489	0.352	0.319	0.472	0.425
Braunschweig	0.522	0.512	0.605	0.525	0.557	0.544
Hannover	0.512	0.514	0.622	0.458	0.558	0.533
Lüneburg	0.494	0.508	0.612	0.402	0.544	0.512
Weser-Ems	0.492	0.516	0.549	0.340	0.539	0.487
Düsseldorf	0.507	0.484	0.636	0.451	0.600	0.536
Köln	0.525	0.478	0.638	0.572	0.611	0.565
Münster	0.503	0.459	0.617	0.398	0.556	0.507
Detmold	0.492	0.457	0.685	0.440	0.550	0.525
Arnsberg	0.500	0.465	0.638	0.417	0.545	0.513
Koblenz	0.503	0.498	0.663	0.423	0.542	0.526
Trier	0.524	0.492	0.569	0.360	0.543	0.498

Rhein Hessen-Pfalz	0.523	0.503	0.791	0.581	0.550	0.590
Saarland	0.497	0.483	0.502	0.378	0.526	0.477
Dresden	0.541	0.462	0.567	0.517	0.529	0.523
Chemnitz	0.510	0.460	0.484	0.415	0.510	0.476
Leipzig	0.540	0.459	0.458	0.496	0.507	0.492
Sachsen-Anhalt	0.473	0.429	0.327	0.328	0.487	0.409
Schleswig-Holstein	0.501	0.506	0.585	0.419	0.552	0.512
Thüringen	0.499	0.460	0.549	0.463	0.513	0.497
Border, Midland and Western	0.515	0.501	0.415	0.462	0.394	0.457
Southern and Eastern	0.539	0.548	0.323	0.739	0.560	0.542
Anatoliki Makedonia, Thraki	0.158	0.174	0.099	0.116	0.197	0.149
Kentriki Makedonia	0.212	0.205	0.151	0.171	0.210	0.190
Dytiki Makedonia	0.186	0.171	0.124	0.164	0.218	0.173
Ipeiros	0.208	0.171	0.104	0.143	0.189	0.163
Thessalia	0.172	0.238	0.099	0.083	0.209	0.160
Ionia Nisia	0.151	0.232	0.098	0.163	0.285	0.186
Dytiki Ellada	0.168	0.237	0.142	0.108	0.163	0.163
Stereia Ellada	0.145	0.237	0.099	0.108	0.235	0.165
Peloponnisos	0.177	0.237	0.099	0.085	0.253	0.170
Attiki	0.279	0.414	0.165	0.479	0.359	0.339
Voreio Aigaio	0.159	0.229	0.162	0.189	0.234	0.195
Notio Aigaio	0.153	0.233	0.150	0.210	0.313	0.212
Kriti	0.164	0.236	0.176	0.141	0.247	0.193
Galicia	0.416	0.348	0.181	0.301	0.383	0.326
Principado de Asturias	0.455	0.445	0.201	0.282	0.395	0.356
Cantabria	0.441	0.449	0.195	0.330	0.400	0.363
País Vasco	0.510	0.484	0.340	0.471	0.498	0.461
Comunidad Foral de Navarra	0.472	0.441	0.377	0.384	0.480	0.431
La Rioja	0.440	0.429	0.178	0.220	0.421	0.338
Aragón	0.444	0.413	0.376	0.417	0.430	0.416
Comunidad de Madrid	0.462	0.529	0.277	0.787	0.520	0.515
Castilla y León	0.425	0.398	0.150	0.280	0.399	0.330
Castilla-la Mancha	0.380	0.363	0.134	0.224	0.260	0.272
Extremadura	0.413	0.397	0.066	0.141	0.205	0.244
Cataluña	0.414	0.476	0.350	0.548	0.475	0.452
Comunidad Valenciana	0.411	0.388	0.230	0.265	0.333	0.325
Illes Balears	0.368	0.349	0.123	0.245	0.392	0.295
Andalucía	0.366	0.402	0.139	0.239	0.229	0.275
Región de Murcia	0.383	0.409	0.184	0.206	0.279	0.292
Ciudad Autónoma de Ceuta	0.339	0.359	0.121	0.298	0.167	0.257

Ciudad Autónoma de Melilla	0.355	0.359	0.121	0.287	0.256	0.276
Canarias	0.359	0.321	0.100	0.159	0.234	0.235
Jadranska Hrvatska	0.215	0.196	0.133	0.312	0.366	0.244
Kontinentalna Hrvatska	0.221	0.204	0.184	0.389	0.351	0.270
Île de France	0.638	0.686	0.546	0.725	0.802	0.679
Bassin Parisien	0.565	0.527	0.432	0.343	0.547	0.483
Nord - Pas-de-Calais	0.572	0.441	0.309	0.297	0.479	0.420
Est	0.581	0.457	0.509	0.444	0.513	0.501
Ouest	0.615	0.539	0.438	0.344	0.549	0.497
Sud-Ouest	0.643	0.517	0.435	0.388	0.548	0.506
Centre-Est	0.648	0.530	0.700	0.473	0.563	0.583
Méditerranée	0.569	0.479	0.446	0.371	0.536	0.480
French overseas departments	0.464	0.274	0.090	0.417	0.331	0.315
Piemonte	0.244	0.282	0.469	0.516	0.493	0.401
Valle d'Aosta/Vallée d'Aoste	0.286	0.345	0.216	0.472	0.476	0.359
Liguria	0.255	0.252	0.362	0.439	0.459	0.354
Lombardia	0.270	0.469	0.441	0.583	0.602	0.473
Provincia Autonoma Bolzano/Bozen	0.316	0.390	0.433	0.221	0.542	0.380
Provincia Autonoma Trento	0.331	0.393	0.342	0.361	0.507	0.387
Veneto	0.262	0.395	0.448	0.399	0.525	0.406
Friuli-Venezia Giulia	0.304	0.355	0.550	0.407	0.496	0.422
Emilia-Romagna	0.291	0.374	0.501	0.464	0.534	0.433
Toscana	0.287	0.281	0.379	0.353	0.490	0.358
Umbria	0.270	0.221	0.295	0.346	0.438	0.314
Marche	0.250	0.245	0.392	0.371	0.447	0.341
Lazio	0.260	0.227	0.253	0.639	0.476	0.371
Abruzzo	0.215	0.194	0.294	0.388	0.391	0.296
Molise	0.237	0.211	0.119	0.356	0.333	0.251
Campania	0.202	0.133	0.196	0.322	0.227	0.216
Puglia	0.200	0.189	0.214	0.244	0.263	0.222
Basilicata	0.204	0.188	0.168	0.348	0.315	0.244
Calabria	0.220	0.066	0.127	0.203	0.204	0.164
Sicilia	0.214	0.160	0.141	0.244	0.193	0.191
Sardegna	0.224	0.214	0.155	0.205	0.303	0.220
Közép-Magyarország	0.359	0.355	0.301	0.780	0.471	0.453
Közép-Dunántúl	0.281	0.282	0.189	0.529	0.442	0.345
Nyugat-Dunántúl	0.290	0.269	0.162	0.531	0.453	0.341
Dél-Dunántúl	0.274	0.275	0.176	0.360	0.379	0.293
Észak-Magyarország	0.274	0.250	0.236	0.549	0.348	0.332
Észak-Alföld	0.271	0.246	0.187	0.380	0.347	0.286
Dél-Alföld	0.287	0.294	0.295	0.298	0.396	0.314

Groningen	0.710	0.519	0.320	0.363	0.526	0.488
Friesland	0.632	0.520	0.347	0.239	0.524	0.452
Drenthe	0.627	0.508	0.331	0.347	0.529	0.468
Overijssel	0.673	0.526	0.489	0.344	0.557	0.518
Gelderland	0.680	0.524	0.482	0.365	0.573	0.525
Flevoland	0.641	0.508	0.329	0.489	0.548	0.503
Utrecht	0.752	0.506	0.402	0.537	0.620	0.563
Noord-Holland	0.728	0.517	0.398	0.487	0.631	0.552
Zuid-Holland	0.697	0.522	0.469	0.453	0.602	0.549
Zeeland	0.617	0.491	0.392	0.314	0.547	0.472
Noord-Brabant	0.678	0.515	0.970	0.444	0.606	0.643
Limburg	0.643	0.509	0.622	0.378	0.557	0.542
Ostösterreich	0.599	0.517	0.476	0.547	0.584	0.545
Südösterreich	0.550	0.484	0.585	0.441	0.545	0.521
Westösterreich	0.548	0.525	0.669	0.399	0.577	0.544
Lódzkie	0.341	0.324	0.201	0.309	0.441	0.323
Mazowieckie	0.402	0.318	0.165	0.348	0.445	0.336
Malopolskie	0.351	0.382	0.265	0.357	0.449	0.361
Slaskie	0.343	0.393	0.130	0.378	0.466	0.342
Lubelskie	0.345	0.320	0.214	0.200	0.399	0.296
Podkarpackie	0.323	0.315	0.131	0.259	0.385	0.282
Swietokrzyskie	0.343	0.308	0.150	0.154	0.397	0.270
Podlaskie	0.363	0.337	0.098	0.190	0.409	0.279
Wielkopolskie	0.336	0.373	0.134	0.292	0.460	0.319
Zachodniopomorskie	0.338	0.333	0.136	0.315	0.426	0.309
Lubuskie	0.336	0.322	0.183	0.277	0.429	0.309
Dolnoslaskie	0.341	0.350	0.173	0.525	0.460	0.370
Opolskie	0.340	0.353	0.081	0.289	0.428	0.298
Kujawsko-Pomorskie	0.322	0.363	0.146	0.259	0.414	0.301
Warminsko-Mazurskie	0.320	0.334	0.083	0.167	0.394	0.260
Pomorskie	0.361	0.394	0.182	0.462	0.449	0.369
Norte	0.342	0.427	0.180	0.237	0.380	0.313
Algarve	0.345	0.347	0.139	0.274	0.409	0.303
Centro	0.348	0.418	0.165	0.198	0.410	0.308
Lisboa	0.408	0.456	0.171	0.514	0.472	0.404
Alentejo	0.371	0.427	0.146	0.237	0.385	0.313
Região Autónoma dos Açores	0.353	0.397	0.108	0.180	0.363	0.280
Região Autónoma da Madeira	0.348	0.393	0.061	0.180	0.374	0.271
Nord-Vest	0.185	0.135	0.089	0.244	0.400	0.210
Centru	0.201	0.184	0.094	0.302	0.372	0.231
Nord-Est	0.167	0.153	0.062	0.131	0.347	0.172
Sud-Est	0.158	0.110	0.011	0.175	0.308	0.152
Sud - Muntenia	0.199	0.192	0.040	0.288	0.324	0.209
Bucuresti - Ilfov	0.309	0.223	0.140	0.680	0.459	0.362

Sud-Vest Oltenia	0.189	0.120	0.045	0.222	0.319	0.179
Vest	0.192	0.172	0.145	0.625	0.377	0.302
Vzhodna Slovenija	0.421	0.356	0.347	0.484	0.450	0.411
Zahodna Slovenija	0.457	0.360	0.388	0.659	0.504	0.474
Bratislavský kraj	0.393	0.292	0.194	0.887	0.546	0.462
Západné Slovensko	0.276	0.308	0.134	0.515	0.453	0.337
Stredné Slovensko	0.292	0.319	0.090	0.399	0.406	0.301
Východné Slovensko	0.291	0.299	0.177	0.373	0.379	0.304
Helsinki-Uusimaa	0.784	0.466	0.682	0.719	0.607	0.652
Etelä-Suomi	0.722	0.486	0.723	0.462	0.534	0.585
Länsi-Suomi	0.739	0.514	0.592	0.465	0.528	0.568
Pohjois- ja Itä-Suomi	0.717	0.486	0.623	0.366	0.508	0.540
Åland	0.765	0.586	0.458	0.543	0.571	0.585
Stockholm	0.890	0.545	0.744	0.849	0.662	0.738
Östra Mellansverige	0.816	0.528	0.760	0.524	0.557	0.637
Småland med öarna	0.776	0.524	0.506	0.350	0.542	0.540
Sydsverige	0.837	0.529	0.850	0.544	0.542	0.660
Västsverige	0.838	0.535	0.644	0.532	0.579	0.626
Norra Mellansverige	0.745	0.507	0.491	0.337	0.519	0.520
Mellersta Norrland	0.754	0.504	0.415	0.397	0.525	0.519
Övre Norrland	0.795	0.505	0.504	0.369	0.546	0.544
North East	0.599	0.486	0.408	0.395	0.480	0.474
North West	0.617	0.490	0.360	0.432	0.571	0.494
Yorkshire and The Humber	0.619	0.493	0.343	0.351	0.531	0.467
East Midlands	0.619	0.475	0.464	0.431	0.539	0.506
West Midlands	0.596	0.503	0.363	0.423	0.541	0.485
East of England	0.626	0.507	0.491	0.557	0.597	0.556
London	0.700	0.582	0.264	0.716	0.824	0.617
South East	0.657	0.538	0.493	0.725	0.670	0.617
South West	0.660	0.489	0.463	0.466	0.566	0.529
Wales	0.629	0.462	0.333	0.359	0.493	0.455
Scotland	0.663	0.488	0.359	0.407	0.561	0.496
Northern Ireland	0.587	0.430	0.281	0.320	0.481	0.420
Eesti	0.498	0.420	0.151	0.419	0.460	0.389
Kypros	0.430	0.376	0.085	0.453	0.398	0.348
Latvija	0.305	0.346	0.105	0.295	0.387	0.288
Lietuva	0.435	0.420	0.094	0.252	0.401	0.320
Luxembourg	0.603	0.610	0.246	0.620	0.648	0.546
Malta	0.463	0.384	0.132	0.635	0.460	0.415

2013-2018	POSTURE	PROPENSITY	OUTPUTS	OUTCOMES	IMPACTS	INDUSTRY
Région de Bruxelles-Capitale / Brussels Hoofdstedelijk Gewest	0.569	0.337	0.390	0.541	0.403	0.448

Vlaams Gewest	0.490	0.607	0.483	0.479	0.510	0.514
Région Wallonne	0.468	0.473	0.429	0.418	0.338	0.425
Severna i iztočna Bulgaria	0.287	0.219	0.210	0.249	0.049	0.203
Yugozapadna i yuzhna tsentralna Bulgaria	0.318	0.268	0.316	0.444	0.144	0.298
Praha	0.457	0.318	0.393	0.661	0.319	0.430
Strední Čechy	0.347	0.406	0.337	0.564	0.309	0.392
Jihozápad	0.349	0.329	0.298	0.479	0.225	0.336
Severozápad	0.327	0.302	0.288	0.444	0.189	0.310
Severovýchod	0.356	0.407	0.388	0.629	0.237	0.403
Jihovýchod	0.388	0.385	0.386	0.576	0.249	0.397
Strední Morava	0.350	0.352	0.357	0.508	0.223	0.358
Moravskoslezsko	0.354	0.290	0.339	0.449	0.221	0.331
Hovedstaden	0.755	0.424	0.485	0.667	0.440	0.554
Sjælland	0.581	0.284	0.428	0.445	0.347	0.417
Syddanmark	0.624	0.247	0.449	0.352	0.341	0.403
Midtjylland	0.650	0.281	0.488	0.429	0.353	0.440
Nordjylland	0.602	0.236	0.406	0.366	0.326	0.387
Stuttgart	0.545	0.508	0.601	0.659	0.418	0.546
Karlsruhe	0.511	0.430	0.566	0.646	0.397	0.510
Freiburg	0.458	0.403	0.580	0.582	0.361	0.477
Tübingen	0.495	0.459	0.592	0.636	0.369	0.510
Oberbayern	0.521	0.463	0.577	0.685	0.450	0.539
Niederbayern	0.417	0.340	0.513	0.521	0.318	0.422
Oberpfalz	0.435	0.369	0.539	0.581	0.336	0.452
Oberfranken	0.440	0.346	0.561	0.493	0.332	0.434
Mittelfranken	0.471	0.426	0.549	0.569	0.366	0.476
Unterfranken	0.450	0.388	0.544	0.529	0.346	0.451
Schwaben	0.431	0.349	0.569	0.550	0.344	0.449
Berlin	0.492	0.375	0.539	0.594	0.367	0.473
Brandenburg	0.427	0.263	0.431	0.477	0.351	0.390
Bremen	0.500	0.295	0.470	0.468	0.332	0.413
Hamburg	0.473	0.326	0.520	0.568	0.398	0.457
Darmstadt	0.480	0.417	0.532	0.596	0.426	0.490
Gießen	0.464	0.326	0.505	0.491	0.348	0.427
Kassel	0.437	0.352	0.529	0.452	0.330	0.420
Mecklenburg- Vorpommern	0.429	0.265	0.455	0.376	0.285	0.362
Braunschweig	0.532	0.437	0.490	0.532	0.344	0.467
Hannover	0.450	0.341	0.519	0.451	0.346	0.421
Lüneburg	0.412	0.327	0.500	0.415	0.322	0.395
Weser-Ems	0.415	0.307	0.485	0.368	0.318	0.379
Düsseldorf	0.437	0.350	0.513	0.448	0.406	0.431
Köln	0.473	0.344	0.537	0.527	0.407	0.458
Münster	0.423	0.275	0.539	0.422	0.350	0.402

Detmold	0.444	0.334	0.553	0.429	0.336	0.419
Arnsberg	0.441	0.331	0.549	0.440	0.354	0.423
Koblenz	0.414	0.284	0.532	0.429	0.331	0.398
Trier	0.422	0.285	0.504	0.354	0.310	0.375
Rheinhessen-Pfalz	0.464	0.373	0.534	0.549	0.364	0.457
Saarland	0.433	0.277	0.484	0.436	0.315	0.389
Dresden	0.489	0.344	0.471	0.480	0.331	0.423
Chemnitz	0.434	0.315	0.465	0.439	0.314	0.393
Leipzig	0.459	0.273	0.480	0.479	0.326	0.403
Sachsen-Anhalt	0.425	0.256	0.414	0.365	0.302	0.352
Schleswig-Holstein	0.430	0.288	0.523	0.420	0.335	0.399
Thüringen	0.444	0.310	0.488	0.452	0.322	0.403
Border, Midland and Western	0.470	0.337	0.437	0.436	0.274	0.391
Southern and Eastern	0.481	0.379	0.443	0.634	0.445	0.476
Anatoliki Makedonia, Thraki	0.363	0.247	0.290	0.250	0.014	0.233
Kentriki Makedonia	0.380	0.275	0.352	0.322	0.078	0.282
Dytiki Makedonia	0.365	0.252	0.329	0.288	0.035	0.254
Ipeiros	0.392	0.223	0.298	0.246	0.046	0.241
Thessalia	0.364	0.243	0.327	0.196	0.048	0.236
Ionia Nisia	0.389	0.225	0.281	0.258	0.032	0.237
Dytiki Ellada	0.380	0.271	0.332	0.236	0.026	0.249
Stereia Ellada	0.348	0.287	0.341	0.236	0.018	0.246
Peloponnisos	0.355	0.212	0.335	0.205	0.021	0.225
Attiki	0.403	0.435	0.377	0.526	0.234	0.395
Voreio Aigaio	0.376	0.211	0.317	0.289	0.044	0.247
Notio Aigaio	0.348	0.331	0.340	0.232	0.049	0.260
Kriti	0.387	0.312	0.391	0.243	0.045	0.276
Galicia	0.438	0.203	0.218	0.347	0.212	0.284
Principado de Asturias	0.433	0.178	0.202	0.396	0.211	0.284
Cantabria	0.436	0.171	0.219	0.362	0.226	0.283
País Vasco	0.493	0.320	0.303	0.535	0.312	0.393
Comunidad Foral de Navarra	0.481	0.282	0.325	0.451	0.260	0.360
La Rioja	0.447	0.201	0.331	0.324	0.197	0.300
Aragón	0.453	0.206	0.289	0.453	0.216	0.323
Comunidad de Madrid	0.472	0.374	0.249	0.678	0.430	0.441
Castilla y León	0.444	0.236	0.205	0.363	0.208	0.291
Castilla-la Mancha	0.422	0.195	0.229	0.310	0.159	0.263
Extremadura	0.427	0.181	0.156	0.216	0.122	0.220
Cataluña	0.447	0.383	0.317	0.510	0.364	0.404
Comunidad Valenciana	0.450	0.239	0.296	0.326	0.239	0.310

Illes Balears	0.423	0.092	0.179	0.282	0.179	0.231
Andalucía	0.431	0.282	0.202	0.314	0.228	0.291
Región de Murcia	0.450	0.195	0.257	0.264	0.172	0.268
Ciudad Autónoma de Ceuta	0.416	0.090	0.114	0.310	0.080	0.202
Ciudad Autónoma de Melilla	0.417	0.078	0.248	0.238	0.092	0.215
Canarias	0.424	0.131	0.133	0.176	0.160	0.205
Jadranska Hrvatska	0.253	0.219	0.207	0.296	0.138	0.223
Kontinentalna Hrvatska	0.265	0.289	0.285	0.344	0.146	0.266
Île de France	0.577	0.577	0.437	0.604	0.939	0.627
Bassin Parisien	0.471	0.393	0.366	0.365	0.470	0.413
Nord - Pas-de-Calais	0.477	0.315	0.356	0.348	0.315	0.362
Est	0.488	0.371	0.386	0.444	0.356	0.409
Ouest	0.497	0.359	0.388	0.368	0.443	0.411
Sud-Ouest	0.537	0.435	0.389	0.391	0.409	0.432
Centre-Est	0.543	0.446	0.458	0.452	0.467	0.473
Méditerranée	0.508	0.381	0.373	0.377	0.419	0.412
French overseas departments	0.409	0.199	0.292	0.364	0.158	0.285
Piemonte	0.265	0.397	0.446	0.560	0.259	0.385
Valle d'Aosta/Vallée d'Aoste	0.245	0.217	0.359	0.506	0.200	0.306
Liguria	0.262	0.263	0.320	0.451	0.231	0.306
Lombardia	0.261	0.434	0.455	0.592	0.389	0.426
Provincia Autonoma Bolzano/Bozen	0.268	0.264	0.445	0.290	0.229	0.299
Provincia Autonoma Trento	0.301	0.249	0.406	0.396	0.244	0.319
Veneto	0.252	0.343	0.502	0.444	0.261	0.360
Friuli-Venezia Giulia	0.282	0.318	0.549	0.440	0.234	0.364
Emilia-Romagna	0.275	0.352	0.459	0.505	0.276	0.373
Toscana	0.266	0.293	0.408	0.397	0.238	0.320
Umbria	0.256	0.235	0.390	0.384	0.208	0.294
Marche	0.247	0.266	0.375	0.436	0.203	0.305
Lazio	0.273	0.283	0.354	0.552	0.291	0.350
Abruzzo	0.239	0.255	0.333	0.417	0.178	0.284
Molise	0.237	0.171	0.274	0.388	0.161	0.246
Campania	0.249	0.269	0.299	0.360	0.150	0.265
Puglia	0.234	0.258	0.318	0.318	0.124	0.250
Basilicata	0.233	0.182	0.295	0.382	0.129	0.244
Calabria	0.236	0.240	0.308	0.273	0.100	0.231
Sicília	0.236	0.260	0.280	0.304	0.115	0.239
Sardegna	0.250	0.182	0.286	0.268	0.124	0.222
Közép-Magyarország	0.336	0.407	0.229	0.581	0.280	0.367
Közép-Dunántúl	0.273	0.260	0.142	0.475	0.169	0.264

Nyugat-Dunántúl	0.261	0.294	0.178	0.485	0.169	0.278
Dél-Dunántúl	0.261	0.242	0.182	0.374	0.129	0.238
Észak-Magyarország	0.259	0.245	0.170	0.447	0.118	0.248
Észak-Alföld	0.271	0.276	0.141	0.372	0.115	0.235
Dél-Alföld	0.272	0.277	0.176	0.317	0.136	0.236
Groningen	0.643	0.210	0.398	0.395	0.339	0.397
Friesland	0.559	0.264	0.415	0.308	0.323	0.374
Drenthe	0.564	0.214	0.418	0.376	0.327	0.380
Overijssel	0.596	0.287	0.447	0.386	0.361	0.415
Gelderland	0.610	0.282	0.443	0.402	0.394	0.426
Flevoland	0.602	0.251	0.415	0.507	0.384	0.432
Utrecht	0.644	0.250	0.428	0.521	0.433	0.455
Noord-Holland	0.632	0.279	0.423	0.508	0.456	0.460
Zuid-Holland	0.625	0.295	0.434	0.472	0.449	0.455
Zeeland	0.552	0.264	0.409	0.348	0.327	0.380
Noord-Brabant	0.619	0.377	0.528	0.461	0.421	0.481
Limburg	0.588	0.304	0.451	0.399	0.371	0.422
Ostösterreich	0.602	0.340	0.458	0.506	0.406	0.462
Südösterreich	0.595	0.431	0.441	0.439	0.322	0.445
Westösterreich	0.568	0.392	0.500	0.413	0.364	0.447
Lódzkie	0.384	0.284	0.281	0.281	0.196	0.285
Mazowieckie	0.395	0.300	0.262	0.371	0.253	0.316
Malopolskie	0.416	0.269	0.305	0.319	0.220	0.306
Slaskie	0.390	0.317	0.203	0.344	0.232	0.297
Lubelskie	0.387	0.222	0.227	0.221	0.176	0.247
Podkarpackie	0.390	0.341	0.349	0.311	0.164	0.311
Swietokrzyskie	0.377	0.183	0.125	0.188	0.175	0.210
Podlaskie	0.385	0.207	0.305	0.210	0.157	0.253
Wielkopolskie	0.384	0.294	0.325	0.277	0.189	0.294
Zachodniopomorskie	0.381	0.243	0.202	0.336	0.171	0.267
Lubuskie	0.376	0.205	0.166	0.255	0.166	0.234
Dolnoslaskie	0.398	0.275	0.247	0.471	0.205	0.319
Opolskie	0.379	0.169	0.185	0.284	0.167	0.237
Kujawsko-Pomorskie	0.384	0.262	0.280	0.267	0.159	0.270
Warminsko-Mazurskie	0.379	0.233	0.226	0.178	0.152	0.234
Pomorskie	0.403	0.268	0.199	0.398	0.200	0.294
Norte	0.379	0.367	0.402	0.300	0.183	0.326
Algarve	0.354	0.170	0.349	0.289	0.169	0.266
Centro	0.381	0.355	0.464	0.297	0.192	0.338
Lisboa	0.435	0.337	0.451	0.507	0.285	0.403
Alentejo	0.354	0.245	0.410	0.304	0.161	0.295
Região Autónoma dos Açores	0.340	0.222	0.403	0.270	0.099	0.267
Região Autónoma da Madeira	0.350	0.165	0.379	0.272	0.138	0.261
Nord-Vest	0.226	0.161	0.080	0.236	0.071	0.155

Centru	0.227	0.187	0.095	0.319	0.051	0.176
Nord-Est	0.228	0.149	0.149	0.211	0.043	0.156
Sud-Est	0.225	0.226	0.175	0.254	0.022	0.181
Sud - Muntenia	0.227	0.234	0.088	0.327	0.043	0.184
Bucuresti - Ilfov	0.267	0.264	0.169	0.535	0.242	0.296
Sud-Vest Oltenia	0.226	0.111	0.073	0.277	0.036	0.145
Vest	0.229	0.154	0.067	0.503	0.074	0.205
Vzhodna Slovenija	0.463	0.355	0.427	0.470	0.238	0.391
Zahodna Slovenija	0.525	0.349	0.424	0.570	0.296	0.433
Bratislavský kraj	0.447	0.258	0.278	0.738	0.313	0.407
Západné Slovensko	0.320	0.268	0.179	0.457	0.181	0.281
Stredné Slovensko	0.322	0.243	0.208	0.385	0.157	0.263
Východné Slovensko	0.322	0.229	0.211	0.347	0.130	0.248
Helsinki-Uusimaa	0.800	0.345	0.487	0.629	0.398	0.532
Etelä-Suomi	0.664	0.370	0.473	0.453	0.345	0.461
Länsi-Suomi	0.698	0.383	0.451	0.466	0.337	0.467
Pohjois- ja Itä-Suomi	0.695	0.425	0.446	0.360	0.320	0.449
Åland	0.617	0.176	0.484	0.529	0.322	0.426
Stockholm	0.757	0.453	0.535	0.685	0.475	0.581
Östra Mellansverige	0.733	0.440	0.470	0.485	0.376	0.501
Småland med öarna	0.629	0.328	0.442	0.368	0.324	0.418
Sydsverige	0.705	0.422	0.509	0.483	0.382	0.500
Västsverige	0.716	0.415	0.476	0.503	0.391	0.500
Norra Mellansverige	0.630	0.307	0.365	0.328	0.303	0.387
Mellersta Norrland	0.608	0.287	0.397	0.369	0.308	0.394
Övre Norrland	0.671	0.325	0.388	0.338	0.318	0.408
North East	0.528	0.309	0.326	0.445	0.306	0.383
North West	0.530	0.372	0.318	0.485	0.441	0.429
Yorkshire and The Humber	0.537	0.269	0.338	0.408	0.385	0.387
East Midlands	0.547	0.365	0.377	0.498	0.386	0.435
West Midlands	0.526	0.346	0.346	0.484	0.392	0.419
East of England	0.568	0.422	0.382	0.490	0.474	0.467
London	0.562	0.329	0.308	0.694	0.767	0.532
South East	0.567	0.413	0.370	0.659	0.585	0.519
South West	0.550	0.370	0.345	0.517	0.413	0.439
Wales	0.534	0.268	0.328	0.404	0.320	0.371
Scotland	0.496	0.282	0.316	0.399	0.391	0.377
Northern Ireland	0.512	0.274	0.253	0.355	0.274	0.334
Eesti	0.466	0.372	0.317	0.415	0.265	0.367
Kypros	0.256	0.148	0.450	0.490	0.200	0.309
Latvija	0.311	0.267	0.176	0.248	0.179	0.236
Lietuva	0.331	0.448	0.291	0.258	0.180	0.302
Luxembourg	0.385	0.254	0.586	0.524	0.406	0.431
Malta	0.512	0.222	0.511	0.560	0.189	0.399

2013-2018	POSTURE	PROPENSITY	OUTPUTS	OUTCOMES	IMPACTS	GOVERNMENT
Région de Bruxelles-Capitale / Brussels Hoofdstedelijk Gewest	0.610	0.424	0.192	0.505	0.587	0.464
Vlaams Gewest	0.660	0.695	0.307	0.495	0.616	0.555
Région Wallonne	0.610	0.452	0.296	0.360	0.469	0.437
Severna i iztochna Bulgaria	0.199	0.160	0.214	0.243	0.297	0.223
Yugozapadna i yuzhna tsentralna Bulgaria	0.158	0.215	0.417	0.503	0.371	0.333
Praha	0.299	0.493	0.265	0.682	0.568	0.461
Strední Čechy	0.306	0.328	0.216	0.616	0.527	0.399
Jihozápad	0.339	0.388	0.150	0.532	0.499	0.381
Severozápad	0.212	0.250	0.180	0.396	0.443	0.296
Severovýchod	0.362	0.372	0.248	0.804	0.493	0.456
Jihovýchod	0.377	0.455	0.288	0.684	0.501	0.461
Strední Morava	0.383	0.390	0.218	0.596	0.481	0.413
Moravskoslezsko	0.293	0.362	0.232	0.513	0.451	0.370
Hovedstaden	0.836	0.593	0.405	0.683	0.635	0.631
Sjælland	0.827	0.527	0.285	0.327	0.546	0.502
Syddanmark	0.825	0.559	0.368	0.337	0.562	0.530
Midtjylland	0.836	0.590	0.430	0.451	0.568	0.575
Nordjylland	0.810	0.591	0.309	0.390	0.544	0.529
Stuttgart	0.703	0.536	0.466	0.962	0.649	0.663
Karlsruhe	0.703	0.557	0.420	0.762	0.607	0.610
Freiburg	0.703	0.535	0.450	0.558	0.580	0.565
Tübingen	0.703	0.534	0.447	0.764	0.596	0.609
Oberbayern	0.699	0.576	0.439	0.804	0.685	0.641
Niederbayern	0.699	0.512	0.338	0.605	0.542	0.539
Oberpfalz	0.699	0.512	0.402	0.651	0.559	0.565
Oberfranken	0.699	0.527	0.442	0.560	0.547	0.555
Mittelfranken	0.699	0.546	0.441	0.564	0.568	0.564
Unterfranken	0.699	0.533	0.397	0.661	0.555	0.569
Schwaben	0.699	0.514	0.400	0.653	0.569	0.567
Berlin	0.666	0.542	0.351	0.496	0.540	0.519
Brandenburg	0.670	0.513	0.268	0.771	0.532	0.551
Bremen	0.713	0.556	0.213	0.471	0.535	0.497
Hamburg	0.707	0.542	0.315	0.605	0.634	0.560
Darmstadt	0.691	0.525	0.346	0.649	0.651	0.572
Gießen	0.691	0.513	0.358	0.436	0.555	0.510
Kassel	0.691	0.494	0.326	0.421	0.563	0.499
Mecklenburg-Vorpommern	0.703	0.545	0.192	0.431	0.472	0.468
Braunschweig	0.705	0.573	0.312	0.694	0.557	0.568
Hannover	0.705	0.548	0.348	0.456	0.558	0.523

Lüneburg	0.705	0.515	0.318	0.366	0.544	0.490
Weser-Ems	0.705	0.526	0.318	0.333	0.539	0.484
Düsseldorf	0.680	0.494	0.356	0.495	0.600	0.525
Köln	0.680	0.531	0.343	0.541	0.611	0.541
Münster	0.680	0.481	0.347	0.406	0.556	0.494
Detmold	0.680	0.474	0.418	0.408	0.550	0.506
Arnsberg	0.680	0.489	0.383	0.503	0.545	0.520
Koblenz	0.700	0.496	0.363	0.402	0.542	0.501
Trier	0.700	0.527	0.326	0.237	0.543	0.466
Rhein Hessen-Pfalz	0.700	0.515	0.393	0.565	0.550	0.545
Saarland	0.719	0.516	0.275	0.528	0.526	0.513
Dresden	0.682	0.548	0.289	0.422	0.529	0.494
Chemnitz	0.682	0.515	0.253	0.449	0.510	0.482
Leipzig	0.682	0.535	0.242	0.477	0.507	0.489
Sachsen-Anhalt	0.634	0.475	0.189	0.318	0.487	0.421
Schleswig-Holstein	0.711	0.529	0.346	0.394	0.552	0.506
Thüringen	0.673	0.513	0.287	0.412	0.513	0.480
Border, Midland and Western	0.660	0.499	0.227	0.335	0.394	0.423
Southern and Eastern	0.639	0.530	0.199	0.587	0.560	0.503
Anatoliki Makedonia, Thraki	0.195	0.215	0.070	0.078	0.197	0.151
Kentriki Makedonia	0.195	0.245	0.112	0.300	0.210	0.212
Dytiki Makedonia	0.195	0.208	0.091	0.144	0.218	0.171
Ipeiros	0.195	0.234	0.091	0.141	0.189	0.170
Thessalia	0.183	0.262	0.124	0.092	0.209	0.174
Ionia Nisia	0.183	0.236	0.094	0.284	0.285	0.216
Dytiki Ellada	0.183	0.272	0.085	0.150	0.163	0.171
Stereia Ellada	0.183	0.229	0.072	0.100	0.235	0.164
Peloponnisos	0.183	0.241	0.082	0.120	0.253	0.176
Attiki	0.211	0.374	0.123	0.629	0.359	0.339
Voreio Aigaio	0.176	0.278	0.134	0.284	0.234	0.221
Notio Aigaio	0.176	0.244	0.095	0.095	0.313	0.185
Kriti	0.176	0.308	0.111	0.118	0.247	0.192
Galicia	0.374	0.357	0.145	0.287	0.383	0.309
Principado de Asturias	0.461	0.447	0.122	0.255	0.395	0.336
Cantabria	0.505	0.468	0.149	0.326	0.400	0.370
País Vasco	0.543	0.481	0.214	0.595	0.498	0.466
Comunidad Foral de Navarra	0.534	0.456	0.265	0.482	0.480	0.443
La Rioja	0.487	0.435	0.240	0.245	0.421	0.366
Aragón	0.478	0.415	0.224	0.379	0.430	0.385
Comunidad de Madrid	0.418	0.510	0.209	0.731	0.520	0.478
Castilla y León	0.433	0.400	0.116	0.240	0.399	0.317

Castilla-la Mancha	0.419	0.352	0.171	0.239	0.260	0.288
Extremadura	0.485	0.418	0.059	0.157	0.205	0.265
Cataluña	0.422	0.455	0.279	0.464	0.475	0.419
Comunidad Valenciana	0.390	0.394	0.300	0.267	0.333	0.337
Illes Balears	0.398	0.344	0.193	0.298	0.392	0.325
Andalucía	0.375	0.405	0.113	0.209	0.229	0.266
Región de Murcia	0.443	0.417	0.265	0.190	0.279	0.319
Ciudad Autónoma de Ceuta	0.358	0.332	0.123	0.221	0.167	0.240
Ciudad Autónoma de Melilla	0.358	0.336	0.128	0.198	0.256	0.255
Canarias	0.312	0.325	0.088	0.136	0.234	0.219
Jadranska Hrvatska	0.264	0.195	0.122	0.277	0.366	0.245
Kontinentalna Hrvatska	0.284	0.258	0.121	0.256	0.351	0.254
Île de France	0.612	0.638	0.310	0.530	0.802	0.578
Bassin Parisien	0.588	0.478	0.240	0.307	0.547	0.432
Nord - Pas-de-Calais	0.512	0.437	0.215	0.312	0.479	0.391
Est	0.572	0.469	0.278	0.422	0.513	0.451
Ouest	0.642	0.520	0.241	0.302	0.549	0.451
Sud-Ouest	0.626	0.530	0.235	0.357	0.548	0.459
Centre-Est	0.617	0.539	0.357	0.378	0.563	0.491
Méditerranée	0.509	0.510	0.243	0.310	0.536	0.422
French overseas departments	0.404	0.292	0.111	0.308	0.331	0.289
Piemonte	0.251	0.287	0.295	0.707	0.493	0.407
Valle d'Aosta/Vallée d'Aoste	0.434	0.335	0.240	0.591	0.476	0.415
Liguria	0.186	0.281	0.205	0.432	0.459	0.313
Lombardia	0.300	0.419	0.297	0.704	0.602	0.464
Provincia Autonoma Bolzano/Bozen	0.476	0.379	0.277	0.209	0.542	0.377
Provincia Autonoma Trento	0.473	0.435	0.201	0.361	0.507	0.395
Veneto	0.312	0.375	0.342	0.482	0.525	0.407
Friuli-Venezia Giulia	0.421	0.385	0.437	0.427	0.496	0.433
Emilia-Romagna	0.362	0.379	0.358	0.586	0.534	0.444
Toscana	0.372	0.317	0.269	0.380	0.490	0.366
Umbria	0.224	0.272	0.246	0.338	0.438	0.304
Marche	0.218	0.252	0.308	0.522	0.447	0.349
Lazio	0.179	0.310	0.167	0.459	0.476	0.318
Abruzzo	0.071	0.229	0.177	0.401	0.391	0.254
Molise	0.114	0.228	0.099	0.357	0.333	0.226
Campania	0.068	0.220	0.142	0.308	0.227	0.193
Puglia	0.113	0.239	0.154	0.328	0.263	0.219
Basilicata	0.080	0.226	0.146	0.342	0.315	0.222
Calabria	0.152	0.173	0.106	0.215	0.204	0.170

Sicilia	0.203	0.231	0.093	0.219	0.193	0.188
Sardegna	0.185	0.263	0.095	0.176	0.303	0.204
Közép-Magyarország	0.217	0.335	0.212	0.626	0.471	0.372
Közép-Dunántúl	0.329	0.277	0.120	0.560	0.442	0.346
Nyugat-Dunántúl	0.343	0.262	0.186	0.562	0.453	0.361
Dél-Dunántúl	0.314	0.274	0.195	0.513	0.379	0.335
Észak-Magyarország	0.313	0.237	0.144	0.445	0.348	0.297
Észak-Alföld	0.270	0.258	0.140	0.489	0.347	0.301
Dél-Alföld	0.322	0.310	0.183	0.422	0.396	0.326
Groningen	0.749	0.585	0.183	0.418	0.526	0.492
Friesland	0.750	0.489	0.248	0.317	0.524	0.465
Drenthe	0.751	0.486	0.219	0.339	0.529	0.465
Overijssel	0.780	0.549	0.311	0.426	0.557	0.524
Gelderland	0.743	0.574	0.307	0.447	0.573	0.529
Flevoland	0.760	0.548	0.230	0.630	0.548	0.543
Utrecht	0.762	0.571	0.247	0.553	0.620	0.551
Noord-Holland	0.731	0.554	0.269	0.667	0.631	0.571
Zuid-Holland	0.747	0.566	0.293	0.559	0.602	0.553
Zeeland	0.752	0.471	0.217	0.322	0.547	0.462
Noord-Brabant	0.749	0.518	0.483	0.512	0.606	0.573
Limburg	0.739	0.533	0.330	0.395	0.557	0.511
Ostösterreich	0.610	0.553	0.296	0.462	0.584	0.501
Südösterreich	0.633	0.521	0.316	0.357	0.545	0.474
Westösterreich	0.620	0.522	0.437	0.400	0.577	0.511
Lódzkie	0.335	0.332	0.381	0.294	0.441	0.357
Mazowieckie	0.373	0.367	0.328	0.486	0.445	0.400
Malopolskie	0.359	0.399	0.405	0.311	0.449	0.385
Slaskie	0.349	0.358	0.218	0.396	0.466	0.357
Lubelskie	0.332	0.345	0.282	0.279	0.399	0.327
Podkarpackie	0.323	0.309	0.444	0.414	0.385	0.375
Swietokrzyskie	0.371	0.301	0.111	0.219	0.397	0.280
Podlaskie	0.381	0.339	0.394	0.288	0.409	0.362
Wielkopolskie	0.394	0.362	0.429	0.268	0.460	0.383
Zachodniopomorskie	0.424	0.322	0.244	0.495	0.426	0.382
Lubuskie	0.443	0.303	0.190	0.260	0.429	0.325
Dolnoslaskie	0.357	0.332	0.294	0.527	0.460	0.394
Opolskie	0.429	0.338	0.179	0.267	0.428	0.328
Kujawsko-Pomorskie	0.424	0.344	0.367	0.334	0.414	0.376
Warminsko-Mazurskie	0.423	0.329	0.280	0.127	0.394	0.311
Pomorskie	0.403	0.384	0.245	0.443	0.449	0.385
Norte	0.443	0.436	0.224	0.252	0.380	0.347
Algarve	0.536	0.357	0.139	0.244	0.409	0.337
Centro	0.477	0.439	0.174	0.282	0.410	0.356
Lisboa	0.503	0.483	0.145	0.482	0.472	0.417
Alentejo	0.631	0.423	0.164	0.256	0.385	0.372

Região Autónoma dos Açores	0.527	0.397	0.152	0.471	0.363	0.382
Região Autónoma da Madeira	0.486	0.388	0.249	0.475	0.374	0.394
Nord-Vest	0.173	0.150	0.078	0.211	0.400	0.202
Centru	0.269	0.169	0.092	0.263	0.372	0.233
Nord-Est	0.172	0.165	0.059	0.195	0.347	0.188
Sud-Est	0.120	0.097	0.020	0.281	0.308	0.165
Sud - Muntenia	0.302	0.172	0.051	0.368	0.324	0.244
Bucuresti - Ilfov	0.170	0.259	0.199	0.596	0.459	0.337
Sud-Vest Oltenia	0.222	0.126	0.056	0.407	0.319	0.226
Vest	0.231	0.172	0.090	0.620	0.377	0.298
Vzhodna Slovenija	0.439	0.336	0.429	0.504	0.450	0.431
Zahodna Slovenija	0.439	0.408	0.357	0.590	0.504	0.460
Bratislavský kraj	0.256	0.336	0.172	0.854	0.546	0.433
Západné Slovensko	0.248	0.285	0.121	0.450	0.453	0.312
Stredné Slovensko	0.316	0.314	0.076	0.397	0.406	0.302
Východné Slovensko	0.303	0.298	0.164	0.318	0.379	0.293
Helsinki-Uusimaa	0.752	0.527	0.401	0.769	0.607	0.611
Etelä-Suomi	0.722	0.558	0.351	0.485	0.534	0.530
Länsi-Suomi	0.756	0.551	0.337	0.494	0.528	0.533
Pohjois- ja Itä-Suomi	0.717	0.553	0.334	0.292	0.508	0.481
Åland	1.000	0.553	0.352	0.719	0.571	0.639
Stockholm	0.816	0.584	0.394	0.883	0.662	0.668
Östra Mellansverige	0.816	0.597	0.376	0.545	0.557	0.578
Småland med öarna	0.807	0.518	0.346	0.435	0.542	0.529
Sydsverige	0.807	0.581	0.458	0.474	0.542	0.572
Västsverige	0.807	0.567	0.361	0.672	0.579	0.597
Norra Mellansverige	0.798	0.504	0.287	0.333	0.519	0.488
Mellersta Norrland	0.798	0.504	0.262	0.360	0.525	0.490
Övre Norrland	0.798	0.590	0.271	0.325	0.546	0.506
North East	0.677	0.496	0.219	0.360	0.480	0.446
North West	0.655	0.493	0.206	0.461	0.571	0.477
Yorkshire and The Humber	0.685	0.502	0.214	0.291	0.531	0.445
East Midlands	0.675	0.480	0.260	0.474	0.539	0.486
West Midlands	0.671	0.492	0.227	0.476	0.541	0.481
East of England	0.708	0.536	0.279	0.420	0.597	0.508
London	0.683	0.570	0.207	0.728	0.824	0.602
South East	0.717	0.553	0.277	0.578	0.670	0.559
South West	0.692	0.503	0.279	0.465	0.566	0.501
Wales	0.688	0.480	0.198	0.254	0.493	0.423
Scotland	0.668	0.529	0.198	0.285	0.561	0.448
Northern Ireland	0.698	0.446	0.180	0.250	0.481	0.411
Eesti	0.524	0.489	0.270	0.429	0.460	0.434
Kypros	0.477	0.360	0.344	0.732	0.398	0.462
Latvija	0.315	0.338	0.200	0.265	0.387	0.301

Lietuva	0.345	0.448	0.164	0.288	0.401	0.329
Luxembourg	0.783	0.616	0.387	0.550	0.648	0.597
Malta	0.461	0.368	0.514	0.801	0.460	0.521

2013-2018	POSTURE	PROPENSITY	OUTPUTS	OUTCOMES	IMPACTS	UNIVERSITY
Région de Bruxelles-Capitale / Brussels Hoofdstedelijk Gewest	0.623	0.387	0.327	0.582	0.661	0.516
Vlaams Gewest	0.580	0.671	0.518	0.475	0.840	0.617
Région Wallonne	0.507	0.380	0.508	0.432	0.664	0.498
Severna i iztochna Bulgaria	0.361	0.168	0.082	0.220	0.430	0.252
Yugozapadna i yuzhna tsentralna Bulgaria	0.505	0.313	0.128	0.489	0.534	0.394
Praha	0.683	0.506	0.204	0.829	0.763	0.597
Strední Čechy	0.459	0.197	0.246	0.609	0.756	0.453
Jihozápad	0.439	0.264	0.193	0.516	0.647	0.412
Severozápad	0.333	0.099	0.178	0.397	0.586	0.319
Severovýchod	0.442	0.191	0.279	0.582	0.649	0.429
Jihovýchod	0.537	0.376	0.264	0.589	0.665	0.486
Strední Morava	0.463	0.231	0.238	0.473	0.633	0.408
Moravskoslezsko	0.435	0.209	0.168	0.461	0.611	0.377
Hovedstaden	0.749	0.410	0.688	0.790	0.879	0.703
Sjælland	0.446	0.270	0.540	0.471	0.795	0.504
Syddanmark	0.502	0.305	0.554	0.317	0.765	0.488
Midtjylland	0.566	0.345	0.724	0.415	0.790	0.568
Nordjylland	0.500	0.414	0.509	0.334	0.761	0.503
Stuttgart	0.583	0.315	0.898	0.641	0.876	0.663
Karlsruhe	0.546	0.401	0.864	0.685	0.885	0.676
Freiburg	0.452	0.342	0.863	0.659	0.832	0.630
Tübingen	0.532	0.342	0.883	0.655	0.853	0.653
Oberbayern	0.603	0.370	0.818	0.779	0.917	0.698
Niederbayern	0.432	0.193	0.670	0.488	0.774	0.511
Oberpfalz	0.453	0.192	0.862	0.612	0.804	0.585
Oberfranken	0.441	0.261	0.745	0.480	0.794	0.544
Mittelfranken	0.498	0.318	0.899	0.632	0.847	0.639
Unterfranken	0.476	0.278	0.783	0.510	0.819	0.573
Schwaben	0.452	0.196	0.778	0.531	0.807	0.553
Berlin	0.502	0.493	0.616	0.716	0.762	0.618
Brandenburg	0.380	0.398	0.512	0.350	0.800	0.488
Bremen	0.492	0.430	0.357	0.491	0.779	0.510
Hamburg	0.485	0.350	0.489	0.640	0.880	0.569
Darmstadt	0.489	0.300	0.658	0.664	0.895	0.601
Gießen	0.446	0.299	0.674	0.529	0.821	0.554

Kassel	0.418	0.226	0.581	0.458	0.788	0.494
Mecklenburg-Vorpommern	0.375	0.381	0.352	0.319	0.684	0.422
Braunschweig	0.532	0.416	0.605	0.525	0.794	0.574
Hannover	0.407	0.333	0.622	0.458	0.794	0.523
Lüneburg	0.364	0.217	0.612	0.402	0.774	0.474
Weser-Ems	0.377	0.249	0.549	0.340	0.753	0.454
Düsseldorf	0.390	0.292	0.636	0.451	0.827	0.519
Köln	0.466	0.409	0.638	0.572	0.856	0.588
Münster	0.383	0.276	0.617	0.398	0.802	0.495
Detmold	0.406	0.253	0.685	0.440	0.781	0.513
Arnsberg	0.391	0.293	0.638	0.417	0.783	0.504
Koblenz	0.358	0.185	0.663	0.423	0.788	0.483
Trier	0.393	0.304	0.569	0.360	0.770	0.479
Rhein Hessen-Pfalz	0.427	0.256	0.791	0.581	0.833	0.578
Saarland	0.381	0.304	0.502	0.378	0.755	0.464
Dresden	0.514	0.456	0.567	0.517	0.771	0.565
Chemnitz	0.436	0.361	0.484	0.415	0.751	0.489
Leipzig	0.461	0.424	0.458	0.496	0.755	0.519
Sachsen-Anhalt	0.367	0.336	0.327	0.328	0.700	0.412
Schleswig-Holstein	0.384	0.295	0.585	0.419	0.776	0.492
Thüringen	0.423	0.365	0.549	0.463	0.756	0.511
Border, Midland and Western	0.637	0.233	0.415	0.462	0.542	0.458
Southern and Eastern	0.654	0.339	0.323	0.739	0.733	0.558
Anatoliki Makedonia, Thraki	0.497	0.232	0.099	0.116	0.223	0.233
Kentriki Makedonia	0.623	0.298	0.151	0.171	0.183	0.285
Dytiki Makedonia	0.563	0.218	0.124	0.164	0.087	0.231
Ipeiros	0.626	0.261	0.104	0.143	0.183	0.264
Thessalia	0.577	0.248	0.099	0.083	0.202	0.242
Ionia Nisia	0.512	0.179	0.098	0.163	0.298	0.250
Dytiki Ellada	0.581	0.268	0.142	0.108	0.111	0.242
Stereia Ellada	0.498	0.153	0.099	0.108	0.181	0.208
Peloponnisos	0.532	0.192	0.099	0.085	0.272	0.236
Attiki	0.706	0.517	0.165	0.479	0.313	0.436
Voreio Aigaio	0.518	0.284	0.162	0.189	0.253	0.281
Notio Aigaio	0.498	0.207	0.150	0.210	0.317	0.276
Kriti	0.579	0.342	0.176	0.141	0.254	0.298
Galicia	0.530	0.264	0.181	0.301	0.423	0.340
Principado de Asturias	0.563	0.239	0.201	0.282	0.437	0.344
Cantabria	0.567	0.281	0.195	0.330	0.488	0.372
País Vasco	0.712	0.273	0.340	0.471	0.609	0.481
Comunidad Foral de Navarra	0.635	0.259	0.377	0.384	0.571	0.445

La Rioja	0.525	0.224	0.178	0.220	0.479	0.325
Aragón	0.529	0.230	0.376	0.417	0.477	0.406
Comunidad de Madrid	0.604	0.509	0.277	0.787	0.604	0.556
Castilla y León	0.528	0.257	0.150	0.280	0.438	0.331
Castilla-la Mancha	0.425	0.178	0.134	0.224	0.270	0.246
Extremadura	0.454	0.272	0.066	0.141	0.181	0.223
Cataluña	0.531	0.480	0.350	0.548	0.497	0.481
Comunidad Valenciana	0.483	0.338	0.230	0.265	0.366	0.336
Illes Balears	0.397	0.187	0.123	0.245	0.435	0.277
Andalucía	0.424	0.411	0.139	0.239	0.197	0.282
Región de Murcia	0.431	0.252	0.184	0.206	0.326	0.280
Ciudad Autónoma de Ceuta	0.373	0.054	0.121	0.298	0.147	0.199
Ciudad Autónoma de Melilla	0.389	0.078	0.121	0.287	0.135	0.202
Canarias	0.436	0.236	0.100	0.159	0.232	0.233
Jadranska Hrvatska	0.493	0.129	0.133	0.312	0.439	0.301
Kontinentalna Hrvatska	0.500	0.290	0.184	0.389	0.442	0.361
Île de France	0.647	0.709	0.546	0.725	0.819	0.689
Bassin Parisien	0.434	0.331	0.432	0.343	0.636	0.435
Nord - Pas-de-Calais	0.435	0.246	0.309	0.297	0.581	0.374
Est	0.459	0.324	0.509	0.444	0.656	0.478
Ouest	0.486	0.357	0.438	0.344	0.678	0.461
Sud-Ouest	0.554	0.395	0.435	0.388	0.681	0.491
Centre-Est	0.545	0.432	0.700	0.473	0.719	0.574
Méditerranée	0.488	0.467	0.446	0.371	0.632	0.481
French overseas departments	0.311	0.207	0.090	0.417	0.288	0.263
Piemonte	0.360	0.273	0.469	0.516	0.589	0.441
Valle d'Aosta/Vallée d'Aoste	0.278	0.137	0.216	0.472	0.576	0.336
Liguria	0.368	0.269	0.362	0.439	0.582	0.404
Lombardia	0.357	0.440	0.441	0.583	0.663	0.497
Provincia Autonoma Bolzano/Bozen	0.335	0.151	0.433	0.221	0.652	0.358
Provincia Autonoma Trento	0.436	0.330	0.342	0.361	0.647	0.423
Veneto	0.380	0.271	0.448	0.399	0.615	0.423
Friuli-Venezia Giulia	0.399	0.291	0.550	0.407	0.618	0.453
Emilia-Romagna	0.379	0.317	0.501	0.464	0.631	0.459
Toscana	0.363	0.314	0.379	0.353	0.583	0.398
Umbria	0.400	0.279	0.295	0.346	0.556	0.375
Marche	0.365	0.196	0.392	0.371	0.550	0.375
Lazio	0.399	0.453	0.253	0.639	0.577	0.464
Abruzzo	0.365	0.257	0.294	0.388	0.502	0.361

Molise	0.358	0.204	0.119	0.356	0.454	0.298
Campania	0.264	0.334	0.196	0.322	0.306	0.284
Puglia	0.270	0.292	0.214	0.244	0.325	0.269
Basilicata	0.328	0.248	0.168	0.348	0.435	0.305
Calabria	0.286	0.255	0.127	0.203	0.254	0.225
Sicilia	0.212	0.308	0.141	0.244	0.266	0.234
Sardegna	0.220	0.283	0.155	0.205	0.370	0.247
Közép-Magyarország	0.554	0.445	0.301	0.780	0.662	0.548
Közép-Dunántúl	0.370	0.183	0.189	0.529	0.585	0.371
Nyugat-Dunántúl	0.394	0.167	0.162	0.531	0.589	0.368
Dél-Dunántúl	0.329	0.171	0.176	0.360	0.524	0.312
Észak-Magyarország	0.278	0.125	0.236	0.549	0.505	0.339
Észak-Alföld	0.331	0.221	0.187	0.380	0.478	0.319
Dél-Alföld	0.385	0.251	0.295	0.298	0.533	0.352
Groningen	0.637	0.416	0.320	0.363	0.758	0.499
Friesland	0.482	0.040	0.347	0.239	0.749	0.371
Drenthe	0.491	0.073	0.331	0.347	0.765	0.401
Overijssel	0.562	0.279	0.489	0.344	0.809	0.497
Gelderland	0.573	0.382	0.482	0.365	0.849	0.530
Flevoland	0.505	0.325	0.329	0.489	0.836	0.497
Utrecht	0.663	0.412	0.402	0.537	0.919	0.587
Noord-Holland	0.640	0.359	0.398	0.487	0.874	0.551
Zuid-Holland	0.598	0.378	0.469	0.453	0.842	0.548
Zeeland	0.432	0.076	0.392	0.314	0.787	0.400
Noord-Brabant	0.596	0.219	0.970	0.444	0.865	0.619
Limburg	0.535	0.279	0.622	0.378	0.828	0.528
Ostösterreich	0.607	0.402	0.476	0.547	0.755	0.557
Südösterreich	0.594	0.347	0.585	0.441	0.737	0.541
Westösterreich	0.548	0.275	0.669	0.399	0.753	0.529
Lódzkie	0.574	0.285	0.201	0.309	0.582	0.390
Mazowieckie	0.646	0.364	0.165	0.348	0.637	0.432
Malopolskie	0.631	0.370	0.265	0.357	0.609	0.446
Slaskie	0.577	0.335	0.130	0.378	0.617	0.408
Lubelskie	0.574	0.292	0.214	0.200	0.548	0.366
Podkarpackie	0.587	0.202	0.131	0.259	0.509	0.338
Swietokrzyskie	0.571	0.159	0.150	0.154	0.538	0.314
Podlaskie	0.547	0.202	0.098	0.190	0.552	0.318
Wielkopolskie	0.564	0.323	0.134	0.292	0.587	0.380
Zachodniopomorskie	0.526	0.170	0.136	0.315	0.562	0.342
Lubuskie	0.520	0.099	0.183	0.277	0.569	0.330
Dolnoslaskie	0.579	0.270	0.173	0.525	0.590	0.427
Opolskie	0.550	0.133	0.081	0.289	0.569	0.324
Kujawsko-Pomorskie	0.524	0.174	0.146	0.259	0.538	0.328
Warminsko-Mazurskie	0.506	0.178	0.083	0.167	0.526	0.292
Pomorskie	0.585	0.251	0.182	0.462	0.594	0.415

Norte	0.445	0.374	0.180	0.237	0.489	0.345
Algarve	0.356	0.196	0.139	0.274	0.507	0.294
Centro	0.449	0.341	0.165	0.198	0.553	0.341
Lisboa	0.552	0.467	0.171	0.514	0.596	0.460
Alentejo	0.389	0.172	0.146	0.237	0.486	0.286
Região Autónoma dos Açores	0.308	0.182	0.108	0.180	0.434	0.242
Região Autónoma da Madeira	0.337	0.163	0.061	0.180	0.448	0.238
Nord-Vest	0.316	0.197	0.089	0.244	0.517	0.273
Centru	0.282	0.133	0.094	0.302	0.479	0.258
Nord-Est	0.243	0.189	0.062	0.131	0.507	0.226
Sud-Est	0.240	0.124	0.011	0.175	0.441	0.198
Sud - Muntenia	0.269	0.128	0.040	0.288	0.453	0.236
Bucuresti - Ilfov	0.537	0.408	0.140	0.680	0.637	0.480
Sud-Vest Oltenia	0.318	0.132	0.045	0.222	0.455	0.234
Vest	0.373	0.162	0.145	0.625	0.512	0.363
Vzhodna Slovenija	0.583	0.121	0.347	0.484	0.608	0.429
Zahodna Slovenija	0.709	0.354	0.388	0.659	0.704	0.563
Bratislavský kraj	0.700	0.349	0.194	0.887	0.753	0.577
Západné Slovensko	0.439	0.188	0.134	0.515	0.554	0.366
Stredné Slovensko	0.432	0.199	0.090	0.399	0.482	0.320
Východné Slovensko	0.399	0.208	0.177	0.373	0.429	0.317
Helsinki-Uusimaa	0.742	0.346	0.682	0.719	0.812	0.660
Etelä-Suomi	0.586	0.388	0.723	0.462	0.745	0.581
Länsi-Suomi	0.640	0.317	0.592	0.465	0.726	0.548
Pohjois- ja Itä-Suomi	0.628	0.374	0.623	0.366	0.693	0.537
Åland	0.533	0.014	0.458	0.543	0.787	0.467
Stockholm	0.698	0.370	0.744	0.849	0.891	0.710
Östra Mellansverige	0.631	0.432	0.760	0.524	0.786	0.627
Småland med öarna	0.505	0.157	0.506	0.350	0.749	0.453
Sydsverige	0.619	0.378	0.850	0.544	0.782	0.635
Västsverige	0.623	0.321	0.644	0.532	0.810	0.586
Norra Mellansverige	0.491	0.161	0.491	0.337	0.701	0.436
Mellersta Norrland	0.476	0.171	0.415	0.397	0.730	0.438
Övre Norrland	0.583	0.460	0.504	0.369	0.744	0.532
North East	0.483	0.234	0.408	0.395	0.691	0.442
North West	0.498	0.264	0.360	0.432	0.786	0.468
Yorkshire and The Humber	0.477	0.258	0.343	0.351	0.761	0.438
East Midlands	0.508	0.228	0.464	0.431	0.791	0.485
West Midlands	0.459	0.199	0.363	0.423	0.758	0.440
East of England	0.537	0.337	0.491	0.557	0.902	0.565
London	0.632	0.394	0.264	0.716	0.904	0.582
South East	0.565	0.361	0.493	0.725	0.917	0.612
South West	0.552	0.273	0.463	0.466	0.810	0.513
Wales	0.488	0.254	0.333	0.359	0.723	0.432

Scotland	0.511	0.365	0.359	0.407	0.751	0.479
Northern Ireland	0.481	0.227	0.281	0.320	0.676	0.397
Eesti	0.500	0.439	0.151	0.419	0.665	0.435
Kypros	0.555	0.122	0.085	0.453	0.506	0.344
Latvija	0.483	0.266	0.105	0.295	0.534	0.337
Lietuva	0.614	0.480	0.094	0.252	0.544	0.397
Luxembourg	0.497	0.462	0.246	0.620	0.881	0.541
Malta	0.393	0.128	0.132	0.635	0.601	0.378

Micro level Quadruple Innovation Helix model results

2020	Civil society	Industry	Government	University
Olive oil	0.385	0.298	0.293	0.270
Wine	0.574	0.368	0.322	0.388
Wine	0.377	0.348	0.235	0.225
Other	0.345	0.319	0.286	0.190
Vegetables	0.415	0.310	0.261	0.284
Olive oil	0.386	0.386	0.399	0.240
Vegetables	0.384	0.381	0.489	0.303
Olive oil	0.524	0.407	0.526	0.318
Honey	0.506	0.411	0.475	0.331
Olive oil	0.393	0.368	0.320	0.244
Olive oil	0.475	0.395	0.521	0.283
Other	0.589	0.482	0.517	0.447
Other	0.269	0.244	0.199	0.169
Olive oil	0.611	0.442	0.573	0.452
Vegetables	0.457	0.389	0.505	0.299
Olive oil	0.418	0.368	0.343	0.288
Olive oil	0.494	0.447	0.523	0.316
Olive oil	0.479	0.356	0.388	0.293
Other	0.440	0.427	0.300	0.295
Wine	0.398	0.391	0.328	0.222
Olive oil	0.488	0.460	0.528	0.350
Other	0.404	0.413	0.377	0.346
Honey	0.534	0.373	0.346	0.351
Olive oil	0.352	0.294	0.214	0.282
Olive oil	0.361	0.396	0.378	0.253
Other	0.323	0.393	0.387	0.222
Wine	0.474	0.487	0.222	0.411
Other	0.461	0.516	0.587	0.285
Other	0.323	0.244	0.187	0.206
Vegetables	0.363	0.393	0.419	0.206
Olive oil	0.503	0.381	0.448	0.327
Olive oil	0.396	0.377	0.279	0.282
Other	0.495	0.436	0.314	0.357

Olive oil	0.429	0.316	0.369	0.314
Dairy products	0.303	0.231	0.255	0.234
Other	0.430	0.302	0.300	0.296
Other	0.495	0.420	0.339	0.322
Other	0.576	0.486	0.478	0.423
Olive oil	0.455	0.353	0.279	0.342
Other	0.376	0.335	0.333	0.246
Other	0.352	0.292	0.316	0.209
Honey	0.436	0.356	0.311	0.240
Dairy products	0.400	0.269	0.168	0.233
Olive oil	0.468	0.407	0.396	0.275
Other	0.337	0.335	0.201	0.296
Other	0.497	0.411	0.569	0.498
Other	0.597	0.452	0.218	0.372
Olive oil	0.365	0.364	0.472	0.215
Other	0.318	0.247	0.194	0.207
Honey	0.155	0.219	0.371	0.139
Honey	0.302	0.279	0.287	0.308
Wine	0.423	0.360	0.347	0.306
Honey	0.483	0.340	0.450	0.321
Wine	0.583	0.477	0.382	0.413
Dairy products	0.484	0.375	0.255	0.480
Wine	0.501	0.380	0.333	0.326
Dairy products	0.470	0.388	0.282	0.340
Wine	0.346	0.300	0.180	0.327
Wine	0.512	0.408	0.412	0.465
Wine	0.196	0.203	0.243	0.160
Other	0.450	0.390	0.353	0.309
Wine	0.421	0.305	0.246	0.358
Olive oil	0.392	0.303	0.304	0.175
Vegetables	0.421	0.309	0.239	0.225
Wine	0.311	0.280	0.154	0.238
Fruits	0.332	0.259	0.310	0.150
Fruits	0.426	0.355	0.555	0.195
Fruits	0.468	0.404	0.477	0.366
Other	0.637	0.504	0.403	0.493
Olive oil	0.450	0.365	0.465	0.288
Vegetables	0.370	0.415	0.509	0.255
Olive oil	0.321	0.301	0.213	0.272
Olive oil	0.473	0.291	0.343	0.293
Dairy products	0.298	0.247	0.233	0.211
Other	0.562	0.396	0.368	0.364
Other	0.451	0.408	0.281	0.246
Wine	0.501	0.380	0.333	0.326
Fruits	0.387	0.364	0.290	0.289
Other	0.386	0.387	0.403	0.256

Other	0.495	0.332	0.342	0.338
Other	0.260	0.186	0.231	0.129
Other	0.196	0.210	0.146	0.243
Honey	0.453	0.361	0.534	0.368
Other	0.423	0.371	0.309	0.223
Olive oil	0.187	0.265	0.401	0.139
Other	0.464	0.481	0.644	0.266
Other	0.436	0.371	0.292	0.219
Other	0.405	0.294	0.300	0.268
Other	0.571	0.445	0.378	0.364
Other	0.353	0.356	0.273	0.204
Vegetables	0.228	0.227	0.208	0.198
Dairy products	0.404	0.356	0.256	0.316
Olive oil	0.514	0.367	0.427	0.277
Dairy products	0.362	0.455	0.473	0.453
Olive oil	0.477	0.480	0.547	0.429
Other	0.571	0.422	0.295	0.423
Olive oil	0.559	0.545	0.494	0.532
Dairy products	0.380	0.267	0.246	0.244
Wine	0.498	0.392	0.356	0.402
Other	0.369	0.326	0.329	0.206
Other	0.325	0.345	0.305	0.252
Olive oil	0.454	0.351	0.331	0.307
Olive oil	0.621	0.502	0.638	0.463
Olive oil	0.466	0.389	0.367	0.331
Other	0.209	0.192	0.175	0.164
Wine	0.434	0.481	0.484	0.448
Olive oil	0.388	0.409	0.469	0.276
Honey	0.322	0.349	0.223	0.327
Honey	0.441	0.310	0.364	0.221
Vegetables	0.463	0.335	0.490	0.254
Other	0.282	0.307	0.299	0.221
Olive oil	0.637	0.458	0.438	0.422
Olive oil	0.410	0.339	0.317	0.253
Honey	0.497	0.366	0.396	0.260
Olive oil	0.489	0.472	0.516	0.471
Dairy products	0.260	0.379	0.349	0.314
Olive oil	0.458	0.421	0.362	0.376
Vegetables	0.523	0.377	0.277	0.411
Olive oil	0.447	0.368	0.435	0.252
Other	0.574	0.389	0.360	0.367

Appendix 5. Macro, meso and micro level clusters' characteristics

Macro level clusters' characteristics

Report			
Tertiary education			
Cluster Number of Case	Mean	N	Std. Deviation
1	44,6818	11	6,47337
2	31,3000	5	6,29466
3	40,0653	12	8,26634
Total	40,3137	28	8,48976

Multiple Comparisons						
Dependent Variable: Tertiary education						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	13,38182 [*]	3,93280	,006	3,5859	23,1778
	3	4,61654	3,04369	,300	-2,9648	12,1979
2	1	-13,38182 [*]	3,93280	,006	-23,1778	-3,5859
	3	-8,76528	3,88126	,081	-18,4328	,9023
3	1	-4,61654	3,04369	,300	-12,1979	2,9648
	2	8,76528	3,88126	,081	-,9023	18,4328
*. The mean difference is significant at the 0.05 level.						

Report			
Quality of education system			
Cluster Number of Case	Mean	N	Std. Deviation
1	4,9830	11	,48547
2	3,2517	5	,28834
3	3,8920	12	,61273
Total	4,2063	28	,84319

Multiple Comparisons						
Dependent Variable: Quality of education system						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower	Upper

					Bound	Bound
1	2	1,73129 [*]	,28169	,000	1,0296	2,4329
	3	1,09094 [*]	,21801	,000	,5479	1,6340
2	1	-1,73129 [*]	,28169	,000	-2,4329	-1,0296
	3	-,64035	,27800	,074	-1,3328	,0521
3	1	-1,09094 [*]	,21801	,000	-1,6340	-,5479
	2	,64035	,27800	,074	-,0521	1,3328
*. The mean difference is significant at the 0.05 level.						

Report			
Lifelong learning			
Cluster Number of Case	Mean	N	Std. Deviation
1	17,5784	11	7,50677
2	3,5500	5	2,48625
3	8,2948	12	3,35040
Total	11,0946	28	7,58368

Multiple Comparisons						
Dependent Variable: Lifelong learning						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	14,02841 [*]	2,87782	,000	6,8603	21,1966
	3	9,28362 [*]	2,22721	,001	3,7360	14,8312
2	1	-14,02841 [*]	2,87782	,000	-21,1966	-6,8603
	3	-4,74479	2,84010	,236	-11,8190	2,3294
3	1	-9,28362 [*]	2,22721	,001	-14,8312	-3,7360
	2	4,74479	2,84010	,236	-2,3294	11,8190
*. The mean difference is significant at the 0.05 level.						

Report			
Foreign doctorate students			
Cluster Number of Case	Mean	N	Std. Deviation
1	35,9936	11	18,68008
2	5,5785	5	4,73261
3	10,4591	12	5,06571
Total	19,6190	28	18,05675

Multiple Comparisons						
Dependent Variable: Foreign doctorate students						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	30,41513 [*]	6,70311	,000	13,7188	47,1115
	3	25,53449 [*]	5,18770	,000	12,6128	38,4562
2	1	-30,41513 [*]	6,70311	,000	-47,1115	-13,7188
	3	-4,88064	6,61526	,744	-21,3581	11,5968
3	1	-25,53449 [*]	5,18770	,000	-38,4562	-12,6128
	2	4,88064	6,61526	,744	-11,5968	21,3581
*. The mean difference is significant at the 0.05 level.						

Report			
Researchers			
Cluster Number of Case	Mean	N	Std. Deviation
1	61,1620	11	15,24065
2	21,5033	5	7,66187
3	34,1353	12	12,51137
Total	42,4972	28	20,32546

Multiple Comparisons						
Dependent Variable: Researchers						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	39,65864 [*]	7,05673	,000	22,0815	57,2358
	3	27,02669 [*]	5,46138	,000	13,4233	40,6300
2	1	-39,65864 [*]	7,05673	,000	-57,2358	-22,0815
	3	-12,63194	6,96424	,186	-29,9787	4,7148
3	1	-27,02669 [*]	5,46138	,000	-40,6300	-13,4233
	2	12,63194	6,96424	,186	-4,7148	29,9787
*. The mean difference is significant at the 0.05 level.						

Report			
New business entry density			
Cluster Number of Case	Mean	N	Std.

			Deviation
1	6,5568	11	5,01361
2	4,8294	5	3,44147
3	7,2924	12	5,89717
Total	6,5636	28	5,10153

Multiple Comparisons						
Dependent Variable: New business entry density						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	1,72731	2,81560	,814	-5,2859	8,7405
	3	-,73568	2,17906	,939	-6,1634	4,6920
2	1	-1,72731	2,81560	,814	-8,7405	5,2859
	3	-2,46299	2,77870	,654	-9,3843	4,4583
3	1	,73568	2,17906	,939	-4,6920	6,1634
	2	2,46299	2,77870	,654	-4,4583	9,3843

Report			
Corruption			
Cluster Number of Case	Mean	N	Std. Deviation
1	80,2273	11	6,44691
2	45,4667	5	2,59915
3	58,0139	12	5,59512
Total	64,5000	28	14,68685

Multiple Comparisons						
Dependent Variable: Corruption						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	34,76061 [*]	3,02620	,000	27,2228	42,2984
	3	22,21338 [*]	2,34205	,000	16,3797	28,0470
2	1	-34,76061 [*]	3,02620	,000	-42,2984	-27,2228
	3	-12,54722 [*]	2,98654	,001	-19,9862	-5,1083
3	1	-22,21338 [*]	2,34205	,000	-28,0470	-16,3797
	2	12,54722 [*]	2,98654	,001	5,1083	19,9862

*. The mean difference is significant at the 0.05 level.

Report			
Opportunity perception			
Cluster Number of Case	Mean	N	Std. Deviation
1	,7053	11	,15612
2	,2835	5	,09999
3	,3417	12	,14429
Total	,4741	28	,23513

Multiple Comparisons						
Dependent Variable: Opportunity perception						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	,42182 [*]	,07724	,000	,2294	,6142
	3	,36360 [*]	,05978	,000	,2147	,5125
2	1	-,42182 [*]	,07724	,000	-,6142	-,2294
	3	-,05822	,07623	,728	-,2481	,1317
3	1	-,36360 [*]	,05978	,000	-,5125	-,2147
	2	,05822	,07623	,728	-,1317	,2481
*. The mean difference is significant at the 0.05 level.						

Report			
Startup skills			
Cluster Number of Case	Mean	N	Std. Deviation
1	,5853	11	,19054
2	,6332	5	,22081
3	,6865	12	,15636
Total	,6372	28	,18114

Multiple Comparisons						
Dependent Variable: Startup skills						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-,04795	,09810	,877	-,2923	,1964

	3	-,10116	,07592	,391	-,2903	,0879
2	1	,04795	,09810	,877	-,1964	,2923
	3	-,05321	,09681	,848	-,2944	,1879
3	1	,10116	,07592	,391	-,0879	,2903
	2	,05321	,09681	,848	-,1879	,2944

Report			
Risk acceptance			
Cluster Number of Case	Mean	N	Std. Deviation
1	,6671	11	,08492
2	,2482	5	,05811
3	,4560	12	,12155
Total	,5018	28	,18212

Multiple Comparisons						
Dependent Variable: Risk acceptance						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	,41894 [*]	,05374	,000	,2851	,5528
	3	,21109 [*]	,04159	,000	,1075	,3147
2	1	-,41894 [*]	,05374	,000	-,5528	-,2851
	3	-,20785 [*]	,05303	,002	-,3399	-,0758
3	1	-,21109 [*]	,04159	,000	-,3147	-,1075
	2	,20785 [*]	,05303	,002	,0758	,3399
*. The mean difference is significant at the 0.05 level.						

Report			
R&D public expenditures			
Cluster Number of Case	Mean	N	Std. Deviation
1	,7887	11	,21876
2	,3953	5	,15814
3	,5066	12	,16110
Total	,5975	28	,24111

Multiple Comparisons						
Dependent Variable: R&D public expenditures						
Tukey HSD						

(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	,39334 [*]	,10028	,002	,1436	,6431
	3	,28208 [*]	,07761	,003	,0888	,4754
2	1	-,39334 [*]	,10028	,002	-,6431	-,1436
	3	-,11126	,09896	,508	-,3578	,1352
3	1	-,28208 [*]	,07761	,003	-,4754	-,0888
	2	,11126	,09896	,508	-,1352	,3578

*. The mean difference is significant at the 0.05 level.

Report			
Venture capital expenditures			
Cluster Number of Case	Mean	N	Std. Deviation
1	,1271	11	,07112
2	,0405	5	,01962
3	,0578	12	,04579
Total	,0820	28	,06475

Multiple Comparisons						
Dependent Variable: Venture capital expenditures						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	,08662 [*]	,02958	,019	,0129	,1603
	3	,06932 [*]	,02289	,015	,0123	,1263
2	1	-,08662 [*]	,02958	,019	-,1603	-,0129
	3	-,01731	,02919	,825	-,0900	,0554
3	1	-,06932 [*]	,02289	,015	-,1263	-,0123
	2	,01731	,02919	,825	-,0554	,0900

*. The mean difference is significant at the 0.05 level.

Report			
R&D business expenditures			
Cluster Number of Case	Mean	N	Std. Deviation
1	1,5761	11	,55718
2	,4853	5	,22289

3	,6273	12	,42147
Total	,9747	28	,66335

Multiple Comparisons						
Dependent Variable: R&D business expenditures						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	1,09073 [*]	,24733	,000	,4747	1,7068
	3	,94877 [*]	,19142	,000	,4720	1,4256
2	1	-1,09073 [*]	,24733	,000	-1,7068	-,4747
	3	-,14196	,24409	,831	-,7500	,4660
3	1	-,94877 [*]	,19142	,000	-1,4256	-,4720
	2	,14196	,24409	,831	-,4660	,7500
*. The mean difference is significant at the 0.05 level.						

Report			
Non-R&D expenditures			
Cluster Number of Case	Mean	N	Std. Deviation
1	,5613	11	,32169
2	,7055	5	,42578
3	,9212	12	,45467
Total	,7413	28	,42099

Multiple Comparisons						
Dependent Variable: Non-R&D expenditures						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-,14427	,21666	,785	-,6839	,3954
	3	-,35993	,16768	,101	-,7776	,0577
2	1	,14427	,21666	,785	-,3954	,6839
	3	-,21566	,21382	,578	-,7482	,3169
3	1	,35993	,16768	,101	-,0577	,7776
	2	,21566	,21382	,578	-,3169	,7482

Report			
Ease of access to loans			
Cluster Number of Case	Mean	N	Std. Deviation
1	4,0212	11	,58630
2	2,7058	5	,69332
3	3,3663	12	,56696
Total	3,5057	28	,75158

Multiple Comparisons						
Dependent Variable: Ease of access to loans						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	1,31538 [*]	,32174	,001	,5140	2,1168
	3	,65489 [*]	,24900	,037	,0347	1,2751
2	1	-1,31538 [*]	,32174	,001	-2,1168	-,5140
	3	-,66049	,31753	,114	-1,4514	,1304
3	1	-,65489 [*]	,24900	,037	-1,2751	-,0347
	2	,66049	,31753	,114	-,1304	1,4514
*. The mean difference is significant at the 0.05 level.						

Report			
Government effectiveness			
Cluster Number of Case	Mean	N	Std. Deviation
1	85,9359	11	5,53622
2	48,6677	5	7,62326
3	66,8974	12	4,91200
Total	71,1215	28	14,84923

Multiple Comparisons						
Dependent Variable: Government effectiveness						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	37,26824 [*]	3,05938	,000	29,6478	44,8886
	3	19,03855 [*]	2,36773	,000	13,1409	24,9362

2	1	-37,26824*	3,05938	,000	-44,8886	-29,6478
	3	-18,22969*	3,01928	,000	-25,7502	-10,7092
3	1	-19,03855*	2,36773	,000	-24,9362	-13,1409
	2	18,22969*	3,01928	,000	10,7092	25,7502
*. The mean difference is significant at the 0.05 level.						

Report			
Ease of starting a business			
Cluster Number of Case	Mean	N	Std. Deviation
1	90,7212	11	4,57913
2	88,8390	5	1,43109
3	88,5003	12	5,33127
Total	89,4333	28	4,55819

Multiple Comparisons						
Dependent Variable: Ease of starting a business						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	1,88221	2,48463	,732	-4,3066	8,0710
	3	2,22093	1,92291	,490	-2,5687	7,0106
2	1	-1,88221	2,48463	,732	-8,0710	4,3066
	3	,33872	2,45206	,990	-5,7689	6,4464
3	1	-2,22093	1,92291	,490	-7,0106	2,5687
	2	-,33872	2,45206	,990	-6,4464	5,7689

Report			
Rule of law			
Cluster Number of Case	Mean	N	Std. Deviation
1	93,2492	11	5,37765
2	50,6383	5	5,10519
3	70,5035	12	6,25248
Total	75,8920	28	16,85961

Multiple Comparisons					
Dependent Variable: Rule of law					
Tukey HSD					
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference	Std. Error	Sig.	95% Confidence Interval

		(I-J)			Lower Bound	Upper Bound
1	2	42,61091 [*]	3,09552	,000	34,9005	50,3213
	3	22,74577 [*]	2,39569	,000	16,7785	28,7130
2	1	-42,61091 [*]	3,09552	,000	-50,3213	-34,9005
	3	-19,86514 [*]	3,05494	,000	-27,4745	-12,2558
3	1	-22,74577 [*]	2,39569	,000	-28,7130	-16,7785
	2	19,86514 [*]	3,05494	,000	12,2558	27,4745
*. The mean difference is significant at the 0.05 level.						

Report			
Time to start a business			
Cluster Number of Case	Mean	N	Std. Deviation
1	10,0379	11	6,26558
2	11,5500	5	5,14397
3	12,8556	12	9,77828
Total	11,5155	28	7,68777

Multiple Comparisons						
Dependent Variable: Time to start a business						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-1,51212	4,24717	,933	-12,0911	9,0669
	3	-2,81768	3,28699	,672	-11,0050	5,3696
2	1	1,51212	4,24717	,933	-9,0669	12,0911
	3	-1,30556	4,19150	,948	-11,7459	9,1348
3	1	2,81768	3,28699	,672	-5,3696	11,0050
	2	1,30556	4,19150	,948	-9,1348	11,7459

Report			
Effectiveness of anti-monopoly policy			
Cluster Number of Case	Mean	N	Std. Deviation
1	5,1504	11	,26016
2	3,5758	5	,12270
3	4,0326	12	,29848
Total	4,3902	28	,69185

Multiple Comparisons						
Dependent Variable: Effectiveness of anti-monopoly policy						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	1,57455 [*]	,14135	,000	1,2225	1,9266
	3	1,11774 [*]	,10940	,000	,8453	1,3902
2	1	-1,57455 [*]	,14135	,000	-1,9266	-1,2225
	3	-,45681 [*]	,13950	,008	-,8043	-,1093
3	1	-1,11774 [*]	,10940	,000	-1,3902	-,8453
	2	,45681 [*]	,13950	,008	,1093	,8043

*. The mean difference is significant at the 0.05 level.

Report			
Transparency of government policymaking			
Cluster Number of Case	Mean	N	Std. Deviation
1	5,2481	11	,51273
2	3,3392	5	,25308
3	4,0837	12	,48216
Total	4,4082	28	,86453

Multiple Comparisons						
Dependent Variable: Transparency of government policymaking						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	1,90894 [*]	,25166	,000	1,2821	2,5358
	3	1,16443 [*]	,19476	,000	,6793	1,6495
2	1	-1,90894 [*]	,25166	,000	-2,5358	-1,2821
	3	-,74451 [*]	,24836	,016	-1,3631	-,1259
3	1	-1,16443 [*]	,19476	,000	-1,6495	-,6793
	2	,74451 [*]	,24836	,016	,1259	1,3631

*. The mean difference is significant at the 0.05 level.

Report			
PCT patents			
Cluster Number of Case	Mean	N	Std.

			Deviation
1	5,0380	11	2,42899
2	,8154	5	,75124
3	1,0454	12	,54263
Total	2,5728	28	2,54429

Multiple Comparisons						
Dependent Variable: PCT patents						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I- J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	4,22261 [*]	,86631	,000	2,0648	6,3804
	3	3,99258 [*]	,67046	,000	2,3226	5,6626
2	1	-4,22261 [*]	,86631	,000	-6,3804	-2,0648
	3	-,23003	,85496	,961	-2,3596	1,8995
3	1	-3,99258 [*]	,67046	,000	-5,6626	-2,3226
	2	,23003	,85496	,961	-1,8995	2,3596
*. The mean difference is significant at the 0.05 level.						

Report			
Trademarks applications			
Cluster Number of Case	Mean	N	Std. Deviation
1	11,6144	11	8,84485
2	5,5461	5	2,90597
3	12,5254	12	12,42460
Total	10,9212	28	9,99035

Multiple Comparisons						
Dependent Variable: Trademarks applications						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	6,06824	5,40886	,510	-7,4043	19,5408
	3	-,91103	4,18605	,974	-11,3378	9,5157
2	1	-6,06824	5,40886	,510	-19,5408	7,4043
	3	-6,97927	5,33797	,404	-20,2752	6,3167
3	1	,91103	4,18605	,974	-9,5157	11,3378

	2	6,97927	5,33797	,404	-6,3167	20,2752
--	---	---------	---------	------	---------	---------

Report			
Design applications			
Cluster Number of Case	Mean	N	Std. Deviation
1	5,2685	11	3,15648
2	3,1667	5	3,22075
3	3,9934	12	4,02449
Total	4,3467	28	3,53342

Multiple Comparisons						
Dependent Variable: Design applications						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	2,10184	1,92753	,529	-2,6993	6,9030
	3	1,27513	1,49176	,673	-2,4406	4,9909
2	1	-2,10184	1,92753	,529	-6,9030	2,6993
	3	-,82671	1,90226	,902	-5,5649	3,9115
3	1	-1,27513	1,49176	,673	-4,9909	2,4406
	2	,82671	1,90226	,902	-3,9115	5,5649

Report			
TEA			
Cluster Number of Case	Mean	N	Std. Deviation
1	7,4357	11	1,83749
2	6,7573	5	3,08110
3	9,4736	12	2,79101
Total	8,1880	28	2,67856

Multiple Comparisons						
Dependent Variable: TEA						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	,67837	1,35345	,871	-2,6929	4,0496
	3	-2,03791	1,04747	,147	-4,6470	,5712

2	1	-,67837	1,35345	,871	-4,0496	2,6929
	3	-2,71628	1,33571	,125	-6,0433	,6108
3	1	2,03791	1,04747	,147	-,5712	4,6470
	2	2,71628	1,33571	,125	-,6108	6,0433

Report			
SMEs with product or process innovations			
Cluster Number of Case	Mean	N	Std. Deviation
1	41,4249	11	5,24579
2	25,6868	5	15,36561
3	26,6043	12	10,82719
Total	32,2628	28	12,22160

Multiple Comparisons						
Dependent Variable: SMEs with product or process innovations						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	15,73808*	5,40341	,020	2,2791	29,1970
	3	14,82059*	4,18183	,004	4,4044	25,2368
2	1	-15,73808*	5,40341	,020	-29,1970	-2,2791
	3	-,91749	5,33259	,984	-14,2001	12,3651
3	1	-14,82059*	4,18183	,004	-25,2368	-4,4044
	2	,91749	5,33259	,984	-12,3651	14,2001
*. The mean difference is significant at the 0.05 level.						

Report			
SMEs with marketing or organisational innovations			
Cluster Number of Case	Mean	N	Std. Deviation
1	43,5560	11	6,18896
2	28,0646	5	15,59648
3	25,3683	12	8,41680
Total	32,9950	28	12,44505

Multiple Comparisons					
Dependent Variable: SMEs with marketing or organisational innovations					
Tukey HSD					
(I) Cluster Number of	(J) Cluster Number of	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval

Case	Case				Lower Bound	Upper Bound
1	2	15,49144 [*]	4,98469	,012	3,0754	27,9075
	3	18,18776 [*]	3,85777	,000	8,5787	27,7968
2	1	-15,49144 [*]	4,98469	,012	-27,9075	-3,0754
	3	2,69631	4,91936	,848	-9,5570	14,9496
3	1	-18,18776 [*]	3,85777	,000	-27,7968	-8,5787
	2	-2,69631	4,91936	,848	-14,9496	9,5570
*. The mean difference is significant at the 0.05 level.						

Report			
SMEs innovating in-house			
Cluster Number of Case	Mean	N	Std. Deviation
1	34,5208	11	6,30512
2	22,9585	5	14,23466
3	23,1620	12	9,84237
Total	27,5881	28	10,79195

Multiple Comparisons						
Dependent Variable: SMEs innovating in-house						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	11,56238	5,14363	,083	-1,2495	24,3743
	3	11,35883 [*]	3,98078	,023	1,4434	21,2743
2	1	-11,56238	5,14363	,083	-24,3743	1,2495
	3	-,20355	5,07621	,999	-12,8475	12,4404
3	1	-11,35883 [*]	3,98078	,023	-21,2743	-1,4434
	2	,20355	5,07621	,999	-12,4404	12,8475
*. The mean difference is significant at the 0.05 level.						

Report			
Employment in knowledge-intensive activities			
Cluster Number of Case	Mean	N	Std. Deviation
1	17,0458	11	2,69338
2	10,8525	5	2,44503
3	12,5628	12	2,81467
Total	14,0186	28	3,65128

Multiple Comparisons						
Dependent Variable: Employment in knowledge-intensive activities						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	6,19333 [*]	1,46166	,001	2,5526	9,8341
	3	4,48299 [*]	1,13122	,002	1,6653	7,3007
2	1	-6,19333 [*]	1,46166	,001	-9,8341	-2,5526
	3	-1,71035	1,44251	,472	-5,3034	1,8827
3	1	-4,48299 [*]	1,13122	,002	-7,3007	-1,6653
	2	1,71035	1,44251	,472	-1,8827	5,3034
*. The mean difference is significant at the 0.05 level.						

Report			
Exports			
Cluster Number of Case	Mean	N	Std. Deviation
1	52,4688	11	6,92965
2	39,1643	5	13,87944
3	51,4884	12	12,47236
Total	49,6728	28	11,61035

Multiple Comparisons						
Dependent Variable: Exports						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	13,30451	5,87077	,080	-1,3186	27,9276
	3	,98040	4,54353	,975	-10,3367	12,2976
2	1	-13,30451	5,87077	,080	-27,9276	1,3186
	3	-12,32410	5,79382	,105	-26,7555	2,1073
3	1	-,98040	4,54353	,975	-12,2976	10,3367
	2	12,32410	5,79382	,105	-2,1073	26,7555

Report			
Knowledge intensive exports			
Cluster Number of Case	Mean	N	Std. Deviation

1	73,6859	11	13,61008
2	40,9819	5	13,55869
3	42,8573	12	11,57490
Total	54,6336	28	19,86096

Multiple Comparisons						
Dependent Variable: Knowledge intensive exports						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	32,70398 [*]	6,87463	,000	15,5804	49,8275
	3	30,82858 [*]	5,32044	,000	17,5763	44,0809
2	1	-32,70398 [*]	6,87463	,000	-49,8275	-15,5804
	3	-1,87540	6,78453	,959	-18,7745	15,0237
3	1	-30,82858 [*]	5,32044	,000	-44,0809	-17,5763
	2	1,87540	6,78453	,959	-15,0237	18,7745
*. The mean difference is significant at the 0.05 level.						

Report			
Sales			
Cluster Number of Case	Mean	N	Std. Deviation
1	11,4511	11	3,95638
2	8,9925	5	4,39511
3	11,0772	12	4,32279
Total	10,8518	28	4,13295

Multiple Comparisons						
Dependent Variable: Sales						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	2,45859	2,26107	,531	-3,1733	8,0905
	3	,37387	1,74989	,975	-3,9848	4,7326
2	1	-2,45859	2,26107	,531	-8,0905	3,1733
	3	-2,08472	2,23143	,624	-7,6428	3,4734
3	1	-,37387	1,74989	,975	-4,7326	3,9848
	2	2,08472	2,23143	,624	-3,4734	7,6428

Report			
Global Competiveness Index			
Cluster Number of Case	Mean	N	Std. Deviation
1	5,3402	11	,17970
2	4,2558	5	,19739
3	4,4753	12	,17491
Total	4,7759	28	,50014

Multiple Comparisons						
Dependent Variable: Global Competiveness Index						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	1,08432 [*]	,09740	,000	,8417	1,3269
	3	,86480 [*]	,07538	,000	,6770	1,0526
2	1	-1,08432 [*]	,09740	,000	-1,3269	-,8417
	3	-,21951	,09613	,077	-,4589	,0199
3	1	-,86480 [*]	,07538	,000	-1,0526	-,6770
	2	,21951	,09613	,077	-,0199	,4589
*. The mean difference is significant at the 0.05 level.						

Report			
GDP per capita			
Cluster Number of Case	Mean	N	Std. Deviation
1	46181,9697	11	16411,79376
2	14157,6667	5	8459,26929
3	16910,2778	12	4182,77685
Total	27918,3333	28	18501,48168

Multiple Comparisons						
Dependent Variable: GDP per capita						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	32024,30303 [*]	6075,55678	,000	16891,1232	47157,4829

	3	29271,69192 [*]	4702,01911	,000	17559,7611	40983,6228
2	1	-32024,30303 [*]	6075,55678	,000	-47157,4829	-16891,1232
	3	-2752,61111	5995,92612	,891	-17687,4445	12182,2223
3	1	-29271,69192 [*]	4702,01911	,000	-40983,6228	-17559,7611
	2	2752,61111	5995,92612	,891	-12182,2223	17687,4445
*. The mean difference is significant at the 0.05 level.						

Report			
Unemployment			
Cluster Number of Case	Mean	N	Std. Deviation
1	6,9225	11	1,78366
2	12,8379	5	6,85204
3	9,3746	12	4,43933
Total	9,0297	28	4,55088

Multiple Comparisons						
Dependent Variable: Unemployment						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-5,91542 [*]	2,25347	,037	-11,5284	-,3024
	3	-2,45211	1,74401	,353	-6,7961	1,8919
2	1	5,91542 [*]	2,25347	,037	,3024	11,5284
	3	3,46331	2,22393	,282	-2,0761	9,0027
3	1	2,45211	1,74401	,353	-1,8919	6,7961
	2	-3,46331	2,22393	,282	-9,0027	2,0761
*. The mean difference is significant at the 0.05 level.						

Report			
Quality of life index			
Cluster Number of Case	Mean	N	Std. Deviation
1	172,0270	11	15,87626
2	115,0993	5	14,21349
3	138,9828	12	19,97876
Total	147,6995	28	27,52441

Multiple Comparisons						
Dependent Variable: Quality of life index						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	56,92764 [*]	9,47759	,000	33,3206	80,5347
	3	33,04416 [*]	7,33493	,000	14,7741	51,3142
2	1	-56,92764 [*]	9,47759	,000	-80,5347	-33,3206
	3	-23,88347 [*]	9,35337	,044	-47,1811	-,5858
3	1	-33,04416 [*]	7,33493	,000	-51,3142	-14,7741
	2	23,88347 [*]	9,35337	,044	,5858	47,1811

*. The mean difference is significant at the 0.05 level.

Report			
High growth			
Cluster Number of Case	Mean	N	Std. Deviation
1	,5826	11	,16185
2	,4658	5	,25140
3	,5762	12	,19910
Total	,5590	28	,19283

Multiple Comparisons						
Dependent Variable: High growth						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	,11678	,10519	,517	-,1452	,3788
	3	,00638	,08141	,997	-,1964	,2091
2	1	-,11678	,10519	,517	-,3788	,1452
	3	-,11040	,10381	,545	-,3690	,1482
3	1	-,00638	,08141	,997	-,2091	,1964
	2	,11040	,10381	,545	-,1482	,3690

Report			
Employment fast-growing enterprises			
Cluster Number of Case	Mean	N	Std. Deviation

1	4,8691	11	1,74006
2	4,1403	5	1,70605
3	4,9265	12	2,17804
Total	4,7636	28	1,89039

Multiple Comparisons						
Dependent Variable: Employment fast-growing enterprises						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	,72885	1,04643	,768	-1,8776	3,3353
	3	-,05741	,80986	,997	-2,0746	1,9598
2	1	-,72885	1,04643	,768	-3,3353	1,8776
	3	-,78626	1,03272	,730	-3,3586	1,7861
3	1	,05741	,80986	,997	-1,9598	2,0746
	2	,78626	1,03272	,730	-1,7861	3,3586

Meso level clusters' characteristics

Report			
Tertiary education			
Cluster Number of Case	Mean	N	Std. Deviation
1	,5582	71	,15074
2	,6779	20	,14967
3	,5060	40	,17135
4	,3479	31	,10184
5	,4549	50	,15144
Total	,5045	212	,17259

Multiple Comparisons						
Dependent Variable: Tertiary education						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-,11971 [*]	,03772	,015	-,2235	-,0159
	3	,05218	,02946	,393	-,0289	,1333

	4	,21026 [*]	,03208	,000	,1220	,2985
	5	,10330 [*]	,02751	,002	,0276	,1790
2	1	,11971 [*]	,03772	,015	,0159	,2235
	3	,17189 [*]	,04081	,000	,0596	,2842
	4	,32997 [*]	,04274	,000	,2124	,4476
	5	,22301 [*]	,03942	,000	,1145	,3315
3	1	-,05218	,02946	,393	-,1333	,0289
	2	-,17189 [*]	,04081	,000	-,2842	-,0596
	4	,15808 [*]	,03566	,000	,0600	,2562
	5	,05112	,03161	,488	-,0359	,1381
4	1	-,21026 [*]	,03208	,000	-,2985	-,1220
	2	-,32997 [*]	,04274	,000	-,4476	-,2124
	3	-,15808 [*]	,03566	,000	-,2562	-,0600
	5	-,10696 [*]	,03406	,016	-,2007	-,0132
5	1	-,10330 [*]	,02751	,002	-,1790	-,0276
	2	-,22301 [*]	,03942	,000	-,3315	-,1145
	3	-,05112	,03161	,488	-,1381	,0359
	4	,10696 [*]	,03406	,016	,0132	,2007

*. The mean difference is significant at the 0.05 level.

Report			
Participation rate in education			
Cluster Number of Case	Mean	N	Std. Deviation
1	14,3149	71	6,98340
2	17,0608	20	9,92020
3	9,9818	40	4,06061
4	4,1694	31	3,01057
5	6,2418	50	3,04422
Total	10,3688	212	7,12212

Multiple Comparisons						
Dependent Variable: Participation rate in education						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-2,74595	1,43512	,313	-6,6954	1,2035
	3	4,33311 [*]	1,12076	,001	1,2488	7,4174
	4	10,14553 [*]	1,22040	,000	6,7870	13,5040
	5	8,07312 [*]	1,04662	,000	5,1928	10,9534

2	1	2,74595	1,43512	,313	-1,2035	6,6954
	3	7,07906*	1,55253	,000	2,8065	11,3516
	4	12,89148*	1,62592	,000	8,4170	17,3660
	5	10,81906*	1,49989	,000	6,6914	14,9467
3	1	-4,33311*	1,12076	,001	-7,4174	-1,2488
	2	-7,07906*	1,55253	,000	-11,3516	-2,8065
	4	5,81242*	1,35653	,000	2,0793	9,5456
	5	3,74001*	1,20259	,018	,4305	7,0495
4	1	-10,14553*	1,22040	,000	-13,5040	-6,7870
	2	-12,89148*	1,62592	,000	-17,3660	-8,4170
	3	-5,81242*	1,35653	,000	-9,5456	-2,0793
	5	-2,07241	1,29595	,500	-5,6388	1,4940
5	1	-8,07312*	1,04662	,000	-10,9534	-5,1928
	2	-10,81906*	1,49989	,000	-14,9467	-6,6914
	3	-3,74001*	1,20259	,018	-7,0495	-,4305
	4	2,07241	1,29595	,500	-1,4940	5,6388
*. The mean difference is significant at the 0.05 level.						

Report			
Researchers			
Cluster Number of Case	Mean	N	Std. Deviation
1	,8811	71	,44320
2	1,4952	20	,54010
3	,6782	40	,28468
4	,4411	31	,36547
5	,3909	50	,18330
Total	,7208	212	,48614

Multiple Comparisons						
Dependent Variable: Researchers						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-,61413*	,09328	,000	-,8708	-,3574
	3	,20284*	,07285	,046	,0024	,4033
	4	,44001*	,07932	,000	,2217	,6583
	5	,49021*	,06803	,000	,3030	,6774
2	1	,61413*	,09328	,000	,3574	,8708
	3	,81697*	,10091	,000	,5393	1,0947

	4	1,05413 [*]	,10568	,000	,7633	1,3450
	5	1,10434 [*]	,09749	,000	,8360	1,3726
3	1	-,20284 [*]	,07285	,046	-,4033	-,0024
	2	-,81697 [*]	,10091	,000	-1,0947	-,5393
	4	,23716	,08817	,059	-,0055	,4798
	5	,28737 [*]	,07817	,003	,0723	,5025
4	1	-,44001 [*]	,07932	,000	-,6583	-,2217
	2	-1,05413 [*]	,10568	,000	-1,3450	-,7633
	3	-,23716	,08817	,059	-,4798	,0055
	5	,05021	,08424	,976	-,1816	,2820
5	1	-,49021 [*]	,06803	,000	-,6774	-,3030
	2	-1,10434 [*]	,09749	,000	-1,3726	-,8360
	3	-,28737 [*]	,07817	,003	-,5025	-,0723
	4	-,05021	,08424	,976	-,2820	,1816

*. The mean difference is significant at the 0.05 level.

Report			
Early leavers			
Cluster Number of Case	Mean	N	Std. Deviation
1	9,3445	71	2,61227
2	8,2942	20	1,68785
3	9,6516	40	4,11707
4	15,9105	31	6,36765
5	12,7544	50	6,72366
Total	11,0677	212	5,30519

Multiple Comparisons						
Dependent Variable: Early leavers						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	1,05037	1,19652	,905	-2,2424	4,3432
	3	-,30710	,93443	,997	-2,8786	2,2644
	4	-6,56595 [*]	1,01750	,000	-9,3661	-3,7658
	5	-3,40985 [*]	,87262	,001	-5,8113	-1,0084
2	1	-1,05037	1,19652	,905	-4,3432	2,2424
	3	-1,35747	1,29442	,832	-4,9197	2,2047
	4	-7,61632 [*]	1,35561	,000	-11,3469	-3,8857
	5	-4,46021 [*]	1,25053	,004	-7,9016	-1,0188

3	1	,30710	,93443	,997	-2,2644	2,8786
	2	1,35747	1,29442	,832	-2,2047	4,9197
	4	-6,25885 [*]	1,13100	,000	-9,3713	-3,1464
	5	-3,10275 [*]	1,00265	,019	-5,8620	-,3435
4	1	6,56595 [*]	1,01750	,000	3,7658	9,3661
	2	7,61632 [*]	1,35561	,000	3,8857	11,3469
	3	6,25885 [*]	1,13100	,000	3,1464	9,3713
	5	3,15610 [*]	1,08049	,031	,1826	6,1296
5	1	3,40985 [*]	,87262	,001	1,0084	5,8113
	2	4,46021 [*]	1,25053	,004	1,0188	7,9016
	3	3,10275 [*]	1,00265	,019	,3435	5,8620
	4	-3,15610 [*]	1,08049	,031	-6,1296	-,1826
*. The mean difference is significant at the 0.05 level.						

Report			
Opportunity perception			
Cluster Number of Case	Mean	N	Std. Deviation
1	,6944	71	,15365
2	,7761	20	,12154
3	,4512	40	,18586
4	,2716	31	,08394
5	,3277	50	,07652
Total	,5079	212	,23010

Multiple Comparisons						
Dependent Variable: Opportunity perception						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-,08172	,03420	,122	-,1758	,0124
	3	,24320 [*]	,02671	,000	,1697	,3167
	4	,42283 [*]	,02909	,000	,3428	,5029
	5	,36674 [*]	,02494	,000	,2981	,4354
2	1	,08172	,03420	,122	-,0124	,1758
	3	,32492 [*]	,03700	,000	,2231	,4267
	4	,50455 [*]	,03875	,000	,3979	,6112
	5	,44846 [*]	,03575	,000	,3501	,5468
3	1	-,24320 [*]	,02671	,000	-,3167	-,1697
	2	-,32492 [*]	,03700	,000	-,4267	-,2231

4	4	,17963*	,03233	,000	,0907	,2686
	5	,12354*	,02866	,000	,0447	,2024
	1	-,42283*	,02909	,000	-,5029	-,3428
	2	-,50455*	,03875	,000	-,6112	-,3979
	3	-,17963*	,03233	,000	-,2686	-,0907
5	5	-,05609	,03089	,367	-,1411	,0289
	1	-,36674*	,02494	,000	-,4354	-,2981
	2	-,44846*	,03575	,000	-,5468	-,3501
	3	-,12354*	,02866	,000	-,2024	-,0447
	4	,05609	,03089	,367	-,0289	,1411

*. The mean difference is significant at the 0.05 level.

Report			
Startup skills			
Cluster Number of Case	Mean	N	Std. Deviation
1	,5683	71	,14737
2	,5361	20	,09609
3	,6252	40	,18202
4	,7273	31	,25460
5	,6852	50	,18666
Total	,6268	212	,18893

Multiple Comparisons						
Dependent Variable: Startup skills						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	,03219	,04534	,954	-,0926	,1570
	3	-,05691	,03541	,494	-,1543	,0405
	4	-,15900*	,03855	,001	-,2651	-,0529
	5	-,11695*	,03307	,005	-,2079	-,0260
2	1	-,03219	,04534	,954	-,1570	,0926
	3	-,08910	,04905	,367	-,2241	,0459
	4	-,19119*	,05137	,002	-,3326	-,0498
	5	-,14914*	,04738	,016	-,2795	-,0187
3	1	,05691	,03541	,494	-,0405	,1543
	2	,08910	,04905	,367	-,0459	,2241
	4	-,10209	,04286	,124	-,2200	,0158
	5	-,06004	,03799	,512	-,1646	,0445

4	1	,15900*	,03855	,001	,0529	,2651
	2	,19119*	,05137	,002	,0498	,3326
	3	,10209	,04286	,124	-,0158	,2200
	5	,04205	,04094	,843	-,0706	,1547
5	1	,11695*	,03307	,005	,0260	,2079
	2	,14914*	,04738	,016	,0187	,2795
	3	,06004	,03799	,512	-,0445	,1646
	4	-,04205	,04094	,843	-,1547	,0706
*. The mean difference is significant at the 0.05 level.						

Report			
Risk acceptance			
Cluster Number of Case	Mean	N	Std. Deviation
1	,6458	71	,09265
2	,6709	20	,08420
3	,4805	40	,16694
4	,2538	31	,10453
5	,4078	50	,08018
Total	,5035	212	,18052

Multiple Comparisons						
Dependent Variable: Risk acceptance						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-,02508	,02763	,894	-,1011	,0509
	3	,16539*	,02157	,000	,1060	,2248
	4	,39202*	,02349	,000	,3274	,4567
	5	,23806*	,02015	,000	,1826	,2935
2	1	,02508	,02763	,894	-,0509	,1011
	3	,19047*	,02989	,000	,1082	,2727
	4	,41710*	,03130	,000	,3310	,5032
	5	,26314*	,02887	,000	,1837	,3426
3	1	-,16539*	,02157	,000	-,2248	-,1060
	2	-,19047*	,02989	,000	-,2727	-,1082
	4	,22663*	,02611	,000	,1548	,2985
	5	,07267*	,02315	,016	,0090	,1364
4	1	-,39202*	,02349	,000	-,4567	-,3274
	2	-,41710*	,03130	,000	-,5032	-,3310

5	3	-,22663*	,02611	,000	-,2985	-,1548
	5	-,15396*	,02495	,000	-,2226	-,0853
	1	-,23806*	,02015	,000	-,2935	-,1826
	2	-,26314*	,02887	,000	-,3426	-,1837
	3	-,07267*	,02315	,016	-,1364	-,0090
	4	,15396*	,02495	,000	,0853	,2226
*. The mean difference is significant at the 0.05 level.						

Report			
Corruption			
Cluster Number of Case	Mean	N	Std. Deviation
1	69,7941	71	11,27292
2	74,1803	20	5,74011
3	49,2797	40	15,86514
4	25,1943	31	8,11095
5	40,2978	50	9,98420
Total	52,8589	212	20,39628

Multiple Comparisons						
Dependent Variable: Corruption						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-4,38621	2,84780	,538	-12,2233	3,4509
	3	20,51435*	2,22400	,000	14,3940	26,6348
	4	44,59977*	2,42172	,000	37,9353	51,2643
	5	29,49633*	2,07688	,000	23,7808	35,2118
2	1	4,38621	2,84780	,538	-3,4509	12,2233
	3	24,90056*	3,08080	,000	16,4223	33,3788
	4	48,98598*	3,22643	,000	40,1069	57,8650
	5	33,88253*	2,97634	,000	25,6917	42,0733
3	1	-20,51435*	2,22400	,000	-26,6348	-14,3940
	2	-24,90056*	3,08080	,000	-33,3788	-16,4223
	4	24,08542*	2,69185	,000	16,6775	31,4933
	5	8,98197*	2,38638	,002	2,4147	15,5492
4	1	-44,59977*	2,42172	,000	-51,2643	-37,9353
	2	-48,98598*	3,22643	,000	-57,8650	-40,1069
	3	-24,08542*	2,69185	,000	-31,4933	-16,6775
	5	-15,10345*	2,57164	,000	-22,1805	-8,0264

5	1	-29,49633 [*]	2,07688	,000	-35,2118	-23,7808
	2	-33,88253 [*]	2,97634	,000	-42,0733	-25,6917
	3	-8,98197 [*]	2,38638	,002	-15,5492	-2,4147
	4	15,10345 [*]	2,57164	,000	8,0264	22,1805
*. The mean difference is significant at the 0.05 level.						

Report			
R&D public expenditures			
Cluster Number of Case	Mean	N	Std. Deviation
1	,4599	71	,14937
2	,5022	20	,13169
3	,3466	40	,14046
4	,2876	31	,12778
5	,2871	50	,09377
Total	,3766	212	,15505

Multiple Comparisons						
Dependent Variable: R&D public expenditures						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-,04228	,03330	,710	-,1339	,0494
	3	,11330 [*]	,02600	,000	,0417	,1849
	4	,17233 [*]	,02832	,000	,0944	,2503
	5	,17286 [*]	,02428	,000	,1060	,2397
2	1	-,04228	,03330	,710	-,0494	,1339
	3	,15558 [*]	,03602	,000	,0564	,2547
	4	,21461 [*]	,03773	,000	,1108	,3184
	5	,21514 [*]	,03480	,000	,1194	,3109
3	1	-,11330 [*]	,02600	,000	-,1849	-,0417
	2	-,15558 [*]	,03602	,000	-,2547	-,0564
	4	,05903	,03147	,334	-,0276	,1456
	5	,05956	,02790	,209	-,0172	,1363
4	1	-,17233 [*]	,02832	,000	-,2503	-,0944
	2	-,21461 [*]	,03773	,000	-,3184	-,1108
	3	-,05903	,03147	,334	-,1456	,0276
	5	,00053	,03007	1,000	-,0822	,0833
5	1	-,17286 [*]	,02428	,000	-,2397	-,1060
	2	-,21514 [*]	,03480	,000	-,3109	-,1194

	3	-,05956	,02790	,209	-,1363	,0172
	4	-,00053	,03007	1,000	-,0833	,0822
*. The mean difference is significant at the 0.05 level.						

Report			
R&D business expenditures			
Cluster Number of Case	Mean	N	Std. Deviation
1	,4560	71	,12497
2	,6532	20	,14272
3	,3449	40	,10873
4	,1272	31	,05772
5	,2053	50	,09550
Total	,3465	212	,19116

Multiple Comparisons						
Dependent Variable: R&D business expenditures						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-,19721*	,02775	,000	-,2736	-,1208
	3	,11110*	,02167	,000	,0514	,1707
	4	,32886*	,02360	,000	,2639	,3938
	5	,25076*	,02024	,000	,1951	,3065
2	1	,19721*	,02775	,000	,1208	,2736
	3	,30831*	,03002	,000	,2257	,3909
	4	,52608*	,03144	,000	,4395	,6126
	5	,44797*	,02901	,000	,3681	,5278
3	1	-,11110*	,02167	,000	-,1707	-,0514
	2	-,30831*	,03002	,000	-,3909	-,2257
	4	,21777*	,02623	,000	,1456	,2900
	5	,13966*	,02326	,000	,0757	,2037
4	1	-,32886*	,02360	,000	-,3938	-,2639
	2	-,52608*	,03144	,000	-,6126	-,4395
	3	-,21777*	,02623	,000	-,2900	-,1456
	5	-,07811*	,02506	,018	-,1471	-,0091
5	1	-,25076*	,02024	,000	-,3065	-,1951
	2	-,44797*	,02901	,000	-,5278	-,3681
	3	-,13966*	,02326	,000	-,2037	-,0757
	4	,07811*	,02506	,018	,0091	,1471

*. The mean difference is significant at the 0.05 level.

Report			
Non-R&D expenditures			
Cluster Number of Case	Mean	N	Std. Deviation
1	,3333	71	,07888
2	,3743	20	,06659
3	,3486	40	,10116
4	,3424	31	,12522
5	,3367	50	,11748
Total	,3422	212	,09964

Multiple Comparisons						
Dependent Variable: Non-R&D expenditures						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-,04105	,02529	,484	-,1106	,0285
	3	-,01533	,01975	,937	-,0697	,0390
	4	-,00917	,02150	,993	-,0683	,0500
	5	-,00347	,01844	1,000	-,0542	,0473
2	1	,04105	,02529	,484	-,0285	,1106
	3	,02573	,02736	,881	-,0496	,1010
	4	,03188	,02865	,800	-,0470	,1107
	5	,03758	,02643	,614	-,0351	,1103
3	1	,01533	,01975	,937	-,0390	,0697
	2	-,02573	,02736	,881	-,1010	,0496
	4	,00616	,02390	,999	-,0596	,0719
	5	,01186	,02119	,981	-,0465	,0702
4	1	,00917	,02150	,993	-,0500	,0683
	2	-,03188	,02865	,800	-,1107	,0470
	3	-,00616	,02390	,999	-,0719	,0596
	5	,00570	,02284	,999	-,0571	,0685
5	1	,00347	,01844	1,000	-,0473	,0542
	2	-,03758	,02643	,614	-,1103	,0351
	3	-,01186	,02119	,981	-,0702	,0465
	4	-,00570	,02284	,999	-,0685	,0571

Report			
EQI			
Cluster Number of Case	Mean	N	Std. Deviation
1	68,7753	71	10,81573
2	73,0984	20	5,64207
3	48,7595	40	15,82518
4	22,5810	31	10,22574
5	38,8404	50	10,59479
Total	51,5916	212	20,87581

Multiple Comparisons						
Dependent Variable: EQI						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-4,32316	2,90173	,570	-12,3086	3,6623
	3	20,01572 [*]	2,26612	,000	13,7794	26,2520
	4	46,19422 [*]	2,46758	,000	39,4035	52,9849
	5	29,93482 [*]	2,11621	,000	24,1111	35,7586
2	1	4,32316	2,90173	,570	-3,6623	12,3086
	3	24,33888 [*]	3,13914	,000	15,7000	32,9777
	4	50,51737 [*]	3,28753	,000	41,4702	59,5646
	5	34,25798 [*]	3,03270	,000	25,9121	42,6039
3	1	-20,01572 [*]	2,26612	,000	-26,2520	-13,7794
	2	-24,33888 [*]	3,13914	,000	-32,9777	-15,7000
	4	26,17849 [*]	2,74283	,000	18,6303	33,7267
	5	9,91909 [*]	2,43157	,001	3,2275	16,6107
4	1	-46,19422 [*]	2,46758	,000	-52,9849	-39,4035
	2	-50,51737 [*]	3,28753	,000	-59,5646	-41,4702
	3	-26,17849 [*]	2,74283	,000	-33,7267	-18,6303
	5	-16,25940 [*]	2,62034	,000	-23,4705	-9,0483
5	1	-29,93482 [*]	2,11621	,000	-35,7586	-24,1111
	2	-34,25798 [*]	3,03270	,000	-42,6039	-25,9121
	3	-9,91909 [*]	2,43157	,001	-16,6107	-3,2275
	4	16,25940 [*]	2,62034	,000	9,0483	23,4705
*. The mean difference is significant at the 0.05 level.						

Report			
Quality of EQI			
Cluster Number of Case	Mean	N	Std. Deviation
1	71,1598	71	9,79394
2	76,0730	20	7,84304
3	53,4497	40	14,95667
4	29,7119	31	12,27534
5	45,4769	50	11,40301
Total	56,1637	212	19,36058

Multiple Comparisons						
Dependent Variable: Quality of EQI						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-4,91323	2,91779	,446	-12,9429	3,1164
	3	17,71010 [*]	2,27866	,000	11,4393	23,9809
	4	41,44792 [*]	2,48123	,000	34,6196	48,2762
	5	25,68292 [*]	2,12792	,000	19,8269	31,5389
2	1	4,91323	2,91779	,446	-3,1164	12,9429
	3	22,62333 [*]	3,15652	,000	13,9367	31,3100
	4	46,36115 [*]	3,30573	,000	37,2639	55,4584
	5	30,59615 [*]	3,04949	,000	22,2040	38,9883
3	1	-17,71010 [*]	2,27866	,000	-23,9809	-11,4393
	2	-22,62333 [*]	3,15652	,000	-31,3100	-13,9367
	4	23,73781 [*]	2,75801	,000	16,1478	31,3278
	5	7,97282 [*]	2,44503	,011	1,2442	14,7015
4	1	-41,44792 [*]	2,48123	,000	-48,2762	-34,6196
	2	-46,36115 [*]	3,30573	,000	-55,4584	-37,2639
	3	-23,73781 [*]	2,75801	,000	-31,3278	-16,1478
	5	-15,76500 [*]	2,63484	,000	-23,0160	-8,5140
5	1	-25,68292 [*]	2,12792	,000	-31,5389	-19,8269
	2	-30,59615 [*]	3,04949	,000	-38,9883	-22,2040
	3	-7,97282 [*]	2,44503	,011	-14,7015	-1,2442
	4	15,76500 [*]	2,63484	,000	8,5140	23,0160
*. The mean difference is significant at the 0.05 level.						

Report			
Impartiality of EQI			
Cluster Number of Case	Mean	N	Std. Deviation
1	71,1991	71	10,11565
2	73,1293	20	4,82147
3	55,1254	40	14,65775
4	30,8608	31	9,75856
5	45,3325	50	10,02196
Total	56,3493	212	18,38478

Multiple Comparisons						
Dependent Variable: Impartiality of EQI						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-1,93016	2,71228	,954	-9,3943	5,5339
	3	16,07373 [*]	2,11816	,000	10,2446	21,9029
	4	40,33826 [*]	2,30647	,000	33,9909	46,6856
	5	25,86656 [*]	1,97804	,000	20,4230	31,3101
2	1	1,93016	2,71228	,954	-5,5339	9,3943
	3	18,00389 [*]	2,93419	,000	9,9291	26,0787
	4	42,26842 [*]	3,07289	,000	33,8119	50,7249
	5	27,79672 [*]	2,83469	,000	19,9957	35,5977
3	1	-16,07373 [*]	2,11816	,000	-21,9029	-10,2446
	2	-18,00389 [*]	2,93419	,000	-26,0787	-9,9291
	4	24,26453 [*]	2,56375	,000	17,2092	31,3199
	5	9,79283 [*]	2,27281	,000	3,5381	16,0475
4	1	-40,33826 [*]	2,30647	,000	-46,6856	-33,9909
	2	-42,26842 [*]	3,07289	,000	-50,7249	-33,8119
	3	-24,26453 [*]	2,56375	,000	-31,3199	-17,2092
	5	-14,47170 [*]	2,44925	,000	-21,2120	-7,7314
5	1	-25,86656 [*]	1,97804	,000	-31,3101	-20,4230
	2	-27,79672 [*]	2,83469	,000	-35,5977	-19,9957
	3	-9,79283 [*]	2,27281	,000	-16,0475	-3,5381
	4	14,47170 [*]	2,44925	,000	7,7314	21,2120
*. The mean difference is significant at the 0.05 level.						

Report			
Total EU expenditures			
Cluster Number of Case	Mean	N	Std. Deviation
1	511,6821	71	543,57083
2	904,6578	20	1196,36747
3	739,4079	40	673,47535
4	353,2477	31	250,82682
5	542,9591	50	429,30103
Total	575,9318	212	621,87463

Multiple Comparisons						
Dependent Variable: Total EU expenditures						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-392,97577	153,87879	,083	-816,4460	30,4945
	3	-227,72584	120,17235	,323	-558,4369	102,9852
	4	158,43440	130,85559	,745	-201,6766	518,5455
	5	-31,27703	112,22271	,999	-340,1109	277,5568
2	1	392,97577	153,87879	,083	-30,4945	816,4460
	3	165,24993	166,46880	,858	-292,8677	623,3676
	4	551,41017 [*]	174,33776	,015	71,6374	1031,1830
	5	361,69874	160,82414	,166	-80,8849	804,2824
3	1	227,72584	120,17235	,323	-102,9852	558,4369
	2	-165,24993	166,46880	,858	-623,3676	292,8677
	4	386,16024	145,45229	,064	-14,1205	786,4410
	5	196,44882	128,94618	,548	-158,4076	551,3052
4	1	-158,43440	130,85559	,745	-518,5455	201,6766
	2	-551,41017 [*]	174,33776	,015	-1031,1830	-71,6374
	3	-386,16024	145,45229	,064	-786,4410	14,1205
	5	-189,71143	138,95651	,651	-572,1160	192,6931
5	1	31,27703	112,22271	,999	-277,5568	340,1109
	2	-361,69874	160,82414	,166	-804,2824	80,8849
	3	-196,44882	128,94618	,548	-551,3052	158,4076
	4	189,71143	138,95651	,651	-192,6931	572,1160
*. The mean difference is significant at the 0.05 level.						

Report			
EPO patents			
Cluster Number of Case	Mean	N	Std. Deviation
1	,4446	71	,11715
2	,6238	20	,15001
3	,2632	40	,09385
4	,1080	31	,03793
5	,1584	50	,06512
Total	,3105	212	,19152

Multiple Comparisons						
Dependent Variable: EPO patents						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-,17922 [*]	,02478	,000	-,2474	-,1110
	3	,18133 [*]	,01935	,000	,1281	,2346
	4	,33654 [*]	,02107	,000	,2786	,3945
	5	,28621 [*]	,01807	,000	,2365	,3359
2	1	,17922 [*]	,02478	,000	,1110	,2474
	3	,36055 [*]	,02680	,000	,2868	,4343
	4	,51575 [*]	,02807	,000	,4385	,5930
	5	,46542 [*]	,02589	,000	,3942	,5367
3	1	-,18133 [*]	,01935	,000	-,2346	-,1281
	2	-,36055 [*]	,02680	,000	-,4343	-,2868
	4	,15520 [*]	,02342	,000	,0908	,2196
	5	,10487 [*]	,02076	,000	,0477	,1620
4	1	-,33654 [*]	,02107	,000	-,3945	-,2786
	2	-,51575 [*]	,02807	,000	-,5930	-,4385
	3	-,15520 [*]	,02342	,000	-,2196	-,0908
	5	-,05033	,02237	,166	-,1119	,0112
5	1	-,28621 [*]	,01807	,000	-,3359	-,2365
	2	-,46542 [*]	,02589	,000	-,5367	-,3942
	3	-,10487 [*]	,02076	,000	-,1620	-,0477
	4	,05033	,02237	,166	-,0112	,1119
*. The mean difference is significant at the 0.05 level.						

Report			
Trademarks			
Cluster Number of Case	Mean	N	Std. Deviation
1	5,3081	71	3,93477
2	6,3047	20	1,97410
3	7,6120	40	8,46174
4	3,1676	31	2,01938
5	6,4597	50	5,22436
Total	5,7954	212	5,24300

Multiple Comparisons						
Dependent Variable: Trademarks						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-,99667	1,29417	,939	-4,5582	2,5648
	3	-2,30397	1,01068	,156	-5,0853	,4774
	4	2,14049	1,10053	,297	-,8881	5,1691
	5	-1,15164	,94383	,740	-3,7490	1,4457
2	1	,99667	1,29417	,939	-2,5648	4,5582
	3	-1,30729	1,40005	,883	-5,1602	2,5456
	4	3,13717	1,46623	,207	-,8979	7,1722
	5	-,15497	1,35258	1,000	-3,8772	3,5673
3	1	2,30397	1,01068	,156	-,4774	5,0853
	2	1,30729	1,40005	,883	-2,5456	5,1602
	4	4,44446*	1,22330	,003	1,0780	7,8109
	5	1,15232	1,08447	,825	-1,8321	4,1368
4	1	-2,14049	1,10053	,297	-5,1691	,8881
	2	-3,13717	1,46623	,207	-7,1722	,8979
	3	-4,44446*	1,22330	,003	-7,8109	-1,0780
	5	-3,29214*	1,16866	,042	-6,5083	-,0760
5	1	1,15164	,94383	,740	-1,4457	3,7490
	2	,15497	1,35258	1,000	-3,5673	3,8772
	3	-1,15232	1,08447	,825	-4,1368	1,8321
	4	3,29214*	1,16866	,042	,0760	6,5083
*. The mean difference is significant at the 0.05 level.						

Report			
Design applications			
Cluster Number of Case	Mean	N	Std. Deviation
1	1,0440	71	,63427
2	1,1857	20	,50323
3	1,4591	40	1,10107
4	,3976	31	,33719
5	1,5816	50	1,48565
Total	1,1680	212	1,02864

Multiple Comparisons						
Dependent Variable: Design applications						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-,14178	,24369	,978	-,8124	,5288
	3	-,41516	,19031	,191	-,9389	,1086
	4	,64639 [*]	,20723	,017	,0761	1,2167
	5	-,53763 [*]	,17772	,023	-1,0267	-,0486
2	1	,14178	,24369	,978	-,5288	,8124
	3	-,27337	,26363	,838	-,9989	,4521
	4	,78817 [*]	,27609	,038	,0284	1,5480
	5	-,39585	,25469	,528	-1,0967	,3050
3	1	,41516	,19031	,191	-,1086	,9389
	2	,27337	,26363	,838	-,4521	,9989
	4	1,06154 [*]	,23034	,000	,4276	1,6954
	5	-,12247	,20420	,975	-,6844	,4395
4	1	-,64639 [*]	,20723	,017	-1,2167	-,0761
	2	-,78817 [*]	,27609	,038	-1,5480	-,0284
	3	-1,06154 [*]	,23034	,000	-1,6954	-,4276
	5	-1,18402 [*]	,22006	,000	-1,7896	-,5784
5	1	,53763 [*]	,17772	,023	,0486	1,0267
	2	,39585	,25469	,528	-,3050	1,0967
	3	,12247	,20420	,975	-,4395	,6844
	4	1,18402 [*]	,22006	,000	,5784	1,7896
*. The mean difference is significant at the 0.05 level.						

Report			
SMEs with product or process innovations			
Cluster Number of Case	Mean	N	Std. Deviation
1	,5937	71	,13288
2	,6639	20	,14518
3	,4380	40	,15550
4	,3175	31	,14575
5	,2787	50	,15941
Total	,4563	212	,20481

Multiple Comparisons						
Dependent Variable: SMEs with product or process innovations						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-,07025	,03717	,326	-,1725	,0320
	3	,15569*	,02903	,000	,0758	,2356
	4	,27615*	,03161	,000	,1892	,3631
	5	,31493*	,02711	,000	,2403	,3895
2	1	,07025	,03717	,326	-,0320	,1725
	3	,22594*	,04021	,000	,1153	,3366
	4	,34640*	,04211	,000	,2305	,4623
	5	,38518*	,03884	,000	,2783	,4921
3	1	-,15569*	,02903	,000	-,2356	-,0758
	2	-,22594*	,04021	,000	-,3366	-,1153
	4	,12045*	,03513	,007	,0238	,2171
	5	,15923*	,03115	,000	,0735	,2449
4	1	-,27615*	,03161	,000	-,3631	-,1892
	2	-,34640*	,04211	,000	-,4623	-,2305
	3	-,12045*	,03513	,007	-,2171	-,0238
	5	,03878	,03356	,777	-,0536	,1311
5	1	-,31493*	,02711	,000	-,3895	-,2403
	2	-,38518*	,03884	,000	-,4921	-,2783
	3	-,15923*	,03115	,000	-,2449	-,0735
	4	-,03878	,03356	,777	-,1311	,0536
*. The mean difference is significant at the 0.05 level.						

Report			
SMEs with marketing or organizational innovations			
Cluster Number of Case	Mean	N	Std. Deviation
1	,4961	71	,14668
2	,5433	20	,14122
3	,3696	40	,13633
4	,3103	31	,15637
5	,2255	50	,15214
Total	,3857	212	,18612

Multiple Comparisons						
Dependent Variable: SMEs with marketing or organizational innovations						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-,04714	,03723	,712	-,1496	,0553
	3	,12651 [*]	,02908	,000	,0465	,2065
	4	,18581 [*]	,03166	,000	,0987	,2729
	5	,27060 [*]	,02715	,000	,1959	,3453
2	1	,04714	,03723	,712	-,0553	,1496
	3	,17365 [*]	,04028	,000	,0628	,2845
	4	,23295 [*]	,04218	,000	,1169	,3490
	5	,31774 [*]	,03891	,000	,2107	,4248
3	1	-,12651 [*]	,02908	,000	-,2065	-,0465
	2	-,17365 [*]	,04028	,000	-,2845	-,0628
	4	,05930	,03519	,445	-,0375	,1561
	5	,14409 [*]	,03120	,000	,0582	,2299
4	1	-,18581 [*]	,03166	,000	-,2729	-,0987
	2	-,23295 [*]	,04218	,000	-,3490	-,1169
	3	-,05930	,03519	,445	-,1561	,0375
	5	,08479	,03362	,090	-,0077	,1773
5	1	-,27060 [*]	,02715	,000	-,3453	-,1959
	2	-,31774 [*]	,03891	,000	-,4248	-,2107
	3	-,14409 [*]	,03120	,000	-,2299	-,0582
	4	-,08479	,03362	,090	-,1773	,0077
*. The mean difference is significant at the 0.05 level.						

Report			
SMEs innovating in-house			
Cluster Number of Case	Mean	N	Std. Deviation
1	,5527	71	,09685
2	,6078	20	,10632
3	,4247	40	,16553
4	,3093	31	,15321
5	,2567	50	,16043
Total	,4284	212	,18928

Multiple Comparisons						
Dependent Variable: SMEs innovating in-house						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-,05515	,03477	,508	-,1508	,0405
	3	,12798*	,02716	,000	,0533	,2027
	4	,24333*	,02957	,000	,1620	,3247
	5	,29595*	,02536	,000	,2262	,3657
2	1	,05515	,03477	,508	-,0405	,1508
	3	,18313*	,03762	,000	,0796	,2867
	4	,29848*	,03939	,000	,1901	,4069
	5	,35110*	,03634	,000	,2511	,4511
3	1	-,12798*	,02716	,000	-,2027	-,0533
	2	-,18313*	,03762	,000	-,2867	-,0796
	4	,11535*	,03287	,005	,0249	,2058
	5	,16796*	,02914	,000	,0878	,2481
4	1	-,24333*	,02957	,000	-,3247	-,1620
	2	-,29848*	,03939	,000	-,4069	-,1901
	3	-,11535*	,03287	,005	-,2058	-,0249
	5	,05262	,03140	,451	-,0338	,1390
5	1	-,29595*	,02536	,000	-,3657	-,2262
	2	-,35110*	,03634	,000	-,4511	-,2511
	3	-,16796*	,02914	,000	-,2481	-,0878
	4	-,05262	,03140	,451	-,1390	,0338
*. The mean difference is significant at the 0.05 level.						

Report			
Employment in medium-high-tech services			
Cluster Number of Case	Mean	N	Std. Deviation
1	,5924	71	,11769
2	,7529	20	,12171
3	,5656	40	,11626
4	,2971	31	,11468
5	,4296	50	,15116
Total	,5209	212	,17927

Multiple Comparisons						
Dependent Variable: Employment in medium-high-tech services						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-,16042 [*]	,03193	,000	-,2483	-,0726
	3	,02680	,02493	,819	-,0418	,0954
	4	,29533 [*]	,02715	,000	,2206	,3700
	5	,16283 [*]	,02328	,000	,0988	,2269
2	1	,16042 [*]	,03193	,000	,0726	,2483
	3	,18722 [*]	,03454	,000	,0922	,2823
	4	,45576 [*]	,03617	,000	,3562	,5553
	5	,32326 [*]	,03337	,000	,2314	,4151
3	1	-,02680	,02493	,819	-,0954	,0418
	2	-,18722 [*]	,03454	,000	-,2823	-,0922
	4	,26854 [*]	,03018	,000	,1855	,3516
	5	,13604 [*]	,02675	,000	,0624	,2097
4	1	-,29533 [*]	,02715	,000	-,3700	-,2206
	2	-,45576 [*]	,03617	,000	-,5553	-,3562
	3	-,26854 [*]	,03018	,000	-,3516	-,1855
	5	-,13250 [*]	,02883	,000	-,2118	-,0532
5	1	-,16283 [*]	,02328	,000	-,2269	-,0988
	2	-,32326 [*]	,03337	,000	-,4151	-,2314
	3	-,13604 [*]	,02675	,000	-,2097	-,0624
	4	,13250 [*]	,02883	,000	,0532	,2118
*. The mean difference is significant at the 0.05 level.						

Report			
Employment in high-tech sectors			
Cluster Number of Case	Mean	N	Std. Deviation
1	4,0043	71	1,66419
2	6,1189	20	1,71803
3	3,7736	40	1,56819
4	1,6883	31	,63866
5	2,6279	50	1,08386
Total	3,4970	212	1,83909

Multiple Comparisons						
Dependent Variable: Employment in high-tech sectors						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-2,11464 [*]	,35872	,000	-3,1018	-1,1274
	3	,23064	,28015	,923	-,5403	1,0016
	4	2,31597 [*]	,30505	,000	1,4765	3,1555
	5	1,37632 [*]	,26161	,000	,6564	2,0963
2	1	2,11464 [*]	,35872	,000	1,1274	3,1018
	3	2,34529 [*]	,38807	,000	1,2773	3,4133
	4	4,43061 [*]	,40642	,000	3,3122	5,5491
	5	3,49096 [*]	,37491	,000	2,4592	4,5227
3	1	-,23064	,28015	,923	-1,0016	,5403
	2	-2,34529 [*]	,38807	,000	-3,4133	-1,2773
	4	2,08533 [*]	,33908	,000	1,1522	3,0185
	5	1,14568 [*]	,30060	,002	,3184	1,9729
4	1	-2,31597 [*]	,30505	,000	-3,1555	-1,4765
	2	-4,43061 [*]	,40642	,000	-5,5491	-3,3122
	3	-2,08533 [*]	,33908	,000	-3,0185	-1,1522
	5	-,93965 [*]	,32394	,033	-1,8311	-,0482
5	1	-1,37632 [*]	,26161	,000	-2,0963	-,6564
	2	-3,49096 [*]	,37491	,000	-4,5227	-2,4592
	3	-1,14568 [*]	,30060	,002	-1,9729	-,3184
	4	,93965 [*]	,32394	,033	,0482	1,8311
*. The mean difference is significant at the 0.05 level.						

Report			
Sales			
Cluster Number of Case	Mean	N	Std. Deviation
1	,4203	71	,07362
2	,4386	20	,09321
3	,4142	40	,11136
4	,3551	31	,11052
5	,3118	50	,13449
Total	,3858	212	,11428

Multiple Comparisons						
Dependent Variable: Sales						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-,01832	,02657	,959	-,0914	,0548
	3	,00613	,02075	,998	-,0510	,0632
	4	,06514 [*]	,02260	,035	,0030	,1273
	5	,10846 [*]	,01938	,000	,0551	,1618
2	1	,01832	,02657	,959	-,0548	,0914
	3	,02445	,02875	,914	-,0547	,1036
	4	,08346 [*]	,03011	,047	,0006	,1663
	5	,12678 [*]	,02777	,000	,0504	,2032
3	1	-,00613	,02075	,998	-,0632	,0510
	2	-,02445	,02875	,914	-,1036	,0547
	4	,05901	,02512	,134	-,0101	,1281
	5	,10233 [*]	,02227	,000	,0411	,1636
4	1	-,06514 [*]	,02260	,035	-,1273	-,0030
	2	-,08346 [*]	,03011	,047	-,1663	-,0006
	3	-,05901	,02512	,134	-,1281	,0101
	5	,04332	,02400	,373	-,0227	,1094
5	1	-,10846 [*]	,01938	,000	-,1618	-,0551
	2	-,12678 [*]	,02777	,000	-,2032	-,0504
	3	-,10233 [*]	,02227	,000	-,1636	-,0411
	4	-,04332	,02400	,373	-,1094	,0227
*. The mean difference is significant at the 0.05 level.						

Report			
Exports			
Cluster Number of Case	Mean	N	Std. Deviation
1	,4936	71	,12755
2	,6664	20	,13699
3	,4861	40	,14740
4	,2340	31	,09305
5	,3642	50	,11808
Total	,4400	212	,17146

Multiple Comparisons						
Dependent Variable: Exports						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-,17289 [*]	,03189	,000	-,2607	-,0851
	3	,00743	,02491	,998	-,0611	,0760
	4	,25959 [*]	,02712	,000	,1850	,3342
	5	,12936 [*]	,02326	,000	,0654	,1934
2	1	,17289 [*]	,03189	,000	,0851	,2607
	3	,18032 [*]	,03450	,000	,0854	,2753
	4	,43248 [*]	,03613	,000	,3330	,5319
	5	,30225 [*]	,03333	,000	,2105	,3940
3	1	-,00743	,02491	,998	-,0760	,0611
	2	-,18032 [*]	,03450	,000	-,2753	-,0854
	4	,25216 [*]	,03015	,000	,1692	,3351
	5	,12193 [*]	,02673	,000	,0484	,1955
4	1	-,25959 [*]	,02712	,000	-,3342	-,1850
	2	-,43248 [*]	,03613	,000	-,5319	-,3330
	3	-,25216 [*]	,03015	,000	-,3351	-,1692
	5	-,13023 [*]	,02880	,000	-,2095	-,0510
5	1	-,12936 [*]	,02326	,000	-,1934	-,0654
	2	-,30225 [*]	,03333	,000	-,3940	-,2105
	3	-,12193 [*]	,02673	,000	-,1955	-,0484
	4	,13023 [*]	,02880	,000	,0510	,2095
*. The mean difference is significant at the 0.05 level.						

Report			
Regional Competiveness Index			
Cluster Number of Case	Mean	N	Std. Deviation
1	,4354	71	,23578
2	,7962	20	,20428
3	-,1343	40	,25985
4	-1,1699	31	,23123
5	-,6324	50	,18445
Total	-,1246	212	,67654

Multiple Comparisons						
Dependent Variable: Regional Competiveness Index						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-,36081 [*]	,05726	,000	-,5184	-,2032
	3	,56964 [*]	,04471	,000	,4466	,6927
	4	1,60525 [*]	,04869	,000	1,4713	1,7392
	5	1,06778 [*]	,04176	,000	,9529	1,1827
2	1	,36081 [*]	,05726	,000	,2032	,5184
	3	,93045 [*]	,06194	,000	,7600	1,1009
	4	1,96606 [*]	,06487	,000	1,7876	2,1446
	5	1,42859 [*]	,05984	,000	1,2639	1,5933
3	1	-,56964 [*]	,04471	,000	-,6927	-,4466
	2	-,93045 [*]	,06194	,000	-1,1009	-,7600
	4	1,03561 [*]	,05412	,000	,8867	1,1846
	5	,49815 [*]	,04798	,000	,3661	,6302
4	1	-1,60525 [*]	,04869	,000	-1,7392	-1,4713
	2	-1,96606 [*]	,06487	,000	-2,1446	-1,7876
	3	-1,03561 [*]	,05412	,000	-1,1846	-,8867
	5	-,53747 [*]	,05170	,000	-,6798	-,3952
5	1	-1,06778 [*]	,04176	,000	-1,1827	-,9529
	2	-1,42859 [*]	,05984	,000	-1,5933	-1,2639
	3	-,49815 [*]	,04798	,000	-,6302	-,3661
	4	,53747 [*]	,05170	,000	,3952	,6798
*. The mean difference is significant at the 0.05 level.						

Report			
GDP			
Cluster Number of Case	Mean	N	Std. Deviation
1	36759,4202	71	10400,53573
2	46411,4083	20	9262,94811
3	23909,1208	40	8821,52736
4	13709,6774	31	4732,13947
5	15715,1467	50	7778,61930
Total	26911,6470	212	14174,91382

Multiple Comparisons						
Dependent Variable: GDP						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-9651,98815 [*]	2216,82769	,000	-15752,6380	-3551,3383
	3	12850,29935 [*]	1731,24181	,000	8085,9687	17614,6300
	4	23049,74277 [*]	1885,14811	,000	17861,8662	28237,6194
	5	21044,27352 [*]	1616,71669	,000	16595,1129	25493,4341
2	1	9651,98815 [*]	2216,82769	,000	3551,3383	15752,6380
	3	22502,28750 [*]	2398,20357	,000	15902,4962	29102,0788
	4	32701,73091 [*]	2511,56635	,000	25789,9683	39613,4936
	5	30696,26167 [*]	2316,88476	,000	24320,2575	37072,2658
3	1	-12850,29935 [*]	1731,24181	,000	-17614,6300	-8085,9687
	2	-22502,28750 [*]	2398,20357	,000	-29102,0788	-15902,4962
	4	10199,44341 [*]	2095,43283	,000	4432,8689	15966,0179
	5	8193,97417 [*]	1857,64049	,000	3081,7978	13306,1506
4	1	-23049,74277 [*]	1885,14811	,000	-28237,6194	-17861,8662
	2	-32701,73091 [*]	2511,56635	,000	-39613,4936	-25789,9683
	3	-10199,44341 [*]	2095,43283	,000	-15966,0179	-4432,8689
	5	-2005,46925	2001,85249	,854	-7514,5132	3503,5747
5	1	-21044,27352 [*]	1616,71669	,000	-25493,4341	-16595,1129
	2	-30696,26167 [*]	2316,88476	,000	-37072,2658	-24320,2575
	3	-8193,97417 [*]	1857,64049	,000	-13306,1506	-3081,7978
	4	2005,46925	2001,85249	,854	-3503,5747	7514,5132
*. The mean difference is significant at the 0.05 level.						

Report			
Gross fixed capital			
Cluster Number of Case	Mean	N	Std. Deviation
1	12985,7841	71	16034,98871
2	26157,6424	20	37368,09008
3	9410,0413	40	12822,86810
4	2416,9989	31	2115,88272
5	4756,4760	50	5143,34180
Total	10067,4337	212	17058,21162

Multiple Comparisons						
Dependent Variable: Gross fixed capital						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-13171,85825 [*]	4026,65087	,011	-24253,0925	-2090,6240
	3	3575,74279	3144,63158	,787	-5078,1982	12229,6838
	4	10568,78525 [*]	3424,18733	,019	1145,5143	19992,0562
	5	8229,30809 [*]	2936,60788	,044	147,8426	16310,7735
2	1	13171,85825 [*]	4026,65087	,011	2090,6240	24253,0925
	3	16747,60104 [*]	4356,10243	,001	4759,7250	28735,4771
	4	23740,64350 [*]	4562,01485	,000	11186,1020	36295,1850
	5	21401,16634 [*]	4208,39476	,000	9819,7778	32982,5549
3	1	-3575,74279	3144,63158	,787	-12229,6838	5078,1982
	2	-16747,60104 [*]	4356,10243	,001	-28735,4771	-4759,7250
	4	6993,04246	3806,14898	,355	-3481,3766	17467,4615
	5	4653,56530	3374,22243	,642	-4632,2036	13939,3342
4	1	-10568,78525 [*]	3424,18733	,019	-19992,0562	-1145,5143
	2	-23740,64350 [*]	4562,01485	,000	-36295,1850	-11186,1020
	3	-6993,04246	3806,14898	,355	-17467,4615	3481,3766
	5	-2339,47716	3636,16944	,968	-12346,1171	7667,1628
5	1	-8229,30809 [*]	2936,60788	,044	-16310,7735	-147,8426
	2	-21401,16634 [*]	4208,39476	,000	-32982,5549	-9819,7778
	3	-4653,56530	3374,22243	,642	-13939,3342	4632,2036
	4	2339,47716	3636,16944	,968	-7667,1628	12346,1171
*. The mean difference is significant at the 0.05 level.						

Report			
GVA			
Cluster Number of Case	Mean	N	Std. Deviation
1	81509,4251	71	67091,93292
2	162074,9270	20	151012,18277
3	57864,8896	40	58078,09325
4	18584,5989	31	22206,84073
5	24072,7776	50	23191,88869
Total	61901,0602	212	77869,80505

Multiple Comparisons						
Dependent Variable: GVA						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-80565,50190 [*]	16886,52403	,000	-127036,7592	-34094,2446
	3	23644,53548	13187,60886	,380	-12647,4073	59936,4783
	4	62924,82617 [*]	14359,97894	,000	23406,5526	102443,0997
	5	57436,64748 [*]	12315,22205	,000	23545,4896	91327,8054
2	1	80565,50190 [*]	16886,52403	,000	34094,2446	127036,7592
	3	104210,03738 [*]	18268,14163	,000	53936,6058	154483,4689
	4	143490,32808 [*]	19131,67442	,000	90840,4776	196140,1785
	5	138002,14939 [*]	17648,70152	,000	89433,4002	186570,8985
3	1	-23644,53548	13187,60886	,380	-59936,4783	12647,4073
	2	-104210,03738 [*]	18268,14163	,000	-154483,4689	-53936,6058
	4	39280,29069	15961,80754	,104	-4646,1719	83206,7532
	5	33792,11200	14150,44166	,123	-5149,5206	72733,7446
4	1	-62924,82617 [*]	14359,97894	,000	-102443,0997	-23406,5526
	2	-143490,32808 [*]	19131,67442	,000	-196140,1785	-90840,4776
	3	-39280,29069	15961,80754	,104	-83206,7532	4646,1719
	5	-5488,17869	15248,96609	,996	-47452,9208	36476,5635
5	1	-57436,64748 [*]	12315,22205	,000	-91327,8054	-23545,4896
	2	-138002,14939 [*]	17648,70152	,000	-186570,8985	-89433,4002
	3	-33792,11200	14150,44166	,123	-72733,7446	5149,5206
	4	5488,17869	15248,96609	,996	-36476,5635	47452,9208
*. The mean difference is significant at the 0.05 level.						

Report			
Poverty			
Cluster Number of Case	Mean	N	Std. Deviation
1	19,3079	71	4,08223
2	16,8862	20	4,26449
3	20,6584	40	7,27979
4	38,5302	31	6,65728
5	25,5642	50	6,15417
Total	23,6206	212	8,82235

Multiple Comparisons						
Dependent Variable: Poverty						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	2,42168	1,44711	,453	-1,5607	6,4041
	3	-1,35049	1,13013	,754	-4,4606	1,7596
	4	-19,22231*	1,23060	,000	-22,6089	-15,8357
	5	-6,25631*	1,05537	,000	-9,1606	-3,3520
2	1	-2,42168	1,44711	,453	-6,4041	1,5607
	3	-3,77217	1,56551	,117	-8,0804	,5361
	4	-21,64399*	1,63951	,000	-26,1559	-17,1321
	5	-8,67799*	1,51243	,000	-12,8401	-4,5158
3	1	1,35049	1,13013	,754	-1,7596	4,4606
	2	3,77217	1,56551	,117	-,5361	8,0804
	4	-17,87183*	1,36787	,000	-21,6362	-14,1075
	5	-4,90582*	1,21264	,001	-8,2430	-1,5687
4	1	19,22231*	1,23060	,000	15,8357	22,6089
	2	21,64399*	1,63951	,000	17,1321	26,1559
	3	17,87183*	1,36787	,000	14,1075	21,6362
	5	12,96600*	1,30678	,000	9,3698	16,5622
5	1	6,25631*	1,05537	,000	3,3520	9,1606
	2	8,67799*	1,51243	,000	4,5158	12,8401
	3	4,90582*	1,21264	,001	1,5687	8,2430
	4	-12,96600*	1,30678	,000	-16,5622	-9,3698
*. The mean difference is significant at the 0.05 level.						

Report			
Unemployment			
Cluster Number of Case	Mean	N	Std. Deviation
1	6,0958	71	2,77516
2	5,2892	20	2,35352
3	8,4055	40	4,27323
4	18,7742	31	7,84763
5	11,2711	50	5,81360
Total	9,5300	212	6,49772

Multiple Comparisons						
Dependent Variable: Unemployment						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	,80660	1,22664	,965	-2,5691	4,1823
	3	-2,30970	,95795	,116	-4,9459	,3266
	4	-12,67842 [*]	1,04311	,000	-15,5490	-9,8078
	5	-5,17532 [*]	,89458	,000	-7,6372	-2,7135
2	1	-,80660	1,22664	,965	-4,1823	2,5691
	3	-3,11630	1,32700	,134	-6,7682	,5356
	4	-13,48503 [*]	1,38973	,000	-17,3095	-9,6605
	5	-5,98192 [*]	1,28200	,000	-9,5100	-2,4539
3	1	2,30970	,95795	,116	-,3266	4,9459
	2	3,11630	1,32700	,134	-,5356	6,7682
	4	-10,36873 [*]	1,15947	,000	-13,5596	-7,1779
	5	-2,86562 [*]	1,02789	,045	-5,6943	-,0369
4	1	12,67842 [*]	1,04311	,000	9,8078	15,5490
	2	13,48503 [*]	1,38973	,000	9,6605	17,3095
	3	10,36873 [*]	1,15947	,000	7,1779	13,5596
	5	7,50311 [*]	1,10769	,000	4,4548	10,5514
5	1	5,17532 [*]	,89458	,000	2,7135	7,6372
	2	5,98192 [*]	1,28200	,000	2,4539	9,5100
	3	2,86562 [*]	1,02789	,045	-,0369	5,6943
	4	-7,50311 [*]	1,10769	,000	-10,5514	-4,4548
*. The mean difference is significant at the 0.05 level.						

Micro level clusters' characteristics

Report			
Tertiary education			
Cluster Number of Case	Mean	N	Std. Deviation
1	15,9545	33	21,37696
2	38,3958	24	27,04786
3	29,0873	63	25,88553
Total	27,3375	120	25,99242

Multiple Comparisons						
Dependent Variable: Tertiary education						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-22,44129 [*]	6,70076	,003	-38,3483	-6,5343
	3	-13,13276 [*]	5,36732	,042	-25,8743	-,3912
2	1	22,44129 [*]	6,70076	,003	6,5343	38,3483
	3	9,30853	5,99146	,270	-4,9147	23,5317
3	1	13,13276 [*]	5,36732	,042	,3912	25,8743
	2	-9,30853	5,99146	,270	-23,5317	4,9147
*. The mean difference is significant at the 0.05 level.						

Report			
Lifelong learning			
Cluster Number of Case	Mean	N	Std. Deviation
1	7,288	33	12,705
2	24,500	24	22,163
3	16,984	63	23,655
Total	15,821	120	21,586

Multiple Comparisons						
Dependent Variable: Lifelong learning						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-17,212 [*]	5,610	,007	-30,529	-3,896
	3	-9,696	4,493	,083	-20,363	,970
2	1	17,212 [*]	5,610	,007	3,896	30,529
	3	7,516	5,016	,295	-4,391	19,423
3	1	9,696	4,493	,083	-,970	20,363

	2	-7,516	5,016	,295	-19,423	4,391
*. The mean difference is significant at the 0.05 level.						

Report			
Human resources			
Cluster Number of Case	Mean	N	Std. Deviation
1	6,7424	33	16,47305
2	23,8125	24	23,79661
3	10,0079	63	17,00107
Total	11,8708	120	19,25880

Multiple Comparisons						
Dependent Variable: Human resources						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-17,07008 [*]	4,93724	,002	-28,7906	-5,3495
	3	-3,26551	3,95474	,688	-12,6537	6,1227
2	1	17,07008 [*]	4,93724	,002	5,3495	28,7906
	3	13,80456 [*]	4,41462	,006	3,3247	24,2845
3	1	3,26551	3,95474	,688	-6,1227	12,6537
	2	-13,80456 [*]	4,41462	,006	-24,2845	-3,3247
*. The mean difference is significant at the 0.05 level.						

Report			
Quality of education system			
Cluster Number of Case	Mean	N	Std. Deviation
1	2,9697	33	,91804
2	3,4583	24	,93153
3	2,9365	63	,93106
Total	3,0500	120	,94246

Multiple Comparisons						
Dependent Variable: Quality of education system						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-,48864	,24885	,126	-1,0794	,1021
	3	,03319	,19933	,985	-,4400	,5064
2	1	,48864	,24885	,126	-,1021	1,0794

	3	,52183	,22251	,054	-,0064	1,0500
3	1	-,03319	,19933	,985	-,5064	,4400
	2	-,52183	,22251	,054	-1,0500	,0064

Report			
Corporate governance			
Cluster Number of Case	Mean	N	Std. Deviation
1	3,2727	33	,76128
2	4,2500	24	,60792
3	3,6349	63	,93845
Total	3,6583	120	,89345

Multiple Comparisons						
Dependent Variable: Corporate governance						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-,97727*	,22411	,000	-1,5093	-,4453
	3	-,36219	,17951	,112	-,7883	,0639
2	1	,97727*	,22411	,000	,4453	1,5093
	3	,61508*	,20039	,007	,1394	1,0908
3	1	,36219	,17951	,112	-,0639	,7883
	2	-,61508*	,20039	,007	-1,0908	-,1394
*. The mean difference is significant at the 0.05 level.						

Report			
Opportunity perception			
Cluster Number of Case	Mean	N	Std. Deviation
1	3,1818	33	,76871
2	4,0833	24	,58359
3	3,7619	63	,79746
Total	3,6667	120	,81306

Multiple Comparisons						
Dependent Variable: Opportunity perception						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-,90152*	,20175	,000	-1,3805	-,4226
	3	-,58009*	,16160	,001	-,9637	-,1965

2	1	,90152*	,20175	,000	,4226	1,3805
	3	,32143	,18040	,180	-,1068	,7497
3	1	,58009*	,16160	,001	,1965	,9637
	2	-,32143	,18040	,180	-,7497	,1068
*. The mean difference is significant at the 0.05 level.						

Report			
Startup skills			
Cluster Number of Case	Mean	N	Std. Deviation
1	3,2121	33	,89294
2	3,2917	24	,75060
3	3,2063	63	,82616
Total	3,2250	120	,82465

Multiple Comparisons						
Dependent Variable: Startup skills						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-,07955	,22293	,932	-,6088	,4497
	3	,00577	,17857	,999	-,4181	,4297
2	1	,07955	,22293	,932	-,4497	,6088
	3	,08532	,19933	,904	-,3879	,5585
3	1	-,00577	,17857	,999	-,4297	,4181
	2	-,08532	,19933	,904	-,5585	,3879

Report			
Risk acceptance			
Cluster Number of Case	Mean	N	Std. Deviation
1	3,1212	33	,85723
2	3,3750	24	,82423
3	3,5556	63	,81869
Total	3,4000	120	,84416

Multiple Comparisons						
Dependent Variable: Risk acceptance						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-,25379	,22280	,492	-,7827	,2751

	3	-,43434 [*]	,17846	,043	-,8580	-,0107
2	1	,25379	,22280	,492	-,2751	,7827
	3	-,18056	,19921	,637	-,6535	,2924
3	1	,43434 [*]	,17846	,043	,0107	,8580
	2	,18056	,19921	,637	-,2924	,6535

*. The mean difference is significant at the 0.05 level.

Report			
R&D expenditures			
Cluster Number of Case	Mean	N	Std. Deviation
1	5,0000	33	4,79257
2	19,2083	24	15,03685
3	9,0397	63	9,88168
Total	9,9625	120	11,19258

Multiple Comparisons						
Dependent Variable: R&D expenditures						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-14,20833 [*]	2,71572	,000	-20,6552	-7,7615
	3	-4,03968	2,17529	,156	-9,2036	1,1243
2	1	14,20833 [*]	2,71572	,000	7,7615	20,6552
	3	10,16865 [*]	2,42825	,000	4,4042	15,9331
3	1	4,03968	2,17529	,156	-1,1243	9,2036
	2	-10,16865 [*]	2,42825	,000	-15,9331	-4,4042

*. The mean difference is significant at the 0.05 level.

Report			
Non-R&D expenditures			
Cluster Number of Case	Mean	N	Std. Deviation
1	10,1818	33	10,35225
2	31,3750	24	25,59817
3	18,1746	63	17,14388
Total	18,6167	120	19,00682

Multiple Comparisons						
Dependent Variable: Non-R&D expenditures						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower	Upper

	of Case				Bound	Bound
1	2	-21,19318 [*]	4,75282	,000	-32,4760	-9,9104
	3	-7,99278	3,80702	,094	-17,0303	1,0447
2	1	21,19318 [*]	4,75282	,000	9,9104	32,4760
	3	13,20040 [*]	4,24972	,007	3,1119	23,2889
3	1	7,99278	3,80702	,094	-1,0447	17,0303
	2	-13,20040 [*]	4,24972	,007	-23,2889	-3,1119

*. The mean difference is significant at the 0.05 level.

Report			
Access to finance			
Cluster Number of Case	Mean	N	Std. Deviation
1	2,5455	33	1,22706
2	3,2083	24	1,02062
3	3,0159	63	1,12869
Total	2,9250	120	1,15346

Multiple Comparisons						
Dependent Variable: Access to finance						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-,66288	,30489	,080	-1,3867	,0609
	3	-,47042	,24422	,136	-1,0502	,1093
2	1	,66288	,30489	,080	-,0609	1,3867
	3	,19246	,27262	,760	-,4547	,8396
3	1	,47042	,24422	,136	-,1093	1,0502
	2	-,19246	,27262	,760	-,8396	,4547

Report			
Organizational growth			
Cluster Number of Case	Mean	N	Std. Deviation
1	3,0606	33	,74747
2	3,8333	24	,48154
3	3,7460	63	,69487
Total	3,5750	120	,74091

Multiple Comparisons					
Dependent Variable: Organizational growth					
Tukey HSD					
(I) Cluster Number of	(J) Cluster	Mean	Std. Error	Sig.	95% Confidence Interval

Case	Number of Case	Difference (I-J)			Lower Bound	Upper Bound
1	2	-,77273 [*]	,18081	,000	-1,2020	-,3435
	3	-,68543 [*]	,14483	,000	-1,0292	-,3416
2	1	,77273 [*]	,18081	,000	,3435	1,2020
	3	,08730	,16167	,852	-,2965	,4711
3	1	,68543 [*]	,14483	,000	,3416	1,0292
	2	-,08730	,16167	,852	-,4711	,2965
*. The mean difference is significant at the 0.05 level.						

Report			
Access to information			
Cluster Number of Case	Mean	N	Std. Deviation
1	2,5455	33	,79415
2	3,4583	24	,88363
3	3,3492	63	,65152
Total	3,1500	120	,82656

Multiple Comparisons						
Dependent Variable: Access to information						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-,91288 [*]	,19912	,000	-1,3856	-,4402
	3	-,80375 [*]	,15950	,000	-1,1824	-,4251
2	1	,91288 [*]	,19912	,000	,4402	1,3856
	3	,10913	,17804	,813	-,3135	,5318
3	1	,80375 [*]	,15950	,000	,4251	1,1824
	2	-,10913	,17804	,813	-,5318	,3135
*. The mean difference is significant at the 0.05 level.						

Report			
Ease of starting a business			
Cluster Number of Case	Mean	N	Std. Deviation
1	2,3030	33	,88335
2	2,4167	24	,88055
3	2,4603	63	,96429
Total	2,4083	120	,92123

Multiple Comparisons						
Dependent Variable: Ease of starting a business						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-,11364	,24858	,891	-,7037	,4765
	3	-,15729	,19911	,710	-,6300	,3154
2	1	,11364	,24858	,891	-,4765	,7037
	3	-,04365	,22227	,979	-,5713	,4840
3	1	,15729	,19911	,710	-,3154	,6300
	2	,04365	,22227	,979	-,4840	,5713

Report			
Time to start a business			
Cluster Number of Case	Mean	N	Std. Deviation
1	2,4242	33	,86712
2	2,7083	24	,80645
3	2,3333	63	,95038
Total	2,4333	120	,90501

Multiple Comparisons						
Dependent Variable: Time to start a business						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-,28409	,24176	,470	-,8580	,2898
	3	,09091	,19365	,886	-,3688	,5506
2	1	,28409	,24176	,470	-,2898	,8580
	3	,37500	,21617	,197	-,1382	,8882
3	1	-,09091	,19365	,886	-,5506	,3688
	2	-,37500	,21617	,197	-,8882	,1382

Report			
Intellectual property rights			
Cluster Number of Case	Mean	N	Std. Deviation
1	1,1818	33	1,48859
2	3,6042	24	3,41982
3	2,7143	63	2,01349
Total	2,4708	120	2,39160

Multiple Comparisons						
Dependent Variable: Intellectual property rights						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-2,42235 [*]	,60307	,000	-3,8540	-,9907
	3	-1,53247 [*]	,48306	,005	-2,6792	-,3857
2	1	2,42235 [*]	,60307	,000	,9907	3,8540
	3	,88988	,53924	,229	-,3902	2,1700
3	1	1,53247 [*]	,48306	,005	,3857	2,6792
	2	-,88988	,53924	,229	-2,1700	,3902
*. The mean difference is significant at the 0.05 level.						

Report			
Product innovations			
Cluster Number of Case	Mean	N	Std. Deviation
1	2,3182	33	2,18953
2	7,4167	24	8,57533
3	5,6984	63	7,09813
Total	5,1125	120	6,72086

Multiple Comparisons						
Dependent Variable: Product innovations						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-5,09848 [*]	1,74822	,012	-9,2486	-,9484
	3	-3,38023 [*]	1,40032	,045	-6,7045	-,0560
2	1	5,09848 [*]	1,74822	,012	,9484	9,2486
	3	1,71825	1,56316	,516	-1,9926	5,4291
3	1	3,38023 [*]	1,40032	,045	,0560	6,7045
	2	-1,71825	1,56316	,516	-5,4291	1,9926
*. The mean difference is significant at the 0.05 level.						

Report			
Marketing innovations			
Cluster Number of Case	Mean	N	Std. Deviation
1	2,8182	33	2,17880
2	9,8542	24	9,96786
3	4,9841	63	5,96966

Total	5,3625	120	6,70725
-------	--------	-----	---------

Multiple Comparisons						
Dependent Variable: Marketing innovations						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-7,03598 [*]	1,69064	,000	-11,0494	-3,0226
	3	-2,16595	1,35421	,250	-5,3807	1,0488
2	1	7,03598 [*]	1,69064	,000	3,0226	11,0494
	3	4,87004 [*]	1,51168	,005	1,2814	8,4586
3	1	2,16595	1,35421	,250	-1,0488	5,3807
	2	-4,87004 [*]	1,51168	,005	-8,4586	-1,2814
*. The mean difference is significant at the 0.05 level.						

Report			
In-house innovations			
Cluster Number of Case	Mean	N	Std. Deviation
1	15,1061	33	26,01615
2	34,2083	24	30,40163
3	31,3810	63	31,17287
Total	27,4708	120	30,43979

Multiple Comparisons						
Dependent Variable: In-house innovations						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-19,10227 [*]	7,96615	,047	-38,0132	-,1913
	3	-16,27489 [*]	6,38090	,032	-31,4226	-1,1272
2	1	19,10227 [*]	7,96615	,047	-,1913	38,0132
	3	2,82738	7,12291	,917	-14,0818	19,7365
3	1	16,27489 [*]	6,38090	,032	1,1272	31,4226
	2	-2,82738	7,12291	,917	-19,7365	14,0818
*. The mean difference is significant at the 0.05 level.						

Report			
Employees in knowledge-intensive activities			
Cluster Number of Case	Mean	N	Std. Deviation
1	8,5455	33	9,38113

2	32,5625	24	24,05669
3	17,8254	63	16,81545
Total	18,2208	120	18,71803

Multiple Comparisons						
Dependent Variable: Employees in knowledge-intensive activities						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-24,01705 [*]	4,55015	,000	-34,8187	-13,2154
	3	-9,27994 [*]	3,64468	,032	-17,9321	-,6278
2	1	24,01705 [*]	4,55015	,000	13,2154	34,8187
	3	14,73710 [*]	4,06850	,001	5,0788	24,3954
3	1	9,27994 [*]	3,64468	,032	,6278	17,9321
	2	-14,73710 [*]	4,06850	,001	-24,3954	-5,0788
*. The mean difference is significant at the 0.05 level.						

Report			
Employees in high-tech activities			
Cluster Number of Case	Mean	N	Std. Deviation
1	5,2424	33	7,17975
2	24,7917	24	23,64268
3	11,7857	63	15,01900
Total	12,5875	120	16,87493

Multiple Comparisons						
Dependent Variable: Employees in high-tech activities						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-19,54924 [*]	4,18638	,000	-29,4873	-9,6111
	3	-6,54329	3,35330	,129	-14,5037	1,4171
2	1	19,54924 [*]	4,18638	,000	9,6111	29,4873
	3	13,00595 [*]	3,74324	,002	4,1198	21,8921
3	1	6,54329	3,35330	,129	-1,4171	14,5037
	2	-13,00595 [*]	3,74324	,002	-21,8921	-4,1198
*. The mean difference is significant at the 0.05 level.						

Report			
Exports			
Cluster Number of Case	Mean	N	Std. Deviation
1	9,1061	33	18,77613
2	56,2500	24	25,88646
3	28,9206	63	29,74017
Total	28,9375	120	30,73515

Multiple Comparisons						
Dependent Variable: Exports						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-47,14394 [*]	7,08181	,000	-63,9555	-30,3323
	3	-19,81457 [*]	5,67255	,002	-33,2807	-6,3485
2	1	47,14394 [*]	7,08181	,000	30,3323	63,9555
	3	27,32937 [*]	6,33218	,000	12,2973	42,3614
3	1	19,81457 [*]	5,67255	,002	6,3485	33,2807
	2	-27,32937 [*]	6,33218	,000	-42,3614	-12,2973
*. The mean difference is significant at the 0.05 level.						

Report			
Sales			
Cluster Number of Case	Mean	N	Std. Deviation
1	7,2121	33	9,47037
2	29,1875	24	20,85864
3	14,8492	63	17,17501
Total	15,6167	120	17,85889

Multiple Comparisons						
Dependent Variable: Sales						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-21,97538 [*]	4,37845	,000	-32,3694	-11,5813
	3	-7,63709	3,50715	,079	-15,9627	,6886
2	1	21,97538 [*]	4,37845	,000	11,5813	32,3694
	3	14,33829 [*]	3,91498	,001	5,0445	23,6321
3	1	7,63709	3,50715	,079	-,6886	15,9627
	2	-14,33829 [*]	3,91498	,001	-23,6321	-5,0445

*. The mean difference is significant at the 0.05 level.

Report			
Market share			
Cluster Number of Case	Mean	N	Std. Deviation
1	13,1515	33	19,83663
2	28,0417	24	23,81492
3	15,0476	63	15,10920
Total	17,1250	120	19,10676

Multiple Comparisons						
Dependent Variable: Market share						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-14,89015 [*]	4,94731	,009	-26,6346	-3,1457
	3	-1,89610	3,96281	,882	-11,3035	7,5112
2	1	14,89015 [*]	4,94731	,009	3,1457	26,6346
	3	12,99405 [*]	4,42362	,011	2,4928	23,4953
3	1	1,89610	3,96281	,882	-7,5112	11,3035
	2	-12,99405 [*]	4,42362	,011	-23,4953	-2,4928
*. The mean difference is significant at the 0.05 level.						

Report			
Net investment			
Cluster Number of Case	Mean	N	Std. Deviation
1	7,7727	33	7,76520
2	27,7500	24	23,24164
3	13,9921	63	14,41843
Total	15,0333	120	16,63546

Multiple Comparisons						
Dependent Variable: Net investment						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-19,97727 [*]	4,09362	,000	-29,6952	-10,2594
	3	-6,21934	3,27900	,144	-14,0034	1,5647
2	1	19,97727 [*]	4,09362	,000	10,2594	29,6952
	3	13,75794 [*]	3,66030	,001	5,0687	22,4472

3	1	6,21934	3,27900	,144	-1,5647	14,0034
	2	-13,75794*	3,66030	,001	-22,4472	-5,0687

*. The mean difference is significant at the 0.05 level.

Report			
Employee retention			
Cluster Number of Case	Mean	N	Std. Deviation
1	67,2727	33	38,61045
2	85,2083	24	18,08670
3	82,6190	63	22,64482
Total	78,9167	120	28,00198

Multiple Comparisons						
Dependent Variable: Employee retention						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-17,93561*	7,31636	,041	-35,3040	-,5672
	3	-15,34632*	5,86042	,027	-29,2584	-1,4342
2	1	17,93561*	7,31636	,041	,5672	35,3040
	3	2,58929	6,54190	,917	-12,9406	18,1192
3	1	15,34632*	5,86042	,027	1,4342	29,2584
	2	-2,58929	6,54190	,917	-18,1192	12,9406

*. The mean difference is significant at the 0.05 level.

Report			
Employee satisfaction			
Cluster Number of Case	Mean	N	Std. Deviation
1	3,6364	33	,69903
2	4,3333	24	,48154
3	3,9524	63	,55150
Total	3,9417	120	,62572

Multiple Comparisons						
Dependent Variable: Employee satisfaction						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-,69697*	,15652	,000	-1,0685	-,3254
	3	-,31602*	,12537	,035	-,6136	-,0184

2	1	,69697 [*]	,15652	,000	,3254	1,0685
	3	,38095 [*]	,13995	,020	,0487	,7132
3	1	,31602 [*]	,12537	,035	,0184	,6136
	2	-,38095 [*]	,13995	,020	-,7132	-,0487
*. The mean difference is significant at the 0.05 level.						

Report			
Turover per employee			
Cluster Number of Case	Mean	N	Std. Deviation
1	23119,3304	33	21949,78912
2	38937,0343	24	25875,64106
3	31472,2242	63	25835,77736
Total	30668,1404	120	25232,27179

Multiple Comparisons						
Dependent Variable: Turover per employee						
Tukey HSD						
(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-15817,70386	6664,29461	,050	-31638,1487	2,7410
	3	-8352,89378	5338,11250	,265	-21025,0998	4319,3123
2	1	15817,70386	6664,29461	,050	-2,7410	31638,1487
	3	7464,81008	5958,85862	,425	-6680,9922	21610,6124
3	1	8352,89378	5338,11250	,265	-4319,3123	21025,0998
	2	-7464,81008	5958,85862	,425	-21610,6124	6680,9922