

Business perspective of innovation ecosystems

Interpretation of the results of a survey in Hungary

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Abstract Term of innovation ecosystem might include various types of players in a localized area. The current paper analyzed park-like innovation ecosystems in Hungary with the purpose of defining characteristic pattern from the main business indicators point of view. Thus, the aim of the research is to explore apparent aggregated performance characteristics of ecosystems by empirical examination of different ecosystems. The conclusions reached as a result of the study different patterns identified along the lines of the three indicators of business effectiveness within the ecosystem: the average increase in turnover, the average increase in financial results and the average change in headcount. On one hand, these aggregated indicators are usable to characterize the various group of ecosystems. Additionally, this approach is feasible to describe not only the sustainability of an ecosystem but also offer an attribute on the development strategy. As a result of this research, the outlined quantitative method of innovation-based ecosystems can be considered for further assessment of innovation ecosystems. This is useful for defining the management strategy of the innovation ecosystem, analyzing the development path of an ecosystem throughout its lifecycle or making preparatory actions in the changing technology environment in order to be prepared for the new technology challenges of an industrial sector.

Keywords—innovation ecosystem, business efficiency, ecosystem assessment, ecosystem strategy, technology impact

INTRODUCTION

The structure of knowledge-based activities requires not only an attractive R&D infrastructure environment but also getting high-added value economic players, localized knowledge, university and research institutions, knowledge-intensive enterprises in place. Having these environments, as called 'parks', can then generate further multiple impacts locally during their operation. The innovation is a true catalysator for such mechanism leading to increased business and R&D performance.

That is the real essence of creating innovation ecosystems in a given region resulting in competitive environment for industrial, research, university players. Innovation ecosystems are also suitable drivers for cooperation and contribute to giving adequate answers to the technology challenges.

LITERATURE OVERVIEW

The term ecosystem usually refers to a group of interacting businesses that depend on each other's activities. The various researchers have highlighted different aspects of the ecosystem depending on the respective purpose of the research. There overview of Jacobides et al. (2019) provides a detailed discussion of classification of ecosystems into categories business ecosystem, innovation ecosystem or platform ecosystem. The classification of Katri (2015) is also in line with this, as mentioning business, innovation and knowledge ecosystems. The purpose of the current paper is outlining a basic method for assessing park-type environments, therefore the mainly focus here is business and innovation parks.

A business ecosystem usually focuses on market-based companies, with the aim of providing a competitive environment for the actors. Following the analysis of Teece (2007), this type of ecosystem can be considered as a community of organizations and institutions, having impact on the operation of enterprises, their customers and their infrastructure. This ecosystem type can be seen as a community of interacting economic actors. The players can influence each other through their activities, even beyond a single industry. Moore (1996) argues that the business ecosystem can be defined as a kind of economic community built on interacting organizations. So, the potential of cooperation also arises in these ecosystems, but usually in a customer-supplier relationship. In this respect, the ecosystem might function as an internal market, which can be taken into account in subsequent detailed interpretations of business performance. Some authors such as Iansiti and Levien (2004) have emphasized the role of business ecosystems as hubs for sustainable business development. In these ecosystems, the performance of each member is related to the overall performance of the ecosystem. The business ecosystem offers an environment that firms need to utilize and that affects the dynamic capabilities of the firms and thus their ability to gain a sustainable competitive advantage. Several authors also mention aspects related to knowledge and innovation in the case of business parks, too. Dhanaraj and Parkhe (2006) argue that business ecosystems have an impact on knowledge

mobility, innovation growth, and the importance of collaborations.

The innovation ecosystem focuses innovation and the structures that support it. The extent to which firms cooperate with each other through different agreements affects the ability to jointly create value for their customers (Adner, 2017). Thus, in innovation ecosystems, independent or interdependent actors interact to create and market innovations that benefit the end user. If the management coordination within the ecosystem is inadequate, then innovations will not be successful, this research topic that has been investigated by several authors (e.g., Adner, 2012; Kapoor & Lee, 2013). The goal of this ecosystem concept is to capture the value relationship between each product, its components and ancillary services. Building on this, the innovation ecosystem can add value to its actors. The innovation generator can also be an actor or a knowledge capital, technological base, network of contacts accumulating in the ecosystem. The actors that generate focus innovation can also be independent and act only as a catalyst in the ecosystem (Brandenburger & Nalebuff (1996). Thus, the issue of locally accumulated knowledge emerges in the case of innovation ecosystems, see, e.g., Alexy et al, 2013; Frankort, 2013). Although the scope of the current paper focuses only on aggregated performance indicator assessment of park-type ecosystems, it is important to mention that further discussions in knowledge aspect of innovation ecosystems is an integral part of judging the ecosystem development capability.

What distinguishes real ecosystems from market-based agreements is that they include producers or service providers who are linked by certain interdependencies. In this sense, ecosystems are different from networks. Powell (2003) examined in detail the networks of standardized formal or informal associations among participants. Ecosystems are made unique by the interdependence of actors tends to standardize, creating a need for new skills within ecosystems (Helfat & Raubitschek, 2017). According to Heikkilä & Kuivaniemi (2012), in connection to the ecosystem concept, the diversity and intensity of actors represents the real difference between the concept of classic business networks and the concept of ecosystems. As Moore (1993) pointed it out, the core business layer of a business ecosystem consists of the parties as a whole that makes up the business: the actors in the business network, such as suppliers, a (potential) central firm, distributors, and customers. Ideally, these actors are concentrated and collaborate in a determined geographical area.

Industrial parks are often mentioned in connection with the concept of business or innovation ecosystems. Numerous studies have examined the mechanisms by which geographically concentrated organizations can benefit from localized operation and thus and their collaboration (Claryssen et al., 2014; Coughlan, 2014). In this way, classical industrial park structures can lead to a knowledge ecosystem, where the main result of which is new knowledge as a multiplied market potential (Quin et al., 1998). The innovation ecosystem approach also emphasizes fostering growth, interaction, and the creation of innovative startups around the so-called

knowledge hubs, or park catalysts (Engel & del Palacio, 2011). There is no clear scientific consensus on the definition of success in measuring the success of an industrial or innovation park. Some authors use financial criteria (investment, turnover, etc.), while others use indicators related to innovation performance (number of start-ups, number of patents, number of new products, etc.). Actors directly involved in ecosystem initiatives often develop their own definition of measurement. There is a belief that physical presence between actors is sufficient to achieve ecosystem goals. Most authors mention that the factors examined can be related to two specific indicators: the number of established companies and their headcount. Although regional development is one of the innovation ecosystems, their contribution to it is often unclear or difficult to measure. However, it can be said that each park has a different impact. The economic structure of the region, the internal organization of the park and the links with local organizations, including local and regional government, universities and other research institutes, all must be taken into account. Several studies (e.g., Vila & Pages, 2008, Katri, 2015) emphasize the importance of driving forces, like innovative and dynamic companies that attract other companies around them.

Performance measures at scientific and research ecosystems is more widely researched. Although these types of ecosystems are usually created for sake of higher innovation and technology outcome, still, there are researches challenging their ecosystem performance (Massey et al., 1992). Nevertheless, conclusions of related authors also can be considered in connection to the topic of the current paper. Westhead and Storey (1995) found that the chances of a firm for survival in a competitive environment are higher when the firm is affiliated with a university, so they argue that the role of innovation ecosystems may prove critical for high-tech small businesses. Castells and Hall (1994) list three main motivations for creating parks: reindustrialization, regional development and creating synergies. According to Storey and Tether (1998), the role of innovation ecosystems and parks is to enable local knowledge bases to commercialize their research ideas. Gower and Harris (1996) concluded that science parks and innovation ecosystems are not only another form of real estate development, but some of their characteristics distinguish them from general real estate development. One of the key differentiating factor is to provide facilities and services that make the link between industry and academia. Vedovello (1997) examines the relationships between a local university and firms in a research park. Although he did not observe a high density in formal relationships between the university and industry, informal contacts were found as dominant factor. Phillimore (1999) examined firms in a technology park, and his findings supported the view that not only synergies between the university and firms in the science park foster innovation, but also synergies between firms. Lee and Yang (2000) evaluated the performance of a park and concluded that the success of the industrial development model it represented can be attributed to human resources.

Based on the shown references above, it can be seen that measurement of innovation ecosystems is still subject of wide range of researches. Therefore, the authors make attempt to use basic financial and operation data of players and interpret the results on strategic level.

RESEARCH METHOD

With regard to innovation ecosystems, the question arises as to the performance and business effectiveness of the players, industrial actors and research institutes and other organizations operating within the framework of the ecosystem. An innovation ecosystem might have different structures, as shown by a wide range of previous and ongoing researches explained above. The paper is based on a survey made in Hungary, where the range of higher-level innovation ecosystems is relatively limited, but innovation ecosystems concept can be derived from industrial parks, incubators and some Science Park initiatives. These three groups of ecosystems are the subject of the current research. Although all of them have different operating models and structures but still carry certain theoretical characteristics of innovation ecosystems in practice, making feasible the final conclusions.

During the research, 16 locations were selected, the specificities of which were examined on the basis of the publicly available business report of their individual actors (a total of 756 organizations). The principle of selection of the examined ecosystems was taking into account the theoretical feature of ecosystems that those involve more actors being concentrated in a physical location under similar operating condition. The selection was made in a representative way, some examined ecosystems have been in operation for several decades, as well as involving those who started their activities a few years ago.

Data have been collected on business activities of players of the innovation ecosystems using reports of financial years 2017-2018-2019:

- the average rate of increase in revenue through the years,
- the average rate of profit growth through the years,
- the average rate of total number of employees through the years.

The average rate of increase in revenue was calculated as follows. Total sum of revenue value was calculated on ecosystem level, adding results of all players. The change in percentage was calculated in 2017-2018 years, then the same in 2018-2019 years, finally aggregating them into total average value. This high-level indicator suggests of how the turnover of organizations in general developed during their operation in an industrial park, science park or incubator. Ideally, sales will continue to grow, but there may be other trends. Calculations related to the average rate of profit growth were made in a similar way. This indicator gives a perception on business efficiency of the players in general. If there is a higher level of growth in profit, the question arises as to what percentage of the profit the owner considers to reinvest and as such, establishes further development on the park. The

calculation is also the same of headcount data. In this case, however, the trend might have more interpretation whether higher human added value or higher technology-based added value is preferred.

The end point of the research methodology is, as the main issue of the present study: what are the typical patterns that can be observed in terms of turnover, profit or loss and headcount for entities operating in an innovation ecosystem. On the basis of the foregoing, this paper concerns answering of the following research questions; without being exhaustive, in particular with a view to establishing further research on the subject:

- what is the business attractivity of a given ecosystem, in view what extent do performance indicators increase or decrease?
- what are the typical patterns that can be observed in the innovation ecosystem from business perspective?
- how can the aggregated average indicators used to evaluate the innovation ecosystem?

RESULTS

The data processed are presented in a scatter diagram, where the horizontal axis shows the examined ecosystems. The vertical axis shows the scatter of the given indicator characteristics of actors within the ecosystems as a result of statistical processing. Each data block shows the minimum and maximum values, the lower and upper quartiles and the median value. Each ecosystem is sorted according to the median value of the characteristic examined. The charts of the three generated indicators (average revenue change, average profit change and average change in employment), are shown in Fig.1., Fig.2. and Fig.3.

Figure 1. shows the multi-faceted scattering in characteristics of the examined industrial parks and other ecosystems. There are some places prosperous in terms of revenue growth where the rate of revenue growth is typically above zero, while there are also explicitly shrinking trends in sales. The degree of deviation also differs; from extremely low deviation to wide scattering (up to 200%).

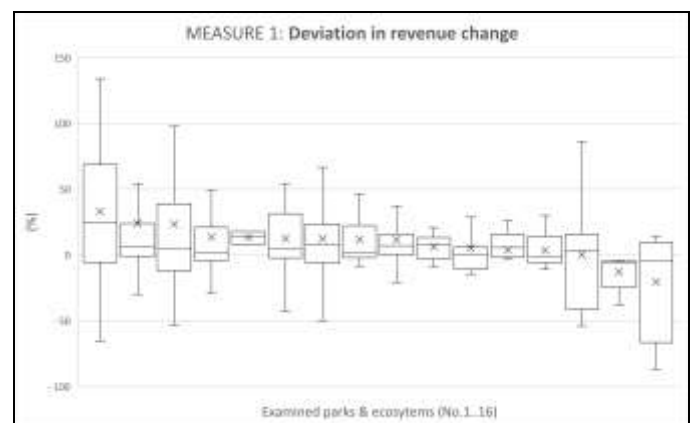


Figure 1. Average values of revenue change

In comparison to the change in turnover, the situation of the change in profit shown in Figure 2. is even less consolidated in terms of values, as there are also significant variations. The feature of scattering is also widely observed, from the rather growing pattern to the mostly decreasing pattern. Similarly, the degree of deviation varies significantly, from very narrow scattering to levels ranging from -200% to +300%.

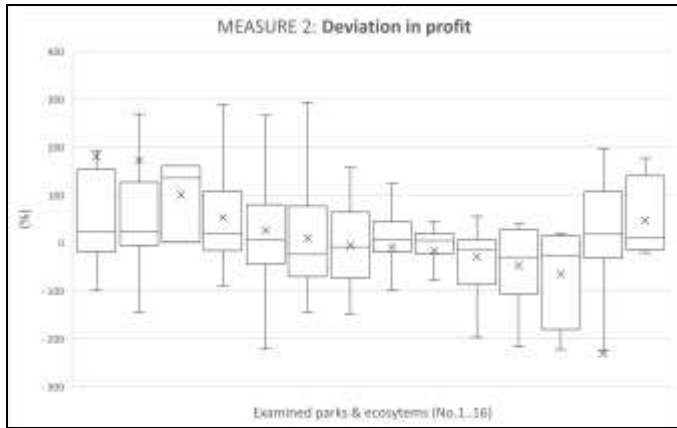


Figure 2. Average values of profit change

Figure 3. shows the degree of change in employment, although there can be seen only a scattering between -30% and +50% in terms of values. Wide range of variation is apparent from those ones more negative, up to the ones in a positive range. The rate of deviation also varies, from the smaller, a few percent, to the spread of up to 60%.

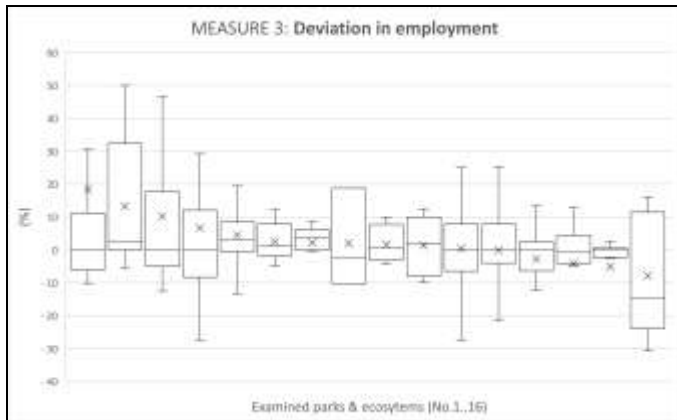


Figure 3. Average values of employee number change

DISCUSSION AND SUMMARY

The question is whether the performance measure pattern of the examined ecosystem are similar. Looking at this aspect,

it can be stated that the answer is clearly no, as there are many different alignments in the light of the three evaluated characteristics. Consequently, the pattern of the three measures differs case by case, end even, the examined statistical values of them vary wide range.

On the basis of the study, it can be concluded that the typical set of the performance measures may be a characteristic of the given ecosystem. Therefore it is necessary to analyze not purely the specific measures alone, and even not the ranking based on them, but also the combination of all the three characteristics. In other words, the same or different trend of the changes of all the three parameters examined (turnover, profit, employment as measures of innovation ecosystem) gives a more realistic picture. Accordingly, based on the trends of the characteristic measures, different patterns suggesting the success of the ecosystem is possible to identify. Looking at the examined ecosystems from this point of view, Table 1 shows the trend summary of the three measures. This one is a simplified approach, indicating only positive or negative trends based on median value. Note, that the sequence of ecosystems in the table and that in the figures differs. The parks in the table were grouped for sake of better overview to see typical clusters.

Table 1. Summary of the results: trends of the three measures

Examined park, ecosystem	Trend of the measure		
	Revenue	Profit	Employment
1	+	+	+
2	+	+	+
3	+	+	+
4	+	+	+
5	+	+	+
6	+	+	+
7	+	-	+
8	+	-	+
9	+	-	+
10	+	-	+
11	+	-	-
12	+	+	-
13	+	+	-
14	+	+	-
15	-	+	-
16	-	-	+

Based on the data interpretation, the examined ecosystems were grouped into three categories as shown in Fig. 4., Fig. 5 and Fig. 6. Two parks have been eliminated from these charts, one due to the extreme good (start-up), the other one as extreme negative results.

Pattern ‘+++’: The case of classic growth where turnover, profit and employment increase together. This is the ideal growth path which is rare, but six of the ecosystems examined show trends like this as shown in Figure 4.

Pattern ‘++-’: The case where profit is sacrificed for certain purpose. The increase in turnover and employment is seen increasing in four of the ecosystems, and in one case the reduction in headcount is minimal, so included it in this group as shown in Figure 5.

Pattern ‘+-+’: The case where business results increase without increasing headcount, for example, indicating a classic operation or growth efficiency trend as shown in Figure 6.

Figure 6. Efficiency-oriented patterns of measures

CONCLUSIONS

As final conclusions of the paper and the essence of the presented survey, the three basic performance characteristics can be well used to describe the various innovation ecosystem performance level and nature. Through this classification, the possible theoretical combinations of trends of measures can be identified, see Table 2. The table also contains those combinations which have not been found during the above explained survey. The patterns identified this way, might be in line with the success of an ecosystem, while each different patterns result in different characteristics in park dynamic. This correlation can be the subject of further discussions and researches.

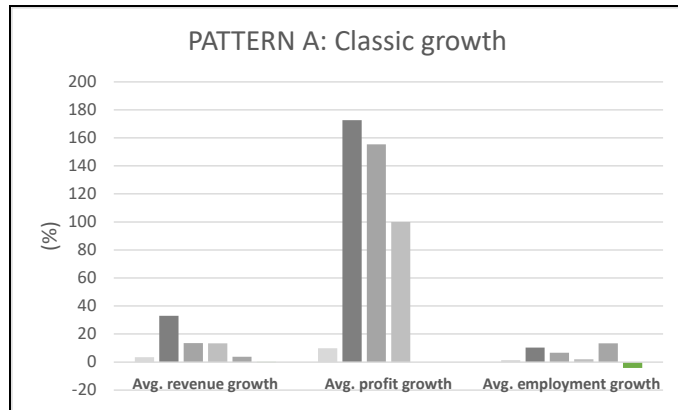


Figure 4. Growth-oriented patterns of measures

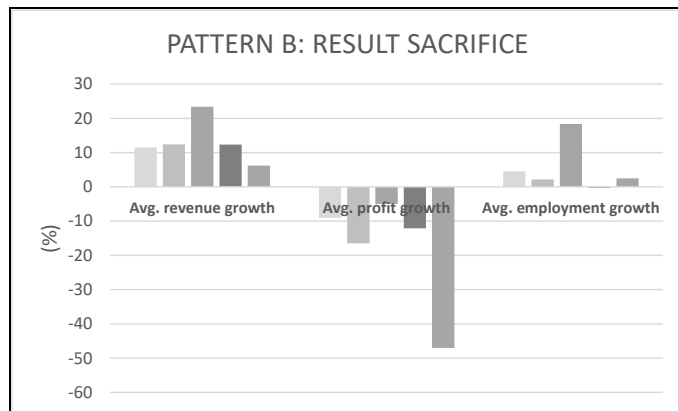


Figure 5. Profit-sacrificed patterns of measures

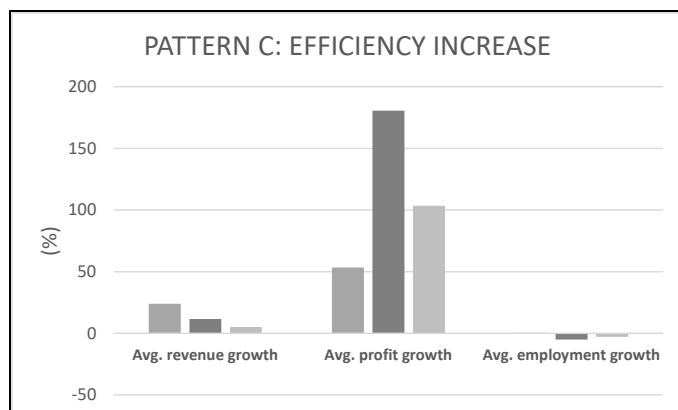


Table 2. Typical patterns of trends of measures

Identified patterns	Aggregated average growth in revenue	Aggregated average growth in profit	Aggregated average growth in employment
BASIC PATTERNS			
Classic growth	+	+	+
Results sacrifice	+	-	+
Efficiency increase	+	+	-
POTENTIAL FOR TURNAROUND			
Revenue potential	+	-	-
Result and employee potential	-	+	+
Result potential	-	+	-
UNHEALTHY BUSINESS PERSPECTIVE			
Business lose	-	-	+
All lose pattern	-	-	-

This approach can be used for evaluation of innovation ecosystems. There is an assumption that the pattern is in line with the ecosystem development dynamic, but it needs further researches. Through this, a better understanding is possible on the development path of innovation ecosystems through their historical cycle. The external impacts like competition and changes in technology also firmly influences the appropriate ecosystem strategy. The strategic business perspective of the specific patterns can contribute to the balanced management of innovation ecosystems in long term as summarized in Fig. 7.

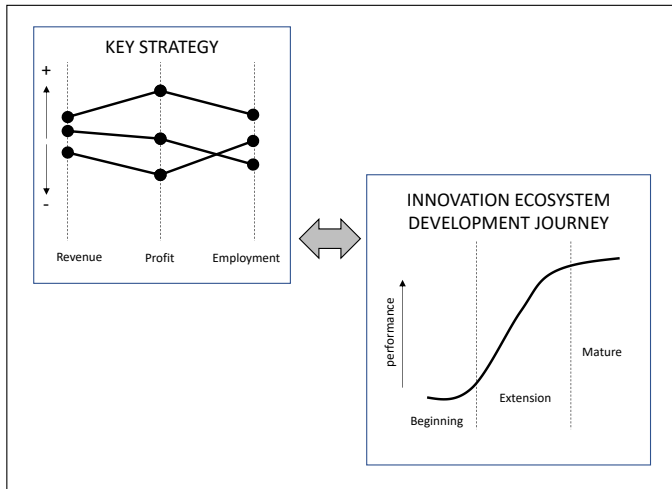




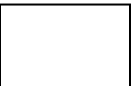

Figure 7. Balanced business perspective for innovation ecosystems

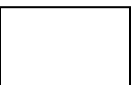
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