

## MEASUREMENT AND EVALUATION OF INNOVATION

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### Abstract

Innovation is considered as a key prerequisite which drives companies to prosperity. Notwithstanding the fact that innovation is of key importance for the company companies often fail to recognize actual benefit of innovation. Evaluation of innovation benefits proceeds often intuitively without any rationale background. This was the impetus for University of Economics in Prague to tackle this issue and launch a project which is aimed at development of a system to be applicable for innovation benefits measurement. Project team performed a quantitative research among Czech Top 100 companies to examine current status of implementation of innovation measurement system. Based on this research methodology for both innovation measurement and company innovation potential was set up. Key output of this research was determination of complex company innovation index. Methodology in question was qualified by Ministry of industry experts to be adopted as an unbiased testing method for the measurement of innovation status of Czech companies. General innovation index was then considered key indicator to enable comparison innovation effectiveness measurement in Czech companies.

**Key words:** innovation effectiveness measurement, methodology, innovation index

**JEL Code:** O30, O31, O32

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### Introduction

Primary goal of the research is the development of innovation assessment methodology with preferred focus on innovation effectiveness measurement in business sector. This primary goal is combined with a secondary goal that consists in methodology modification or its extension to be applicable for innovation assessment in non-profit sector.

Innovation is an underlying factor of a modern entrepreneurship as well as one of key generators of company value (Kim et al., 2015, Kelm et al., 1995). In addition innovation or company capability to innovate represent key success factors based on which the company builds competitive advantage (Jřinová, K. et al., 2014, Smith et al., 2014). Companies to be successful in the market in the long run need to look for areas which enable them to win competitive advantage. Such a competitive advantage may consists in better economic

effectiveness, differentiation of own products from competitor's ones or eventually in focusing on specific product or customer segments. In this regard we speak about "*prosperity factors*" whose successful building and development is the basis for competitive advantage creation (Veber, 2009, Love et al., 2015). According to their characteristics these prosperity factors might be either *internal* to be manageable by the company or *external* which are beyond the scope the company's management. Internal prosperity factors might be either *hard* (clearly articulated and measurable) or *soft* (to be expressed and measured with difficulties only). Internal factors of prosperity can be developed especially through innovation. As a matter of principle innovation cannot be cut down on product innovation only but it is necessary to take also into consideration other types of innovation like process, organizational and marketing innovation. Very often the reinforcement of competitive position is based on the combination of all types of innovation. Innovation, its generation, adoption and implementation is a topic for whole company. That's why the responsibility for innovation process cannot be assigned to some part of a company let alone company department (e.g. R&D). Despite cogent value added to be generated by innovation there is paradoxical unwillingness for the companies to challenge risks to be combined with the innovation process. Companies do not have to deal exclusively with the risk of irreversibly invested funds only but also with the loss of customers' confidence who are disappointed by unrealized or squandered innovation. On top of that company management must reckon with the frustration of company employees who are aware of material and emotional impacts on both company and its employees as a consequence of innovation process failure. High quality management of innovation processes requires exact measurement of its effects so that the results of this measurement could be used either for possible correction of currently solved innovation project or for lessons learned to be applied to upcoming innovation projects.

Problematics explored deals specifically with methodology of innovation measurement. Measurement of innovation effectiveness and innovation benefits is not approached unanimously and measurement of innovation benefits is considerably subjective. Far more complicated situation is in non-profit sector. In this sector econometric approaches are quite subdued and measurement of innovation effects is mainly intuitive. Companies in some extent cope with the assessment and quantification of incremental innovation (especially product innovation) where revenues and expenditures associated with specific innovation are quite exactly quantifiable. More difficult situation comes into existence when additional non-financial benefits are due to be assessed. Among these benefits reinforcement of technological know-how, enrichment of company knowledge base, improvement of competence profiles of

dedicated employees, creation and retention of pro-innovative corporate culture and the development and perfection of key persons (idea champions, project sponsors and leaders) can be ranked. There is a strongly supported opinion that the evaluation of opportunities plays significant role as well (Baron & Tang, 2011). Some gap can be also identified in the assessment of innovation synergies where benefits to be generated by independent innovations are multiplied and result in synergic effects which enhance shareholders' value.

## **1. Scientific work methodology**

Methodology of scientific work comes out of thorough literature research which was aimed at monitoring methods to be used for innovation assessment in abroad. Literature search maps innovation measurement problematic as it was developed and addressed by individual authorities over past five years. Based on this research all existing approaches were critically assessed and compared to reveal both their common features and differences. The next step was qualitative research to be conducted by in-depth interviews with innovation experts and specialists in this problematic. Responded group covered both Czech a foreign experts coming from profit and non-profit sectors. Consequently questionnaire research was performed across group of companies to be consolidated under umbrella Czech Top 100<sup>1</sup> so that the feedback from the most reputable Czech companies would be obtained (Czech Top 100, 2014). For the facilitation of data and information collection the platform of international conference IMACS (Innovation Management and Corporate Sustainability) was used (IMACS, 2015). Information obtained were complemented on by practical findings and experience of individual researchers which were obtained either in direct or indirect engagement in profit or non-profit organizations. Information obtained were processed into structured methodology of innovation assessment which was commented by Czech and foreign experts.

## **2. Innovation measurement approaches in current management practice**

In general, literature research which was conducted confirmed that this problematic of innovation measurement was reflected by companies or management authorities (Evans, 2013; Moreno et al., 2014; Wang et al., 2014). On the other hand no comprehensive and structured methodologies which would be universally applicable at least in separate profit and non-profit organizations have not been addressed and validated so far. Apart from this there

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<sup>1</sup> CZECH TOP 100 Association has been monitoring companies in Czech Republic since 1994. Base on objective criteria and collaboration with foremost experts the Association creates and posts ranking of 100 the most important companies in Czech Republic.

exist procedures which concern the assessment of innovation potential either in respective countries (Foray & Hollanders, 2015) or in EU as a whole (European Innovation Scoreboard, 2015). In general these indicators helped reveal what is at the bottom of country capability to keep on sustainable competitive edge. In addition there are indicators which indirectly measure the effectiveness of innovation, e.g. through the analysis of a product life cycle (Luz et al., 2015).

Pitra (2006, p. 295) deals with innovation measurement preferably from the point of view of financial gains even though some of his considerations concern non-financial criteria. He places emphasis preferably on hard metrics of innovation measurement like return on investment of innovation projects, organization earnings power, impact of innovation on company financial health, return on capital employed, financial effects evaluation (e.g. increase in working capital turnover) etc. Some of his arguments might be questioned like the prerequisite for immediate profitability of the investment when it is put on the market. The author applies certain approaches to be known from *Value Stream Mapping* concept where he examines total cycle time so as to maximize *Manufacturing Cycle Efficiency* (MCE). For the measurement of innovation Balanced Scorecard method is also applicable. This method draws attention not only to financial aspects but also to internal processes, learning and growth potential and marketing aspects. The author also emphasizes the need for the implementation of risk measurement system. Risks to be combined with innovation should be identified, analysed and measured so that appropriate risk mitigation provision could be chosen and implemented. Viewing innovation from the point of view of benefits without involvement of risks is insufficient for complex innovation assessment since benefits and risks must be properly balanced. To get at the roots of profit-destroying complexity, companies need to identify their innovation fulcrum which means the point at which the level of product innovation maximizes both revenues and profits (Gottfredson & Aspinall, 2005). Organization should keep on maintaining this balance point in the long run. Tools which help maintain this balance point are modularity of technical solution, profitability of new products must be higher than previous ones etc. Tidd et al. (2007, p. 511) define the basic requirements of the success of innovation in its anchoring in corporate strategy, functional external and internal links, supportive mechanisms enabling the implementation of changes and supportive organizational environment. He places emphasis on effective mechanism of innovation implementation and organizational environment which supports innovation (creativity, idea generation, problems solving). As possible metrics of the effectiveness of innovation process he alternatively suggests number of patents, number of scientific papers published, number of

newly launched products, share of sales from newly launched products on total company sales, product costs, market share, product quality etc. Relevant information can be also obtained from the inputs into innovation process like percentage of sales to be reinvested into R&D, investment into training and recruitment of new employees etc. Some soft metrics like customer satisfaction measurement also play a key role and shouldn't be omitted. The author also termed some parameters as strategic success indicators among which he ranks either the growth of the sales or market share as well as increased profitability or value added. In addition there may exist specifically constructed metrics like:

- number of new ideas ( in the sense of product or process innovation) to be generated at the beginning of innovation process,
- the extent of a failure to be recorded within a framework of development and commercial utilization of innovation (negative metric),
- number or percentage of development time or budget exceeding,
- the output from the measurement of customer satisfaction with innovation,
- innovation development time in comparison with business branch standards,
- number of man-days in relation to one completed innovation,
- average innovation implementation time,
- measures of continuous improvement like number of innovation ideas per employee, number of teams to be in charge of problems solution, savings per employee, cumulative savings etc.

In addition to these metrics it is possible to assess innovation by means of soft elements of management like creative company environment or the scope in which corporate strategy is communicated to employees. Another factor which is usually conditional for the success of innovation project is carrying out high quality audit of innovation solution. Based on properly formulated control criteria it is possible to define the list of checking factors which can be assigned point scoring. Such criteria should encompass following questions: Does the company elaborate clearly shaped innovation strategy? Does the company have an access to sources which are inevitable for the completion of innovation? Does the company have flexible external links to be necessary for utilization of innovation at disposal? Does the company create appropriate pro-innovation environment? Specific attention is devoted to the measurement of service innovation which can be assessed as per five components like strategy, process, organization, tools/technologies and systems. These factors map the organization in its entirety specifically its orientation on objectives, activities coordination,

ability to transform inputs into outputs, system integration into functional entities etc. Each of these parameters is assigned point scoring. Results are plotted to so call radar chart. Based on comparison with competitors or branch standards it is possible to identify strengths and weaknesses of the organization. Results to be deduced from this approach were tested and verified on the sample of more than 100 English and American companies.

Davila et al. (2009, s. 145) offer systemic approach to innovation. He regards measurement of innovation as critical success factor (CSF) of the whole innovation. He also warns against using excessive number of mostly incoherent metrics which doesn't lead to expected results. He speaks for such a number of metrics to fit in with the extent of one page. On top of that he formulates several management practices to be applied upon development of assessment model: It deals typically with following rules:

- selection of what we want to measure (what is measured also exists),
- understanding business model of an organization and the adaptation of the system of measurement to this business model,
- awareness of what we want to measure on a discreet levels of an organization; in this respect we have three options: communication of strategy and basic mental models, performance monitoring and learning,
- setting and adjustment of measurement system so as to be in consonance with strategies of incremental, semi-radical and radical innovation,
- changing innovation measurement system so as to be in consonance with changes in strategy and organization,
- the system of innovation measurement must be developed in the way to avoid seven barriers to innovation success.

### **3. Self-Assessment Innovation Index (SAII)**

SAII methodology consists of 40 questions, classified into four thematic groups (conceptual activities, management infrastructure, resources, operational management of the innovation process), while the maximum number of points that can be obtained from one of the questions is five. The maximum number of points to be gained by answering all 40 questions is 200. In the context of self-evaluation, an expert corporate team will choose from each question the answer that is closest to the business reality. In case of questions, which offer a list of answers, select those that relate to the evaluation of the organization. Each answer is assigned a score. SAII index is then calculated according to the following equation (1). In practice all

the calculations are performed by purposefully developed software. The operator enters data only.

$$SAII = \frac{\Sigma \text{obtainedpoints}}{200} \times 100 [\%] \quad (1)$$

### 1.1 SAII evaluation

Each company is classified into one of the categories listed below according to the achieved scores (see tab. 1).

**Tab. 1: Classification of companies according to the achieved scores in the categories of innovation**

Range of SAII [%]	Position on the innovationscale
80 – 100	An excellently innovative company
60 - 79	A well innovative company
40 - 59	An above-average innovative company
<40	A below-averageinnovativecompany

Source: ownresearch

**An excellently** innovative company is a business entity, which has managed the procedural and organizational aspects of innovation management and which can systematically build innovative organization attributes, which are the following (Tidd et al., 2007):

- Shared vision, leadership and the will to innovate,
- An appropriate organizational structure,
- Key individuals,
- An effective teamwork,
- A continuous individual development,
- Broad communication,
- A high level of involvement in innovations,
- A creative climate,
- A learning organization.

Such a company systematically develops and uses its innovative competencies which enable it to effectively transform their knowledge into company's products, creating and maintaining their competitive advantage. An important paradigm, on which the organizational development is based, is the application of systematic approaches to management of innovation processes, which ensure a proportional development of an organization. The path to innovation excellence is supported by an active use of feedback, which provides an important reflection on mistakes and shortcomings, as well as on positive aspects of the

management of innovation process. The company does not have significant problems with the management of its resources, both financial and technological, human and informational. The company systematically monitors and evaluates benefits of innovations through the use of "hard" and "soft" metrics, thereby gaining a comprehensive picture of the benefits of innovations for the company. The company is able to finance its activities with a suitable combination of its own and foreign sources, including grants from various types of grant projects, which usually achieve an above-average success. It is also typical for an excellently innovative company that it can perform both breakthrough and incremental innovations in the same extent, while these innovations mutually reinforce each other. An important element, which distinguishes an excellently innovative company from others, is building and maintaining a pro-innovative corporate culture. This culture initiates and supports innovative thoughts and ideas, it supports information and knowledge sharing across the company and it helps to cultivate innovation champions and leaders.

**A well innovating company** follows the practices of excellently innovative companies in many ways, however, it fails to fulfil some of the criteria, or it is able to achieve above-average but not excellent results across all the monitored areas and criteria. The company has a formalized methodology for managing of the innovation process, which is respected and fulfilled, with some minor deficiencies and deviations. Although the innovation process is well structured and formal, its management does lead to some occasional shortcomings. The company seeks to build and cultivate a pro-innovation culture, which would enable an acceleration of innovative efforts. The company is still capable of combining breakthrough innovations with incremental ones, even if breakthrough innovations are implemented rather irregularly. Similarly, the chance to gain a grant aid is lower than in excellently innovative companies. The company does not have major problems with searching for and engaging of creative workers, who are able to pursue their professional ambitions in this environment.

**An average innovative company** is a business entity, where innovations represent certain insights about the necessities, which prevent the company from landing up with a significant technological handicap. Innovative efforts of such entity are largely based on incremental innovations implemented in the framework of technical development. Breakthrough innovations are rarely implemented. Similarly, the success of sourcing is significantly reduced. The company is not quite attractive for young creative workers, who do not identify this company as an entity, which would provide them with a professional and career development. The company has hindered access to capital, where the willingness of



fundings to support the development of innovations at the level of technical improvements is limited. Similarly, the possibility of obtaining grant support is reduced, because the company is not able to document above-average effective research and development activities.

A **below-average innovative company** represents an entity, which does not lose the ability to innovate, but its potential for innovation is greatly reduced and limited. Any innovation efforts are focused almost exclusively on incremental innovations, which are unsystematically implemented as "ad hoc" activities. Innovative efforts respect the status quo, there is a lack of a sophisticated innovation management. Measuring of benefits of innovations is realized using a small number of hard metrics of a financial nature (typically profit from innovations). The company has trouble obtaining funds, which would support their innovative efforts. The company does not systematically build a pro-innovation corporate culture, which would become the initiator of innovation efforts. The company is not a sought-after employer for creative workers, as they don't see such a stagnant non-innovative environment as an option, which would lead to the fulfilment of their aspirations. The company does not attempt to obtain a grant support for its innovative business, because it is not able to produce a coherent and convincing innovative project, which would be a candidate for funding from grant funds.

## **1.2 Instrumentation and benefits of SAI**

In practice, the evaluation is conducted via software interfaces, which ensure an adequate user comfort. All calculations are run automatically. A team of business experts, who will carry out self-evaluation, will only collect a set of answers, which correlate with reality to the maximum possible extent. Involvement of the expert team composed of a cross-section of employees of various professions or staff with interdisciplinary skills is seen as necessary as a result of a comprehensive approach to the methodology.

The greatest benefit of the proposed methodology *Self-Assessment Innovation Index* (SAII) is based on the breadth and complexity of the applied indicators, and typically also on the ability to analyse and evaluate benefits of both breakthrough and incremental innovations. Unlike existing methods, which focus on comparing countries or sectors (typically The European Innovation Scoreboard - EIS), the SAI methodology focuses on evaluating of the innovation potential of individual companies. The SAI methodology does not serve for an external disqualifying evaluation, but it is a tool of self-reflection for companies and also their clue of how to evaluate their own performance using an innovative combination of hard (especially financial) and soft (behavioural) metrics. The SAI methodology allows

companies both to evaluate the quality of the currently implemented innovative processes, and to find an untapped potential in their own innovative business.

## Conclusion

Managerial practice shows how important is the measurement of innovation for organic development of the organization. Establishment of clear, understandable and transparent methodology is a pre-condition for effective measurement of innovation process effectiveness. The proposed methodology offers a comprehensive evaluation index of the degree of innovativeness of the tested businesses. Self-Assessment Innovation Index (SAII) expresses the innovative potential of a business with the utmost objectivity, including with regard to its ability to reflect modern innovative trends, to promote and realize breakthrough and incremental innovations, to create pro-innovative corporate culture and to transform the intellectual potential of the company into innovative products.

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