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Evaluating Innovative area performance, an application to Science and Technology Park of Crete

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Evaluating Innovative area performance, an application to Science and Technology Park of Crete

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Keywords

Regional clusters, regional innovation, small business agglomerations, regional cluster performance, small business clusters evaluation, critical success factors

Executive summary

This article aims to describe the application of a suitable set of factors to evaluate small business regional innovative performance. The questionnaire survey method was used to collect data from a sample of fourteen business executives, representing companies established and operating in the innovative area of Science and Technology Park of Crete (STEP-C). STEP-C is located in Heraklion in the Island of Crete in southern Greece.
An analysis was deployed to evaluate cluster performance using eleven different factors associated with cluster progress and development.
As innovative area formation undergoes many critical processes during its formation, proper evaluation of its basic characteristics is of vital importance for its future development.
Several methods have been applied by scholars for the qualification of innovative areas' processes. The development of regional innovative areas, in which more actors are usually small enterprises, has not been examined thoroughly in the literature due to the lack of available cluster specific statistic data and to the limited econometric sectoral data.
The set of factors proposed in this paper aims to support the formulation and implementation of regional cluster initiatives. Each cluster scores a different value on each of the eleven factors empowering the cluster managers to establish a solid perception about the strands that need development in each cluster.
In this study, each of the eleven factor consists of a set of questions relevant to the factors' content. The questions are answered by cluster actors using a Likert scale and the frequency of the answers define the final factor score. The present study encounters original work on establishing a set of factors capable of describing a small business regional cluster status and can be used by cluster decision makers to decide which aspects to consider for further development of the cluster.

Introduction

Small and Medium enterprises benefit from clusters from labor pooling and matching, knowledge spillovers, sharing inputs, and shopping externalities (Fu et al., 2017).
Cluster evaluation methods ranging from simply qualitative to the more quantitative ones (Morgulis-Yakushev and Sölvell, 2017; Schmiedeberg, 2010) are already exist in the literature. Reporting methods, case studies, econometric methods, systemic approaches and cost-related approaches are used as cluster performance approaches. While a complete evaluation encompasses both qualitative and quantitative analysis, yet practical reasons and lack of detailed data on regional level impose that only part of this process is applied. Typically, neither general industry classifications nor

administrative regions are adequate to capture the boundaries of a cluster (Sternberg and Litzenberger, 2004). The identification of policy relevant innovation cluster indicators faces other challenges since they fail to capture basic features of clusters that are essential to understand the state and performance of a cluster. Such factors are supply chain and forward market linkages, partnerships, knowledge sharing, social capital, and local sources of tacit knowledge.

Multi-sectoral nature of many clusters makes traditional statistical data, aggregated by industrial classifications such as NAICS (North American Industry Classification System), to have little or no use for analysis, especially in emerging technology areas such as nanotechnology (Charles H. Davis et al., 2006). Available Science and Technology Indicators statistics are usually aggregated at a regional or national level and it is difficult to identify economic activity that occurs at a sub-regional or cluster level (Arthurs et al., 2009).

However, a set of indicators adequate to measure both the current state and prospects for innovation cluster development is essential for policy makers and stakeholders as cluster analysis enables accurate and effective policy and management intervention. An understanding of a cluster's internal workings – components, structures, processes, routines and development pathways - is critical to support the development of a successful cluster (Arthurs et al., 2009).

The development of sets of factors, capable to evaluate cluster performance has been the subject of several works (Arthurs et al., 2009; Kamath et al., 2012; Porter, 1990) and include socio-political climate, government/public policy, business climate, availability of labor, existence of inter-firm linkages, historical factors, local innovation/entrepreneurship, leading/anchor firms, high concentration of firms, availability of capital and infrastructure, suppliers, competitors / collaborators and market demand.

Several authors in the past (Arthurs et al., 2009; Athiyaman and Parkan, 2008; Charles H. Davis et al., 2006; Ciappei and Simoni, 2005; Crespo, 2011; Fu et al., 2017; Gagné et al., 2010; Hospers and Beugelsdijk, 2002; Klofsten et al., 1999; Lindqvist et al., 2003; Lundequist and Power, 2002; Morgulis-Yakushev and Sölvell, 2017; Morosini, 2004; Porter, 1998, 1990; Sölvell et al., 2008) present aspects affecting cluster formation, development and performance. Mueller and Jungwirth (Mueller and Jungwirth, 2016) developed a set of hypotheses on the relation between the contextual, the structural and the functioning determinants of clusters and cluster effectiveness, according to their study, planning security and trust seem to have a substantial and beneficial effect on a cluster's ability to reach stated goals.

According to Morgulis-Yakushev and Sölvell (Morgulis-Yakushev and Sölvell, 2017) for a cluster to develop there exist seven "gaps" which it has to overcome, and therefore they defined a cluster-bridge chart to draw comparisons between different clusters, or define the progress of a cluster during time. The gaps according to the same authors are firm-to-firm gap, firm-to-research gap, firm-to-education gap, firm-to-capital gap, firm-to-public gap, firm-to-other clusters gap and firm-to-global gap.

Methodology

In this study, we applied a set of eleven different factors using a survey method on small business regional cluster members (Johnson, 1998) to decide about the present state of a cluster and to predict which future actions should be taken in order to develop and expand it (Iammarino and Mccann, 2006; Klofsten and Jones-Evans, 1996; Mawardi et al., 2011). The present work is based on a review of small enterprises hosted in the Incubator of STEP-C in Crete. The research process was carried out in five steps: in the first step desk search was performed for literature review and problem formulation. In the second step a preliminary definition of the success factors was performed based on literature material already collected. In the third step interviews with companies' representatives were performed and questions were grouped to success factors. During the fourth step the analysis for STEP-C was performed, based on the success factors defined, while in the fifth final step, analysis conclusions and recommendations were performed.

In this paper the method CSF11 (Katharakis M., 2017) was applied to evaluate the Science and Technology Park of Crete (STEP-C) performance. CSF11 method is a set of eleven predefined Critical Success Factors (CSF) with which a Science Parks' efficiency can be captured and its level of integration realised and monitored. In this study, the CSF11 method was applied to capture critical

success factors concerning science park development, operation and innovation promotion. The CSF11 method records the status of a Science Park in a questionnaire of 60 closed-type questions about the conditions which exist inside a cluster and the data to be monitored to make the necessary corrections and ensure its success. Each question of the questionnaire could be answered using a Likert three level scale comprising of answers “disagree”, “agree” and “fully agree”. Each question was formed with a positive meaning so that disagree means a low-quality output for the cluster and fully agree means a positive result for the cluster in this specific question. The questionnaire was addressed to the CEO and Senior members of tenant companies of the Science and Technology Park of Crete (STEP-C) and their answers were recorded using live interviews. The 60 questions were grouped in 5 different categories each of them representing an area of Science Park growth. The five categories are: Science Park Vision, Operational and Supportive Factors, Network, Resources, Critical Mass. Then eleven CSF were developed each one representing a main area of intervention which can improve cluster effectiveness. The eleven CSF are: Entrepreneurship, Capital Access, Specialization of Enterprises and Human Capital, Access to Markets, Support Services, Membership Competition and International Competitiveness, Access to Information, Communication, Leadership, Innovation, Cooperation. Each CSF is comprised of a subset of the 60 questions which are relevant with the specific factors content. A positive scoring of Likert scale for each question forms the final value of the specific CSF as a ratio -frequency - of correct answers over the total number of answers normalized to one. Using the CSF11 results a Strength, Weakness, Opportunities, Strengths, (SWOT) analysis was applied in which certain conclusions were drawn concerning the concrete steps which must be considered to improve STEP-C performance.

In this study, the categories affecting cluster performance were formulated on the basis of innovative area progress evaluation with a special focus to:

a. Small and very small business,
b. Initial stages of clustering, and
c. Absence of reliable econometric data.

Based on the literature describing cluster performance and evaluation, eleven categories were defined, cited as critical success factors (CSF11) capturing the performance and development status of a cluster as follows:

CSF11_1. Entrepreneurship
CSF11_2. Access to capital
CSF11_3. Specialization of enterprises and human capital,
CSF11_4. Access to markets
CSF11_5. Support Services - Natural Infrastructure
CSF11_6. Member competition and international competitiveness
CSF11_7. Access to information
CSF11_8. Support of Information and Communication
CSF11_9. Leadership
CSF11_10. Innovation
CSF11_11. Cooperation

Based on the frequency of answers to questions, table 1 (Appendix 2) shows the frequencies of the affirmative answers "Agree" and "Fully Agree" for each of the questions that make up each factor. These frequencies have been excerpted for each cluster as a quotient of all the affirmative answers to the questions of each CSF11 with the total number of the CSF11 responses for that particular factor.

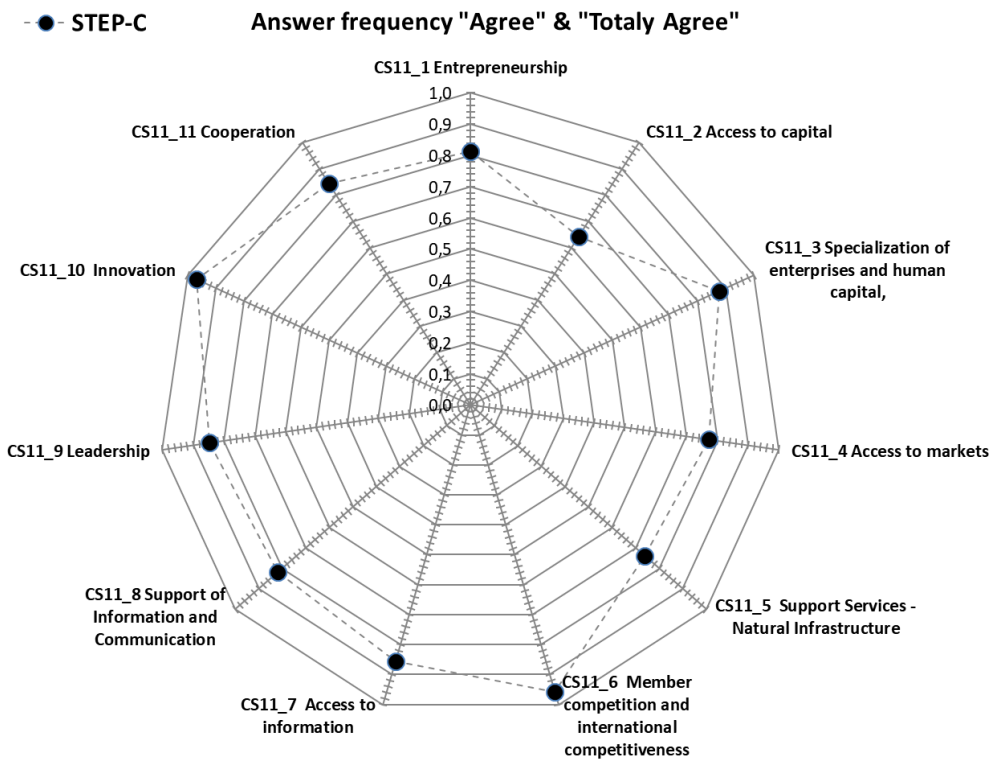
To extract the frequency of affirmative responses (F_i) of each index (i) (with i = 1 ... 11), the sum of the positive answers $n_{i,\,p}$ is first deduced from the sum of the questions that make up the index, then it is divided by the sum of index questions ($n_{i,total}$).

These frequencies have been calculated as a quotient of all the affirmative answers to the questions of each of the groups 1-11 over the total answers of that particular group for that particular cluster.

$$F_i=\frac{\Sigma(agree)+\Sigma(totally\ agree)}{n_{i,total}}=\frac{\sum n_{i,p}}{n_{i,total}}$$

To extract the F_i frequency for the total cluster sample, we calculate the affirmative responses for all respondents for all clusters for each group.

Results and discussion



Based on the frequencies of affirmative questionnaires responses, for STEP-C we notice that the cluster in general has a performance above 6 to all CSF factors.

Strong Performance

STEP-C shows a strong performance on "CSF11_6: Member competition and international competitiveness". This factor also determines the cluster's final competitiveness as it measures the individual company competitiveness (Porter, 1998). The factor also contains a measure of the competition amongst STEP-C companies which drives to constant improvement (Fundeanu and Badele, 2014; Steinfield et al., 2012). The factor also evaluates the competitiveness at international level, which is also high for STEP-C. The score manifests that the STEP-C companies improve continuously so that they comply with international competition standards. The questioning of cluster practices on the ability to support partners' competitiveness is carried out by questionnaire questions 17, 20, 24, 51, 52.

STEP-C also shows a strong performance on "CSF11_10: Innovation". Innovation as a concept lies at the basis of all bottom-up collaborative efforts and it is the reason of cooperation. The cooperation that leads to the creation of the cooperative scheme is attempted in order to give solutions to problems (Brakman and Van Marrewijk, 2013; Chatterji et al., 2014; Temouri, 2012). The participants' interest in innovation is expressed by their willingness to invest in research and innovation, as also from their actions towards the integration of new technologies and innovations

in the production process, and finally in their relations with the research ecosystem of their region (Lai et al., 2014; Mossig and Schieber, 2016). In addition, through spontaneous knowledge and spillovers, new products are created with collaborations and innovative solutions are found. The questions that identify the dimension of innovation within the cluster are 13, 19, 21, 32, 46, 48, 51, 52, 53.

Weak Performance

STEP-C exhibits relatively low scores for "CSF11_2: Access to capital", The access to capital factor CSF11_2 refers to the ability of cluster companies to leverage funding to implement their actions by the mobilization of the necessary financial resources (Fundeanu and Badele, 2014; Krugman, 1981; Morgulis-Yakushev and Sölvell, 2017). The possible cluster connection to the international market can provide capital, thus enhancing the cluster's liquidity and growth and in this case the good score shown at CSF11_6 can help. CSF11_2 is investigated by questions 40, 43.

Low score is also a case for "CSF11_4: Access to markets", which means that the relationship between the partners of the cluster and the international markets needs improvement. The tenant companies of STEP-C, cannot function as an isolated island, as it is necessary to participate and interact with international markets (Fundeanu and Badele, 2014; Morgulis-Yakushev and Sölvell, 2017). As this factor evaluates also the relationship with cluster suppliers and competitors it also shows the ability to influence and receive information on the characteristics and value of products which orients production (Porter, 1998; Sölvell et al., 2009). Similarly, importing or exporting human capital, and in particular technically trained human capital, is a criterion for both development and sustainability. The likelihood of companies having access to the markets is determined by questions 26, 38, 39, 40, 49.

Finally, STEP-C shows low score on "CSF11_5: Support Services - Natural Infrastructure". The processes implemented within the cluster to support its activity serves for its coherent development, as well as creatively for the birth of new ideas to attract remarkable human resources but also new actors into the cluster (Boja, 2011; Steinfield et al., 2012; Trippl et al., 2015). To support business development it is useful to strengthen, secure and promote intellectual property infrastructures (e.g. TTOs) and policies (IP strategy) through the provision of targeted training and the creation of collaborative spaces.

The existence of natural infrastructures contributes also to this factor by ensuring the technical feasibility of constructions, the technology transfer process, the access to information, the ease of movement of goods and people resulting in reduced cost and ease of access to products markets (Parker, 2010). Further development of natural infrastructures is needed to enhance the attraction of the best qualified scientists or qualified personnel, because of the possibility of ensuring a better quality of life, contributes to the development of an eco-system that promotes innovation and can cope with the international competition. The cluster's practices of supporting its partners as well as its human capital are registered by the questions 10, 16, 19, 20, 29, 31, 33, 34, 35, 41, 42 of the questionnaire.

Opportunities and threats

STEP-C shows a good score in the success factors CSF11_1, CSF11_3, CSF11_7, CSF11_8, CSF11_9 and therefore there is no need for immediate intervention while the strong performance on these factors is of crucial importance to enhance low performance of the other factors analyzed above. Good performance, however, should be remained to increase competitiveness in the long-run. In this regard, specific actions must be progressively designed and carried out to maintain performance. For example, considering CSF_1, CSF_3, CSF_7, CSF_8, CSF_9 and CSF_11 as opportunities, STEP-C tenant companies need to enhance their cooperation with the main innovation actors in the area, e.g. the academic (University and the Technical University of Crete,

TEI of Crete) and research organisations (Foundation for Research & Technology - Hellas (FORTH), Hellenic Center for Marine Research (HCMR), Mediterranean Agronomic Institute of Chania (MAICH), the Chambers of Commerce and other players in order to improve their performance in the areas of entrepreneurship, cooperation, leadership, access to information, human capital and Information and Communication.
To reduce the effects of limited access to capital (CSF11_2), access to markets (CSF_4) and support services - infrastructures (CSF_5) companies are necessary to exploit all existing opportunities regarding the cooperation with financial institutions and participation of collaborative projects. Collaborations should be attempted either within the region (intra-regional collaboration) or beyond the boundaries of the region (inter-regional collaboration). Specifically, it is of crucial importance to improve the performance of these three factors in the sense that funding and access to market and infrastructures will not shift from regular day-to-day business growth barriers to serious entrepreneurial obstacles which will harm companies innovativeness and organisational performance.

Conclusions

The present research refers to the identification of the attributes necessary for the evaluation of an innovation area such as a Science Park that promotes innovativeness of its members. In this paper, we are considering the creation of a Science Park as a process of introducing innovation into regional structures, given that small businesses dominate at European, national and regional level. Many of the existing companies in the regional level are often structures based mostly on family tradition and lack of innovation. In particular, technological innovation that requires systematic research and management strategy is almost absent from small businesses with no specialized departments and processes as well as funds to support it. The "burdensome" changes in entrepreneurship and the operation of small businesses as a consequence of globalization, requires the creation of such conditions at a regional level so that small businesses can enhance their level of innovation. In this paper, we prove that Using the CSF11 analysis, it is possible to capture the main Science Park attributes to form an audit concerning its basic characteristics. The implementation of the above method supports the drawing of conclusions on the benefit of the Park's progress and implementation and the effects that cluster activity can have on local development through improved competitiveness. From the study of parameters and groupings, useful conclusions can be drawn about the viability, but also the Science Park's present state and the actions to be taken to improve and develop it. Following the combination of CSF11 method results and SWOT analysis a comprehensive proposal is formed which depicts a strategy with which STEP-C can improve its performance while it makes use of its innovative characteristics.

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Appendix 1: Questionnaire

1. The vision of the cluster has been precisely identified - it is focused
2. There is at least one Cluster partner who develops the vision
3. All partners share the common vision
4. A cluster brand already exists
5. The brand has been contacted within the cluster
6. The brand has been contacted outside the cluster
7. The cluster is not a mere result of public initiative
8. The initial momentum of the cluster is maintained
9. There is local political support for cluster human capital -Accommodation, entertainment, transport-.
10. There is local political support for the cluster business
11. The cluster is capable of developing common policies
12. There is agreement among partners on cluster policy development
13. Cluster companies invest in developing new technologies
14. Business decision-making leadership is overriding academic
15. Consultation is conducted on the vision to suit the needs
16. There is agreement of the partners in forming a common strategy for the cluster
17. There is at least one powerful partner within the cluster
18. There is healthy competition between cluster businesses
19. There is co-operation among the cluster partners
20. Within the cluster, an intellectual property management framework has been developed
21. There is a framework to support the competitiveness of enterprises when joining the cluster
22. Trust has been developed (eradication) between cluster partners
23. There is interaction between cluster partners and research institutions
24. There are partners in the cluster that are competitive at international level
25. There are partners in the cluster that have products with global recognition
26. Added value is generated by the partnerships of the cluster partners
27. There is an electronic information platform with prospective employees, suppliers or customers
28. There is a procedure for resolving the differences of cluster members
29. There is a common understanding of addressing cluster issues
30. There are repetitive communication actions of cluster members
31. There is the possibility of rotation of employees among the cluster enterprises
32. There are established actions to enhance cluster membership
33. New products are created by the synergy of cluster members
34. Cluster training is carried out on the basis of the partners' needs
35. There is a network of knowledge transfer and know-how
36. There is a know-how management system produced within the cluster
37. Common provisions are made by the cluster
38. There is a mutual promotion of cluster businesses
39. The cluster is linked to the international market through staff imports or investment or know-how
40. The cluster is linked to the international market through imports of raw materials and components
41. The cluster is linked to the international market by exporting products or investments
42. There exists the necessary Physical Infrastructure to complete the cluster vision
43. There exists the necessary local physical infrastructure to support entrepreneurship
44. There exists access to finance for the completion of the planned cluster project
45. There exists a knowledgeable, technically relevant cluster staff
46. In relation to international competition, the skills that support the cluster already exist in the participating companies
47. Cluster participants are prepared to innovate
48. There is a high level of management staff on clustering issues
49. There are technological institutes and research institutes within the cluster
50. The key suppliers of the cluster with the member companies are close
51. There are actions to promote know-how exchange through networking

52. All partners are capable of leading the cluster into international innovation
53. The total number of enterprises is capable of maintaining clustering processes in terms of innovation
54. All partners are able to lead the cluster into new research
55. There is an organized information-making system for decision-making in the cluster
56. The cluster actors have launched joint entrepreneurship actions in the cluster-project-
57. The cluster has formed a vision
58. The cluster has attracted the necessary members for its success
59. The cluster has set up a network
60. The cluster has the necessary resources for its operation.

Appendix 2: Answers to questions 1-60

B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	B13	B14	B15	B16	B17	B18	B19	B20	B21	B22	B23	B24	B25	B26	B27	B28	B29	B30	B31	B32	B33	B34	B35	B36	B37	B38	B39	B40	B41	B42	B43	B44	B45	B46	B47	B48	B49	B50	B51	B52	B53	B54	B55	B56	B57	B58	B59	B60
2	3	2	1	2	1	2	2	1	1	2	2	2	3	3	2	2	3	2	1	2	3	3	3	2	2	1	1	1	3	1	2	1	1	2	1	2	2	2	1	1	1	1	1	3	2	2	3	2	2	3	2	2	2	2	2	3	2	2	1
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