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Indicators and research metodology of the process innovation

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1. INTRODUCTION

As only that subject can be analyzed, which is measured, therefore the measurement is substantial from research point of view, especially on the field of innovation, because of its state-of-the-art nature. The question of innovation measurement is discussed within the literature from Schumpeter's often quoted publication's date, 1912, but the economic environment and the technical developments had been changed in the last more than 100 years. In the light of the above mentioned, I made my literature review based on the last 10 years English language publications, considering the obsolesce of the scientific results. It is assumed, that the collection of the indicators and applied research methods from the previous studies might contribute to further theories in the field of economics and business economics too. In this article, I use the current, international organizations used understanding, and argue that the further theories are based on the original one. According to the Oslo Manual, the types of the innovation are the following: product innovation, process innovation, organizational innovation and marketing innovation (OECD, 2005). As from my scientific interest is related to the process innovation, this one is aimed to extract, however these for can not be separated from each other sharply. There are several institutions had been created for innovation research, the most relevant to this paper are the following: The innovation research method, statistic data collection and analysis of the EUROSTAT is governed by the related EU regulation, this makes the collected data transparent and comparable. The Community Innovation Survey (CIS) collects periodic data within the EU, The European Innovation Scorecard is, where the EU results are compared to global context. The INNO-Policy Trend chart, which is an independent institution, focusing on the EU member states' innovation performance. Last but not the least; the Mannheim Innovation Panel (ZEW) is collecting data on one of the strongest economies of the EU, the German one, since 1993.

In order to use the common definition, I regard the process itself as activity, which covers the performing of given tasks, framed by time and space, having start and end point; assigned with inputs and outputs, as it is agreed within the literature (Davenport, 1993; Papinniemi, 1999) On the other hand, the understanding of the process innovation measurement is important from comparison point of view. For example, the results of this article are going to be used for the analysis of the performance of Hungarian beer manufacturers, but having their data and the described method, the data collection and analysis can be performed within the neighboring countries with similar economical conditions.

2. INDICATORS

The applied indicators are depending on the hypothesizes of the research and the data collection, they are presented as follows from different aspects.

Resource-based indicators are playing important role from the statistic data collection and data availability point of view. As example, I would mention the ratio of the BSc degree owners within the segment of the Hungarian whole population in the age between 18 and 64 years. In this paper, the economy and business economy shall be regarded as same from indicator point of view, for example, the employee of a company is the member of the Hungarian population.

Input-based indicators (or so called short term indicators) are those, which contributing to the realization of the innovation process, for example, the financial expenses (in the same currency, eg. USD or EUR), in order to make the performance of different countries comparable.

As illustration of the above, for example:

- GERD, which means Gross Domestic Expenditure on R&D
- BERD, which means Business Expenditure on R&D
- GOVERD, which means Governmental Expenditure on R&D

I would like to note, that from the above, only the GOVERD indicator can be regarded unconditionally valid, the companies are not obliged to share this kind of data in their full understanding and because of global financial reasons, the reported amount in a given country can influence another business unit's performance in another country.

Process-focused indicators (considering their duration, so called mid-term indicators) are describing the whole innovation process, including its duration, resources, etc.

For example:

- number of patents (PC)
- amount of investment into development project (EUR)
- return on investment from new offers (EUR)
- rate between investment projects (%)
- planned and realized performance (%)
- average duration of the project development (days)

However, it is interesting that the indicators are depending from the data source, for example the above written "rate between investment projects": it can be the return rate, the rate of amount of investment and can also be the rate of complexity. Process focal points are applied, when the whole process is under investigation, not only part of it. From Total Cost of Ownership analysis point of view, the change in one factor might result to decrease/increase of an other one.

Output-focus indicators (or so called long term indicators) are able to present the end of a given project, make the conclusion, whether had the project reach its planned goal or not.

For example:

- number of innovations per 1000 employees (pc/1000)
- profitability (cost/profit, EUR)
- customer satisfaction (%)
- market enter time (day)
- idea generation (day)

Applying the above indicators, the performance of companies, industries and regions can be compared because of the transparent data from a general source.

Completing the above collection, we can declare, that beside of the above three indicators, categorization can happen on static or dynamic point of view, which means that the measurement might related to a fix time or a given period.

In global context, some of the indicators can not be applied because of the different environment of data collection; therefore complex indicators shall be applied in order to take more factors into consideration.

For example

- Global Competitiveness Index,
- Summary Innovation Index
- Talent Index
- Innovation output indicator (IOI)(EB, 2014).

To summarise, it can be said that depending of the focal point of the research, there are various indicators can be applied. Considering the creation of a complex indicator, we shall be aware that the different source of data (with different unit of measure, different scaling and different data gathering periods) might vary, therefore they shall be synchronized before.

3. RESEARCH METHODS IN THE LITERATURE

Considering the international literature's relevant publications, I hereby summarize the engineering and economic researchers' papers in ascending order, which means that the oldest one is the first and the latest at the end.

1. table: Summary on the important publications in process innovation

Researcher	Methodology	Year of publication	Research area
Hipp – Grupp	Number of applications of trademarks	2005	Engineering
Li, Liu – Ren	Structural equation model	2007	Engineering
Luo – Chang	Visualized process analysis	2013	Engineering
Becker – Egger	Conditional mean-independence	2013	Economics
Nelson et. al.	index terms and domain expert assessment	2014	Economics
Lim – Suh	Visualized process development cycles	2015	Engineering
Kim et al.	Input-output analysis	2015	Economics
Ibert – Müller	Horizontal process analysis	2015	Economics
Hullova et al.	Complementarity-capabilitymatrix	2016	Economics
Li – Ni	Dynamic control model	2016	Economics
Knight et. al.	Table on System and individual level barriers and enablers	2016	Economics
Córcoles et al.	Discrete-Time Duration Analysis	2016	Economics
Janger et. al.	Create composite indicator	2017	Economics

Source: own creation

Reviewing the above, we can make a conclusion as the researchers used to apply the following methods:

- visualization
- their own models
- complex analyses
- indicators

There isn't a significant difference between the engineering and economics researches, only the subject of the research shall define the applied method, and –obviously- the available data.

My professional point of view is, that the better understanding of processes (and their analyses and development) can be done with process visualization, therefore it creates the opportunity to make visible the differences, combined with the fix time related numeric indicators.

The depth of the innovation (regardless it is incremental or radical) researchers used to understand on different ways, so they apply in multiple formats in the literature: one group of researchers are considering the incremental process innovations as process development, another group argues as the process innovation is simply the application of external innovation processes internally. (Reichstein and Salter, 2006; Pilav-Velic – Marjanovic, 2016)

The similar debate can be observed at the tool of visualization: the value chain analysis makes the structural understanding reasonable at some cases, but in other papers, publishers are using this only as illustration. As it can be highlighted from the table 1, the tools of process development can be applied in process innovation too. For example, the fishbone-analysis (or so called Ishikawa analysis) focusing on the 4Ms (man, method, material and machine) as method for cause and effect analysis. The continuous development's round also can be an option, its self-closing line symbolize the steps each after and the never ending development.

4. APPLICATION WITHIN THE INDUSTRY SECTOR

There are several researches in the literature regarding to the Low Technological Intensity manufacturing industries as beer industry or paper industry's processes and products, since 1990. (Hansen – Serin 1997; Jacobson – Staffan 2005; Tunzelmann – Acha 2006; Hirsch-Kreinsen 2015; Kirner, Kinkel – Jaeger 2009; Robertson – Smith, 2008, Heidenreich, 2009). Generally, it can be observed that the researchers are agreed on that the increased innovational performance not used to be achieved by firms individually, but in strong cooperation within the supply chain, independently from the industry. (Soosay et al., 2008; Nieto – Santamaría, 2007; Kibbelling et al., 2013). It is interesting to see, that among the SMEs (small and medium enterprises), the innovation sometimes is based on a specific colleague, who plays crucial role in the innovation process, sometimes with the result with „naked feet" innovation. (Naked fee innovation had been applied in the literature to those innovations, where the environment does not focus on innovation, but the external factors make the innovation some kind of must, the invented product/process shall replace an expensive, alternative solution.)

5. CONNECTION BETWEEN THE PROCESS AND PRODUCT INNOVATION

As the conclusion of the reviewed paper, I was able to realize three different understanding of the connection between the two types of innovation.

Some researchers (pl. Kurkkio et al. (2011), Novotny – Laestadius (2014)) considering the product innovation as starter point to the process innovation, so in the line of the elements, creation of the product shall be prior than the new product, because the new process is needed because of change in the product.

The logic behind of these understandings is that the sales of the products results different margins, therefore the sales of a more lucrative product shall be prioritized in front of sustain a less lucrative one.

As opposite, there are theories, where the product innovation shall start at process innovation (Martínez-Ros (2000), Lager (2002), Lim et al. (2006) Martínez-Ros – Labeaga (2009)), because the change in the environment shall influence the inputs to the process, so the newly created product must be the result of a process innovation.

The third way is the ignorance of the insignificant connection between the types (Damanpour, 2010), Van de Ven et al. (2013), (Pisano and Shih, 2012), (Battisti – Stoneman, 2010), Evangelista – Vezzani (2010)) because of their low correlation. Some of the studies showed that there is no significant correlation, both of the innovations can be understood and applied alone, as a single one.

My personal opinion is, that the innovation's five types (based on the Schumpeterian theory) shall be harmonized with each other, in order to contribute the organizational (and financial) corporation targets. Bonnano – Hawort's (1998) experience showed that the types not obviously shall be separated, they can be applied in the same time, based on the firms' management's decision, supposing, that their decisions are reflecting to the market processes.

Utterback (1996), and later Pisano (1997) and Lager (2000) had showed that the simultaneous innovation types are part of the normal operation of the market players.

At the same time, we shall take it into consideration, that in case of monopoly market, the support of two parallel innovations might lead to the cannibalization within the product portfolio. (Lambertini – Mantovani, 2009).

6. PROCESS INNOVATION WITHIN LOGISTIC PROCESSES

The topicality of the process innovation is supported by the fact that more global researcher team are working on it, in the following, I'll categorize the process innovations by logistic sub-functions, as they are generally part of an organization.

Procurement: the „KIBS" (Knowledge Intensive Business Services) are playing crucial role in our today's procurement, because they make the unit able to let the whole company prepare to the new business processes and to create new categories to the strategic and operational procurement.

Distribution, inventory management and warehousing: raw material-based warehousing concepts (Rojas és Leiva, 2016), especially int he FMCG industry.

Transportation (applying the results of the technological innovation): low or zero CO emission processes, and regarding to its management, we can see that the reverse logistics and shared-economy will have deeper influence on the existing processes. (Jianxiong, Z. R. D., 2017)

Order management: big data creation, analysis and sharing between the members of the whole supply chain, in order to reduce the bullwhip-effect. (Manders, Caniëls, Ghijsen, 2016)

ICT background of the above: new, cloud based solutions will be more and more popular among the SCM processes, which are in line with the Industry 4.0 processes, parallel, the reduced number of capex spending (a.k.a. investments) will contribute to the better cash flow. (Maruyama – Zennyo, 2017)

It is worth to mention that the process innovation used to be examined among the high technological industries, but the medium or low intensity industries are often out of scope. (Robertson – Tunzelman, 2008), but Heidenreich's (2009) research shows that the innovation is available at the SMEs at all type except product.

7. CONCLUSIONS

The aim of the paper was to contribute to the better and up-to-date understanding of the process innovation indicators and its research methods as a literature based secondary research, based on international publications.

Listing the existing, broad and international bodies' (as UN, EU, etc) researches and the types of indications might help to analyze the above mentioned organizations' reports and the related publications.

The table summarized previous researches show the difference between the engineering and economical point of view, despite of the subject of the analyses shall be the same. This difference can let the researchers understand the common points in order to create interdisciplinary research groups on the field of process innovation.

The managerial application of the results shows the validity of the research topic and makes the consequences able to make the managers' decision making process more accurate.

As my research topic is the process innovation within the Hungarian beer manufacturers' supply chain, this paper shall contribute to my dissertation's theoretical part also.

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