
ECONOMICS

Sociology

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Received: March, 2016
1st Revision: June, 2016
Accepted: October, 2016

DOI: 10.14254/2071-789X.2016/9-4/3

JEL Classification: C18,
D22, M21, O32, P47

Keywords: financial measures, nonfinancial measures, management control, innovation scorecard.

THE USE OF FINANCIAL AND NONFINANCIAL MEASURES WITHIN INNOVATION MANAGEMENT CONTROL: EXPERIENCE AND RESEARCH

ABSTRACT. The paper deals with the issue of innovation performance measurement and management control and takes as its starting point the current state of affairs and specific conditions arising from today's business environment. Based on the findings from long-term empirical research carried out under the auspices of the Faculty of Business and Management, Brno University of Technology and Czech Scientific Foundation it provides an overview of the issues related to innovation performance measurement and management control. On the basis of desk-based research and empirical studies, a management control system approach to innovation performance measurement suitable for Czech business environment called the Innovation Scorecard is being proposed.

Introduction – Why to Measure?

Innovation contributes to the winning of competitive advantages (Kozubikova & Zoubkova, 2016; Lahovnik & Breznik, 2014). Substantial evidence exists that innovation process and resulting innovation outputs are the important determinants of company performance, indicating that innovators outperform non-innovating companies (Baldwin & Gellatly, 2003; Calabrese *et al.*, 2013; Gronum *et al.*, 2012; Guo *et al.*, 2005; Klomp & van Leeuwen, 2001; Li & Atuahene-Gima, 2001; Mansury & Love, 2008; Pittaway *et al.*, 2004; Rosenbusch *et al.*, 2011; van Wijk *et al.*, 2008; Zhou, 2006).

Innovations are not separate activities in the company, but they proceed in the form of processes that encourage change and have to be successfully terminated (Cooper, 1998; Greve, 2003; Tidd *et al.*, 2005). Successful innovations are the result of management, marketing, scientific, technological, organisational, financial, business and other types of activity. Market participants act together with employees, technologies and environmental influences, all of them being dynamic and relatively independent.

For business success company's management has to regularly evaluate the performance of their innovations. This evaluation must be carried out comprehensively. In each phase of the innovation process (see *Figure 1*) the question must be asked as to whether

it makes sense to continue with the task and not just from a technical perspective but also in marketing terms. It is essential to ascertain whether the set of technical parameters can be achieved and whether innovation has any prospects of success at some market. In addition, it is necessary to analyse deviations from the expected costs, term changes and their causes, and to assign responsibility for what has caused them. The aim is to learn how to better cope with the innovation process and thus build knowledge upon experience gained. If the company does not use this approach, then there is a risk that it will repeat the same mistakes in the future.

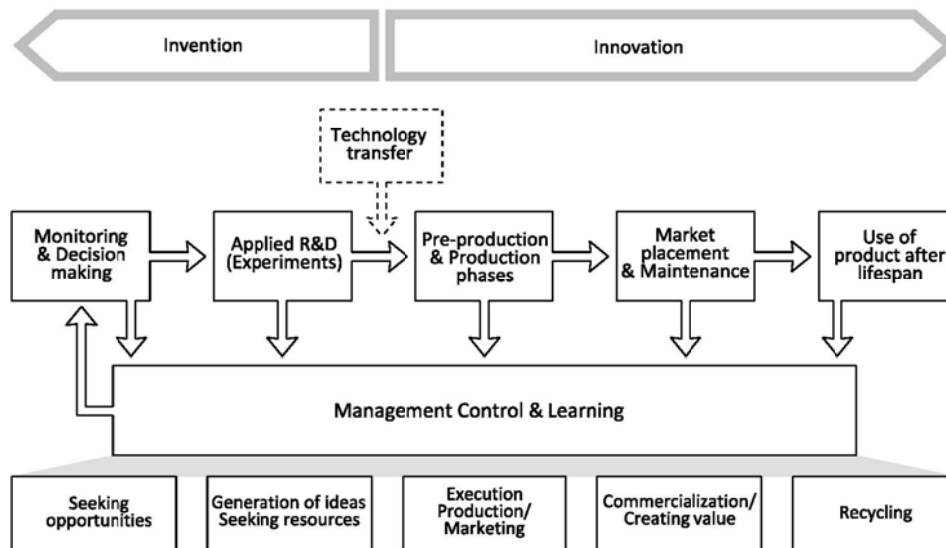


Figure 1. Innovation process

Therefore, the cognitive aim of this study is to present knowledge and findings in the field of innovation performance and management control as these areas are currently being dealt with in Czech as well as foreign expert literature and in the practice of Czech manufacturing industry. There are many indicators for assessing company's success in a wider sense but if we refer to innovations it can be difficult to choose the right ones.

Then, the creative aim is to contribute to the study of innovation management with a proposal of a conceptual performance measurement and management framework for innovation processes suitable for Czech business environment. The framework is based specifically on project management, the input–process–output–outcomes model (Brown, 1996), the Stage Gate approach (Cooper, 1998) and the Balanced Scorecard (Kaplan & Norton, 1996).

The study begins with theory and definition of the essential terms. The theoretical part is followed by an empirical analysis investigating the current state of affair in Czech manufacturing. On the basis of desk-based research and empirical study, a management control system approach to innovation performance measurement suitable for Czech business environment called the Innovation Scorecard is proposed in the discussion section.

The research presented in this study is valuable for several reasons. Firstly, it is one of the few comprehensive studies to address the question of what methods of innovation performance measurement are implemented in innovative Czech manufacturing companies. Secondly, the research takes into account the specifics of the investigated issue, such as measurement in soft systems, the core microlevel of measurement, and the specifics of Czech business environment after the financial crisis. Thirdly, only a few recent studies provide an attempt to develop a Balanced Scorecard framework for innovations. Garcia Valderrama *et al.*

(2008a) developed a general Balanced Scorecard model limited to innovations, and both GarciaValderrama *et al.* (2008b) and Eilat *et al.* (2008) also proposed an integrated data envelopment analysis and Balanced Scorecard approach to evaluating innovation projects.

The paper has the following unique outcomes:

- Key insights and tools derived from the latest academic research, consulting companies' publications and practitioners' experience.
- Key results on how Czech companies measure and control the performance of their innovation processes.
- A discussion about the current situation and possible development trends in innovation performance measurement and management control.
- A road map to developing a management control system called Innovation Scorecard.

1. Literature Review

The significance of innovation was highlighted as early as the beginning of the 20th century by Schumpeter (1912). His concept of innovation became the basis for numerous studies and modern concepts in the sphere of innovation (e.g. Drucker, 1985; OECD, 2005; Porter, 1990; Rothwell, 1992; Valenta, 1969). Innovation is in this study understood in line with the Oslo Manual (OECD, 2005), which is the foremost international source of guidelines for the collection and use of data on innovation activities in industry (Gault, 2013). The Oslo Manual defines four types of innovation that encompass a wide range of changes in companies' activities: (i) product innovations, (ii) process innovations, (iii) organisational innovations and (iv) marketing innovations. Thus innovation is the culmination of a whole series of scientific, research, technical, organisational, financial and commercial activities that collectively constitute the innovation process (Vlcek, 2002).

Measuring efficiency and contribution to value of innovation has become a fundamental concern for managers and executives in the last decades. Many studies have been written aimed at discussing the issue and suggesting possible approaches to the performance measurement, innovation and R&D management literature (e.g. Bassani *et al.*, 2010; Chiesa & Frattini, 2009; Merschmann & Thonemann, 2011; Wingate, 2015). Despite this there are no uniform guidelines in the professional literature for measuring the performance of innovations. Every innovation is unique, specific, and intended to bring competitive advantage and company growth (Bonner *et al.*, 2001).

Therefore, how to measure innovation? What kind of metrics to choose? Empirical studies give various approaches to use:

- A number of implemented innovation (e.g. Garcia & Calantone, 2002; Danneels & Kleinschmidt, 2001).
- Bibliometric indicators (e.g. Thomas & McMillan, 2001; Verbeek *et al.*, 2002).
- Technometric patent data (e.g. Acs *et al.*, 2002; Chiesa & Frattini, 2009).
- R&D expenditure (e.g. Brouwer & Kleinknecht, 1996; Doukas & Switzer, 1992; OECD, 2009; Zizlavsky & Karas, 2014).
- Economic metrics (e.g. Chiesa & Frattini, 2009; Cooper *et al.*, 2004; Hauschildt & Salomo, 2007; Ryan & Ryan, 2002; Thomaschewski & Tarlatt, 2010).

Unlike most of the previous studies on innovation, in this study we not only measure innovation through R&D expenditure, patents or implemented innovations. There are several well known limitations for these measurement (Brouwer & Kleinknecht, 1996; Griliches, 1990; Patel & Pavitt, 1995). The importance of other dimensions of innovation, such as managerial or organisational change, investment in design or skills and management of the innovation process itself is increasingly acknowledged (OECD, 2009). Therefore the paper

deals with economic indicators. For clarity they are divided into financial and nonfinancial indicators.

Financial indicators are indispensable for assessing business performance. Just they can inform the managers about the company's capability of creating value and allow them to check whether any employed measures contributed to the creation of value. Methods for economic analysis are currently the most diffused methods for evaluation of innovation projects (Ryan & Ryan, 2002). Although the existing methods largely differ in their implementation, they all share a common principle, that is, the capital budgeting approach for calculating the economic return of a project as a sequence of discounted cash flows (Chiesa & Frattini, 2009). Other popular performance innovation metrics in industry are the percentage of revenues from new products, percentage of growth in new products, and overall profits generated by new products (Cooper *et al.*, 2004).

However, assessing the results of innovations only in terms of its economic benefits may not be the most advantageous way. The development and improvement of measurement systems therefore took the path of supplementing financial indicators with many other non financial indicators used by companies seeking to measure and evaluate the development of basic success factors in their respective strategic areas (Ittner & Larcker, 1998; Kaplan & Norton, 1996; Neuman *et al.*, 2008; Vaivio, 1999). It was clear that traditional systems of measuring performance could not succeed in the changing conditions of global business (Johnson & Kaplan, 1987). Then, many authors have concluded that, due to the complexity of the concept to be measured (i.e. innovation processes), multiple integrated measurements of output need to be utilised (Tipping *et al.*, 1995; Utunen, 2003; Werner & Souder, 1997) in order to obtain both a quantitative and qualitative measurement and, in the meantime, more information on the effectiveness of the innovations measured (Werner & Souder, 1997). Therefore the concept of performance measurement used in this study – Innovation Scorecard – refers to the use of a multi dimensional set of performance measures for the planning and management of a business and follows principles of performance measurement system design (see *Table 1*).

Table 1. Principles for performance measurement system design

Globerson (1985)	Maskell (1991)	Bourne <i>et al.</i> (2003)
Performance criteria must be chosen from the company's goals.	The measures should be directly related to the company's manufacturing strategy.	Performance measurement refers to the use of a multidimensional set of performance measures.
Performance criteria must make possible the comparison of companies that are in the same business.	Nonfinancial measures should be adopted.	Performance measurement should include both financial and non-financial measures, internal and external measures of performance and often both measures which quantify what has been achieved as well as measures which are used to help predict the future.
The purpose of each performance criterion must be clear.	It should be recognised that measures vary between locations – one measure is not suitable for all departments or sites.	Performance measurement cannot be done in isolation.
Data collection and methods of calculating the performance criterion must be clearly defined.	It should be acknowledged that measures change as circumstances do.	Performance measurement is only relevant within a reference framework against which the efficiency and effectiveness of action can be judged.
Ratio based performance criteria are preferred to absolute numbers.	The measures should be simple and easy to use.	Performance measures should be developed from strategy.
Performance criteria should be under the control of the	The measures should provide fast feedback.	Performance measurement has an
	The measures should be designed so that they	

<p>evaluated organisational unit. Performance criteria should be selected through discussions with the people involved (customers, employees, managers, etc.). Objective performance criteria are preferable to subjective ones.</p>	<p>stimulate continuous improvement rather than simply monitor.</p>	<p>impact on the environment in which it operates. Starting to measure, deciding what to measure, how to measure and what the targets will be, are all acts which influence individuals and groups within the company. Once measurement has started, the performance review will have consequences, as will the actions agreed upon as a result of that review. Performance measurement is being used to assess the impact of actions on the stakeholders of the company whose performance is being measured.</p>
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2. Methodology

The research framework is based on four primary research projects carried out in Czech innovative companies under the auspices of the Faculty of Business and Management of Brno University of Technology and one comprehensive research project supported by the Czech Science Foundation.

A total of 53 mostly production companies participated in the first project called *Research into the Level of Development of Innovation Potential, Creation and Evaluation of the Innovation Strategy of Medium-Sized and Large Machine-Industry Companies in the South Moravian Region in the Czech Republic* (Reg. No. AD 179001M5) conducted in 2009. This project uncovered several unfavourable findings on the state of management of innovative activities. Therefore this area was examined in detail in three subsequent research projects called *Development of Knowledge for Improvement of Information Support of the Economic Management of Company Development in Accordance with Development of the Business Environment* (Reg. No. FPS10-17) undertaken in 2010, *Development of Knowledge for Improvement of Information Support of the Economic Management of a Company* (Reg. No. FP-S-11-1) in 2011 and *Efficient Management of Companies with Regard to Development in Global Markets* (Reg. No. FP-S-12-1) in 2012.

These projects became the bases for in-depth research carried out in 2013-2015 within the Czech Scientific Foundation post-doc research project *Innovation Process Performance Assessment: a Management Control System Approach in Czech Small and Medium-sized Enterprises* (Reg. No. 13-20123P) in the field of innovation performance measurement and management control.

The fundamental unit of research interest is the company. This study presents a shift from a macroeconomic level of exploration to the sector and especially the level of the individual business. This level of investigation requires in particular the application of qualitatively based methodological procedures and allows a deeper understanding of the analysed phenomena.

The concept of the innovation performance solutions in this study depends on the following premises:

- The company is the source of innovation.
- Innovation performance, that is the ability to carry out the desired innovation, can be seen as one of the most significant factors in the competitiveness and efficiency of a company.

- Innovations are, in the context of the subject of the research, in the economic/organisational (not technical) category.
- Innovative outputs from companies cannot be restricted to the innovation of products, as steadily greater significance is being ascribed to the remaining types of innovation (according to the Oslo Manual (OECD, 2005)) and that is true even in companies of a production character.
- Innovation is not just a matter of the company's outputs but also changes in the sources of the internal environment of the concern and relations between these and changes in relationships with relevant entities in the external environment.
- The condition for innovative outputs (products and services) is comprehensive innovation, which represents a purposeful chain of all the mentioned changes in the internal and external environments of the company.

Research work relies mainly on a systemic approach, which is normally applied for its ability to consider the situation in the context of external and internal circumstances. It employs a combination of different methods and techniques from various scientific disciplines – triangulation. In this study two types of triangulation are taken into account:

- Data – the use of varied data sources: (i) information made available publicly; (ii) information from questionnaire surveys; (iii) information from interviews.
- Methodological – the use of a combination of data gained with the aid of questionnaires, analysis of available materials and semi-structured interviews.

Analysis is used as a method for obtaining new information and its interpretation. When processing secondary data, the method of secondary analysis was utilised. A source of secondary data was the professional literature, especially foreign – books, journals and articles from scientific and professional databases (Web of Science, Scopus, Emerald, EBSCO, DOAJ etc.) with respect to their professional level and relevance. The theoretical background for the solving of the issues in question is made up not only of innovation management but also financial management, performance measurement and management control. The methodological background and to a certain extent also the framework is made up of standard methods for the evaluation of the business environment, innovation performance and the quality of sources.

A questionnaire-based survey was implemented to gather information and determine the real state of solved issues of performance measurement and management control of innovations in Czech companies. It was decided to carry out the research via a random selection of various-sized innovative companies from manufacturing industry in the Czech Republic. This choice is related to the fact that managerial tools primarily originated and subsequently developed in manufacturing companies. The second feature was the fact that manufacturing industry is considered the most significant industry for the development of the Czech economy since it is the largest sector. This allows a sufficient number of companies to be contacted to participate in the study. It is estimated that the target population consists of over 11,000 manufacturing companies.

Synthesis is primarily used to announce the results, formulate conclusions, and produce a methodological proposal for the management control of innovation process performance. Induction is utilised especially when generalizing all the findings achieved in the questionnaire survey, and it is also applied when general principles are defined for the methodological proposal for the assessment of innovation process performance based on specific data from individual companies. Verification of dependencies found was verified by the application of deduction.

The feedback method allows a reconsideration of every step in research to make sure the research does not deviate from its original aim and its starting points. Statistical methods

are utilised when analysing primary data and their results are presented in tables and charts in following section.

3. Research Results

Companies for surveys were selected from the databases Technological Profile of the Czech Republic, Kompas and Amadeus database provided to the company Bureau Van Dijk. The real return rates can be considered as very good because return rates of mail-back questionnaires are usually less than 10%. The detailed statistics of the questionnaire inquiries are shown in *Table 2*.

Table 2. Overall statistics of the questionnaire surveys

	Research 2009	Research 2010	Research 2011	Research 2013-2015
Target population	Manufacturing enterprises in the Czech Republic			
Research sample	Innovative manufacturing enterprises in the Czech Republic			
Number of addressed companies	250	800	650	2,877
a) By e-mail	230	750	650	2,807
b) By personal visit	30	50	0	70
Number of undelivered e-mails	13	35	27	98
Number of partially filled questionnaires	4	9	13	153
Number of completely filled questionnaires	53	139	212	354
Real return	21.2%	17.4%	34.1%	12.30%

Source: Own research.

As stated in beginning of this study, the need of management control system is crucial in innovations. Therefore, a key area of surveys were the questions of evaluation for innovative projects – whether and how it is decided the innovation is viable. When asked whether the companies had evaluated the implemented innovative projects, the vast majority answered affirmatively in all period under consideration, 79%, 64% and 79% of respondents, respectively (see *Figure 2*). Besides what is disquieting is the fact that this area is neglected by ca one third of the respondents even though innovations are implemented by them.

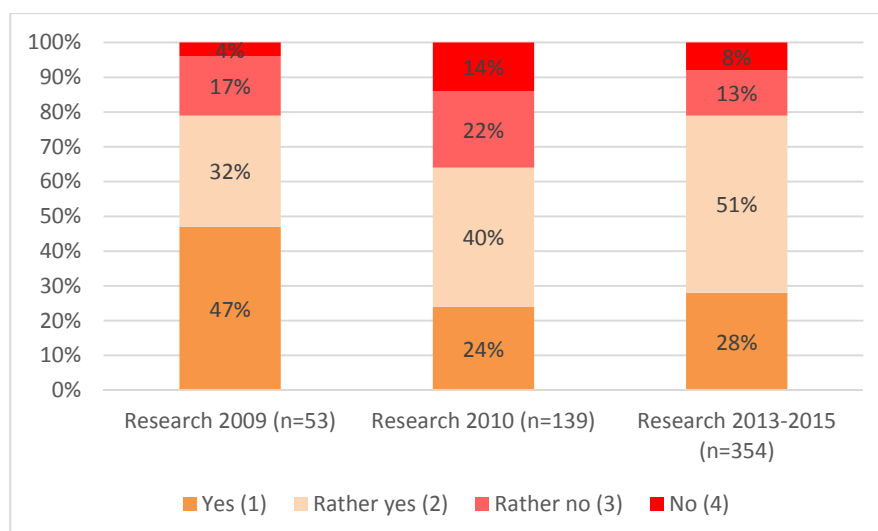


Figure 2. Evaluation of innovative projects

Source: Research 2009, 2010, 2013-2015.

Here, the initial presumption that companies vary in innovation project evaluation depending on their size is going to be tested by Kruskal-Wallis test for each research project (see Table 3). For this purpose, following hypotheses are set.

Null hypothesis: Level of innovative activity evaluation is equal for all categories of company size.

Alternative hypothesis: Level of innovative activity evaluation is not equal for all categories of company size.

Table 3. Results of Kruskal-Wallis test

Research 2009 (n=53)					
Size	Micro (1)	Small (2)	Medium (3)	Large (4)	Overall
N	7	11	16	19	53
Median	3.000	2.000	1.500	1.000	
Ave Rank	39.2	33.5	25.1	20.3	27
Z	2.25	1.57	-0.58	-2.36	
H = 10.12 DF = 3 P = 0.018					
H = 11.81 DF = 3 P = 0.008 (adjusted for ties)					
Research 2010 (n=139)					
Size	Micro (1)	Small (2)	Medium (3)	Large (4)	Overall
N	27	32	40	40	139
Median	3.000	2.000	2.000	2.000	
Ave Rank	88.7	76.9	65.6	56.2	70.0
Z	2.69	1.11	-0.81	-2.57	
H = 11.97 DF = 3 P = 0.007					
H = 13.15 DF = 3 P = 0.004 (adjusted for ties)					
Research 2013-2015 (n=354)					
Size	Micro (1)	Small (2)	Medium (3)	Large (4)	Overall
N	26	101	158	69	354
Median	2.000	2.000	2.000	2.000	
Ave Rank	210.8	179.9	178.1	160.1	177.5
Z	1.72	0.28	0.10	-1.58	
H = 4.81 DF = 3 P = 0.186					
H = 5.71 DF = 3 P = 0.127 (adjusted for ties)					

Research 2009: The test statistic (H) has a p-value of 0.018 unadjusted, resp. 0.008 adjusted for ties, indicating that the null hypothesis can be rejected at $\alpha = 0.05$ levels higher than 0.018, resp. 0.008 in favour of the alternative hypothesis of at least one difference among the treatment groups of company size.

Research 2010: Analogously as Research 2009, the test statistic (H) has a p-value of 0.007 unadjusted, resp. 0.004 adjusted for ties, indicating that the null hypothesis can be rejected at $\alpha = 0.05$ levels higher than 0.007, resp. 0.004 in favour of the alternative hypothesis of at least one difference among the treatment groups of company size.

Research 2013-2015: Data and results of Kruskal-Wallis did not confirm alternative hypothesis, i.e. it has not been proved that level of innovative activity evaluation is not equal for all categories of company size. However, this result contradict previous result as well as general knowledge and experience in management control. Therefore, gained data are modified and Spearman's rank correlation is calculated (see *Table 4*).

Table 4. Calculated Spearman's correlation coefficient

	No.	Spearman R	t(N-2)	P-Value
Category2009 & Size2009	53	-0,465196	-3,75297	0,000449
Category2010 & Size2010	139	-0,306548	-3,76954	0,000242
Category2015 & Size2015	354	-0,105305	-1,98674	0,047726

Here, it has been proved that there exists significant relationship between size of the company and innovative activities evaluation at a 5% significance level. In other words, the larger company is the innovative activity evaluation is performed.

In 2010 for businesses which responded affirmatively (n=89) to the above question, the method of evaluating the innovative activities has been examined. The results are shown in the diagram below (see *Figure 3*). The prevailing approach is the monitoring of financial indicators or, more precisely, the monitoring of costs with respect to operating profit and the fulfilment of turnover based on the sales plan. Other data and indicators have not been essential for the surveyed enterprises. In 23% of respondents, the objectives and strategies of innovative activities are transformed into a comprehensive system of measurable financial and nonfinancial indicators. Although it should be noted that after overcoming the barriers and reluctance of the managers to communicate more detailed information about their systems of innovation evaluation, these systems proved not to be very appropriate, while being biased in favour of financial indicators.

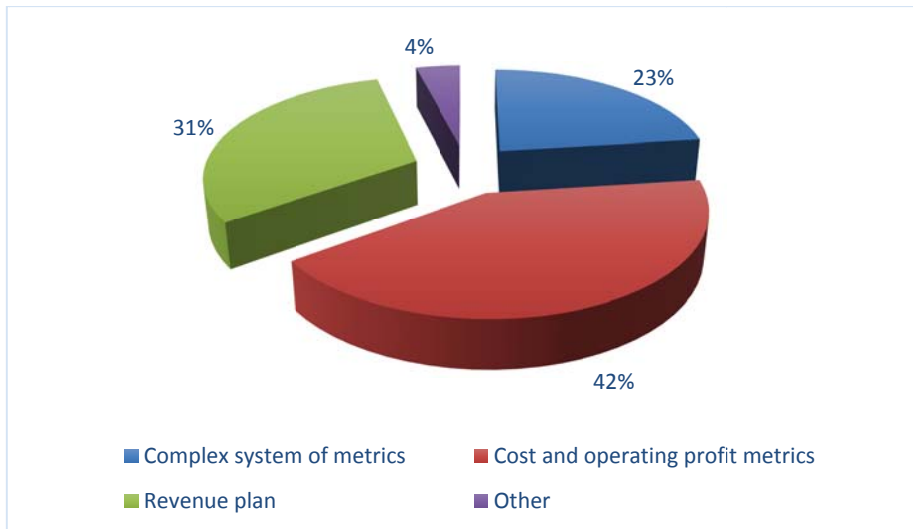


Figure 3. Ways of innovation evaluation (n=89)

Source: Research 2010.

Therefore, within research survey 2013-2015 the period since when has the company implemented innovation management control system (MCS) was examined (281 respondents in total).

Table 5. Period of innovation MCS implementation (n=281)

Category (Number of employees)		Micro (1-9)	Small (10-49)	Medium (50-249)	Large (>250)	Total
Less than 5 years	No.	12	29	25	8	74
	%	57.14	35.80	20.00	14.81	26.33
From 5 to 10 years	No.	7	33	56	25	121
	%	33.33	40.74	44.80	46.30	43.06
From 11 to 15 years	No.	2	14	36	15	67
	%	9.52	17.28	28.80	27.78	23.84
More than 15 years	No.	0	5	8	6	19
	%	0.00	6.17	6.40	11.11	6.76
Total	No.	21	81	125	54	281
	%	100.00	100.00	100.00	100.00	100.00

Source: Research 2013-2015.

Another initial presumption *Large companies have implemented their innovation management control system for a longer time than SMEs* is going to be tested. Independence statistical testing of two qualitative characters is carried out for statistical dependency verification. The null hypothesis is going to be tested that random values are not dependent in comparison with the alternative hypothesis.

Null hypothesis: Size of the company and longer period of innovation management control system implementation are not related to each other.

Alternative hypothesis: Size of the company and longer period of innovation management control system implementation are related to each other.

Table 6. Relation research of period of MCS implementation and size of the company (n=281)

Period of MCS implementation/Size of company	SMEs	Large	n _i
Less than 5 years	66	8	74
From 5 to 10 years	96	25	121
From 11 to 15 years	52	15	67
More than 15 years	13	6	19
n _i	227	54	281
Calculated test criterion: Chi-Sq = 5.835; DF = 3; P-Value = 0.120			

Source: Research 2013-2015.

For a selected significance level $\alpha = 0.05$ a quantile chi-sq (3) is determined = 7.815. Because the value of test criterion was not realized in the critical field ($5.835 < 7.815$ and p-value = 0.120) the alternative hypothesis is rejected on five percentage level signification and null hypothesis is accepted. In other words, companies evaluate innovation processes no matter what the period of MCS implementation.

Then, the relevant reasons for innovation MCS implementation and their importance were surveyed for the same group of respondents. Moreover, they evaluated the importance of these reasons. The measurement instrument used in the questionnaire to estimate the importance of reasons for innovation MCS implementation was evaluated a five- item Likert scale: 1 – very important, 2 – important, 3 – neutral, 4 – not important, 5 – completely unimportant. In the summary of the percentage ratio of positive answers, i.e. values 1 (very important) and 2 (important), the order of individual possibilities was determined (see Table 7).

Table 7. Reasons for innovation MCS implementation (n=281)

	1		2		3		4		5		Cronbach's Alpha
	very important		important		neutral		not important		un-important		
	No.	%	No.	%	No.	%	No.	%	No.	%	
Motivation and remuneration	99	35	117	42	48	17	10	4	7	2	0.9840
Business strategy planning	123	44	82	29	45	16	23	8	8	3	0.9819
Reduction of wasting resources	126	45	77	27	38	14	26	9	14	5	0.9826
Idea improvement	91	32	104	37	43	15	28	10	15	5	0.9814
Communication	101	36	75	27	56	20	33	12	16	6	0.9813
Legitimacy to innovation	74	26	88	31	52	19	44	16	23	8	0.9865
Stakeholders relationship	58	21	74	26	87	31	32	11	30	11	0.9823

Source: Research 2013-2015.

Respondents gave following most important reasons for innovation MCS: motivation and remuneration, business strategy planning, reduction of wasting resources, idea

improvement and communication, respectively. Cronbach's alpha coefficient for each construct is above 0.98, and for all seven factors it equals to 0.9853. This means strong internal consistency and good reliability of scale.

In addition, respondents were asked to indicate their use of the evaluation techniques they use within innovative activities to provide the information for decision-making and control. The questionnaire focused on the 16 core project level evaluation metrics (financial and nonfinancial) of innovation performance. This set of metrics was formed after the literature review of the most frequently innovation management control tools (Carenzo & Turolla, 2010; Cokins, 2009; Davila *et al.*, 2013; Niven, 2005; Skarzynski & Gibson, 2008; Tzokas *et al.*, 2004).

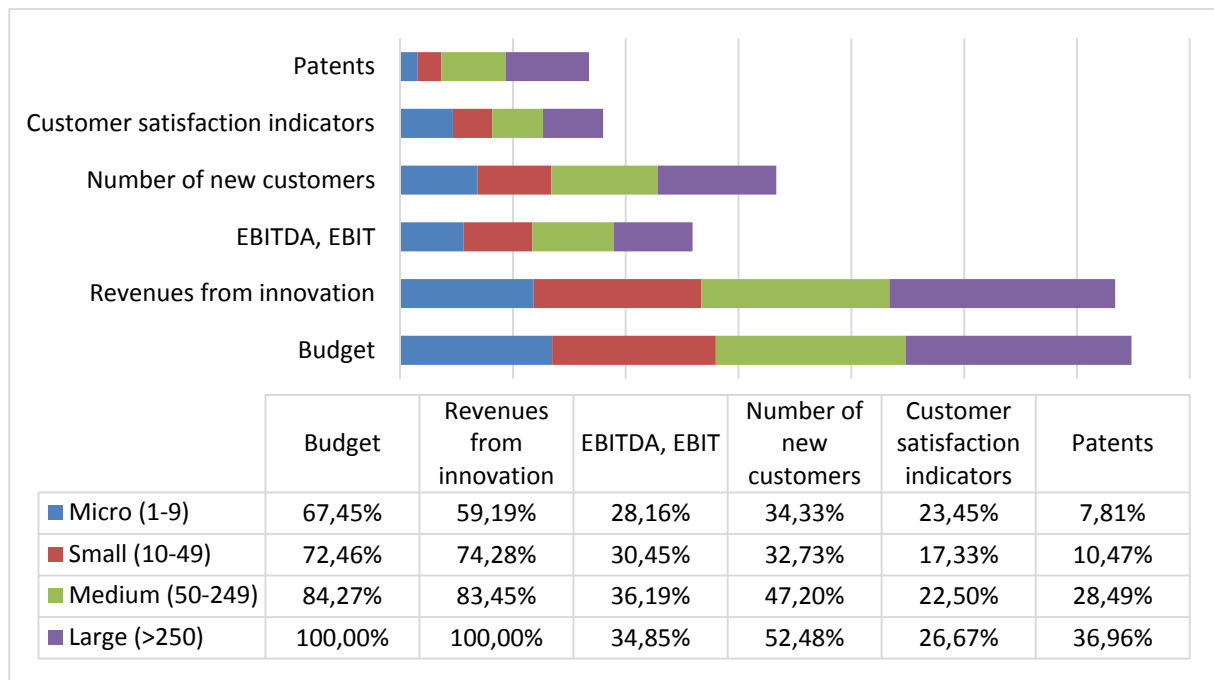


Figure 4. Top 3 innovation evaluation methods from financial and nonfinancial tools (n=281)
Source: Research 2013-2015.

Here again in 2013-2015 results showed that in Czech economics most managers still use mainly financial indicators to assess innovation performance and its components (see *Figure 4*). Budget, revenues from innovation and EBITDA are the most frequently applied indicators. Since we are studying the Czech manufacturing business environment, i.e. for profit sector, innovation evaluation must always be based on a group of logically interrelated financial indicators.

On the other hand, the majority of managers in Czech manufacturing companies also feel that non financial indicators should be used to monitor the undertaken innovative efforts and projects. The managers should rely more on non financial indicators than on the financial ones because these indicators provide a better assessment of progress in real time and of the probability of success. Thus the use of complex innovation indicators is the best option.

Among all the performance measurement systems, e.g. Performance Measurement Matrix (Keegan *et al.*, 1989), the Performance Pyramid (McNair *et al.*, 1990), the Integrated Performance Measurement Systems (Bititci *et al.*, 1997), the Performance Prism (Neely & Adams, 2001), Data Envelope Analysis (Charnes *et al.*, 1978), Quantum Performance Measurement (Hronec, 1993), EFQM Excellence Model (European Foundation for Quality Management, 1999), the Tableau de Bord (Lebas, 1994) or Productivity Measurement and

Enhancement System (Pritchard, 2008), the Balanced Scorecard seems most appropriate for introducing a complex system of measuring innovation performance for an entire company (e.g. Bremser & Barsky, 2004; Donovan *et al.*, 1998; Horvath & Partners, 2016; Kaplan & Norton, 1996; Kaplan & Norton, 2001; Kerssens-van Drongelen & Cook, 1997; Li & Dalton, 2003; Niven, 2005; Niven 2014; Pearson *et al.*, 2000).

Nonetheless the introduction of a comprehensive Balanced Scorecard system, although its philosophy is simple and logical, is too challenging for most Czech businesses – in terms of time, organisation, and finance. The empirical evidence from 2013-2015 research demonstrates the low adoption rate of the Balanced Scorecard. A gap between micro and small companies and medium and large companies was found. In the first two groups (micro and small companies) Balanced Scorecard is implemented only in minority group. Less than 3% of respondents adopted this method. Most Czech companies, especially medium and large, monitor performance of innovation by using specific financial and non financial measures but without any logical link between them. In other words only a small number of companies, especially large ones and those having different perspectives, actually understand the importance of the cause and -effect relationship between metrics. Here, the gap between global and Czech companies has been discovered (cf. Davila *et al.*, 2009; Chiesa & Frattini, 2009; Hendricks *et al.*, 2012).

While a company may not choose to adopt a formal Balanced Scorecard management system, it can learn and use the key concepts. The Balanced Scorecard helps managers to implement strategy through the development of an integrated set of relevant financial and non-financial measures. The non-financial measures, if properly selected, should be drivers of sustained profitability. The author therefore advises integration of selected features and indicators of the Balanced Scorecard and to create one's own specific Innovation Scorecard that would best capture the factors and metrics of innovation activities of the individual company is suggested. The selection of the relevant indicators must be tailored to the company as each innovation is unique, specific, and intended to bring competitive advantage and company growth (e.g. Bonner *et al.*, 2001; Hart *et al.*, 2003; Hauser & Zettelmeyer, 1997; Vahs *et al.*, 2010).

Hence next section proposes on the basis of literature review and empirical research an original management control system approach to assessment of innovation performance on a micro-level suitable for Czech business environment, called the Innovation Scorecard.

4. Innovation Scorecard Conceptual Framework

The basic structure of the Innovation Scorecard draws on Horvath's long-term experience (Horvath & Partners, 2016) with the implementing of the BSC and involves the following phases: (i) defining innovation strategy; (ii) setting strategic goals; (iii) constructing a relationship of cause and effect with the help of a strategic map; (iv) the choice of metrics; (v) establishing target values. In content these five phases collectively form an integrated whole. This gives rise to a sample approach, conceived in the form of concrete instructions for the process of implementing the Innovation Scorecard.



Figure 5. Innovation Scorecard implementation (modified from Horváth & Partnes, 2016)

Due to the scope of the paper this section is focused only on the design of conceptual innovation performance measurement framework. Therefore, it is based on the presumptions that:

- The company has already defined its innovation strategy (according to e.g. Bessant & Tidd, 2011; Bonner *et al.*, 2001; Hayes, 2007; Kerssens-van Drongelen & Bilderbeek, 1999; Lafley & Charan, 2008; Pearson *et al.*, 2000; Skarzynski & Gibson, 2008; Thomaschewski & Tarlatt, 2010; Tidd *et al.*, 2005; Vahs *et al.*, 2010).
- The company has already set performance goals and fine-tuned the balance (e.g. Kaplan & Norton, 1993; Porter, 1998; Skarzynski & Gibson, 2008).
- The company has already established its innovation business model (e.g. Davila *et al.*, 2013).

Following the Stage Gate model by Cooper (1998; 2008), the input–process–output–outcomes model (Brown, 1996), performance measurement system design rules (Azzone *et al.*, 1991; Bourne *et al.*, 2003; Dixon *et al.*, 1990; Globerson, 1985; Goold, 1991; Kaplan & Norton, 1992; Maskell, 1991; Neely *et al.*, 1996) and the methodology of Innovation Scorecard, the innovation process can be divided into distinct stages and should be separated by management decision gates. This means an effective as well as an efficient approach, so that the new product can be moved from idea to launch in a systematic way.

Every stage is preceded by one gate. At each stage information is gathered to reduce project uncertainties and risks which is then evaluated at the following gate. Gates represent decision points with deliverables (what the innovation team brings to the decision point) and must meet/should meet criteria where the company can decide if it will proceed with the innovation project or if it is to be stopped, held or recycled. Thus gates are also referred to as “Go/No Go check points” where a decision to invest more or not is made (Cooper, 1998; 2008). At the gates below average projects should be stopped and resources should be allocated to other promising projects.

By comparing models of the innovation process (Zizlavsky, 2013) and for the original purpose – to create a simple innovation performance measurement system framework for the Czech business environment – five distinct evaluation gates are selected: (i) idea screening; (ii) project selection; (iii) innovation preparation and market test; (iv) analysing market test results, after launch assessment; and (v) post implementation review (see *Figure 6*). Each of these phases is important for the success of innovation.

While the entire innovation process is described as being linear, it moves in non linear cycles and must take place along the spiral of the long-term growth of a company (Kopcaj, 2007; Moss, 1989). The linear models of innovation are useful for describing key steps in the innovation process (Carlsson *et al.*, 1976). Rather, the innovation process is chaotic and non linear (Anderson *et al.*, 2004).

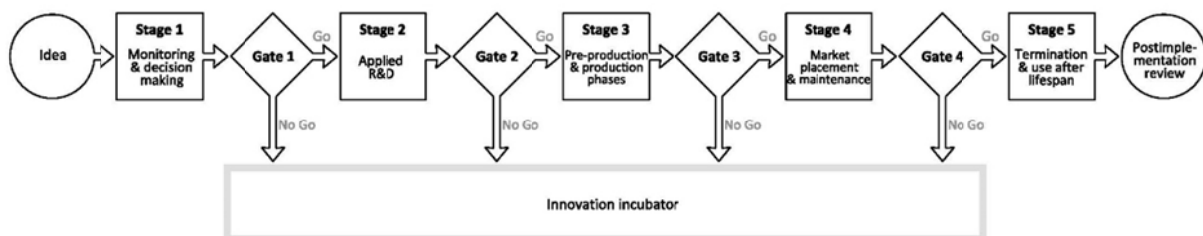


Figure 6. Modified Stage Gate process (Cooper, 1998, p. 108) according to innovation process (Zizlavsky, 2013, p. 5)

Before the evaluation of the innovation process, an essential factor of innovation assessment has to be mentioned. Timing is key for innovation success as well as the reason for most failures in the context of innovation (e.g. Berth, 1993; Thomaschewski & Tarlatt, 2010). One challenge here is that promising projects – with the wrong timing – can be killed off in a very linear stage of project. If an idea falls through the innovation processes then it is just gone, even though it might hold promise at a future point when the company is better prepared to execute it. A solution could be an “Innovation incubator” – if the projects are interesting, but the timing is off, then the competent manager can catch the falling projects in the innovation incubator (Lindegaard, 2015).

Gate 1 consists of measurement inspiration related to activities which are devoted to identification of ideas for innovation projects. This phase is divided into factors which depend on whether ideas are actively generated or collected from existing resources, as well as if they originate from internal or external stakeholders. Therefore idea screening is the first of a series of evaluations of whether the idea is according to the strategy of the company. It begins when the collection of inventive ideas is complete.

It is an initial assessment to weed out impractical ideas. This initial evaluation cannot be very sophisticated as it is concerned with identifying ideas that can pass on to the applied R&D stage to be developed into concepts and can be evaluated for their technical feasibility and market potential.

The influence of innovation ideas is generally still very unclear and technical or economic success is therefore difficult to estimate. The typical innovation killer is a question like “How profitable is this new opportunity?” Of course, asking detailed questions about profitability is not wrong but many companies tend to ask this question very early – at a stage when it is impossible to answer it.

There are only rough economic estimates and data collection concentrates primarily on the sales volumes of overall and submarkets as well as the distribution of market shares. Risk analyses are regularly carried out in the initiation phase as regards technical feasibility and economic success (Gaiser *et al.*, 1989). Precise cost and revenue estimations and allocations can still not be made since the use of the innovation and its associated products or services has not been specified yet. The recorded values cannot be allocated to the innovation yet. The recording process only indicated possible leeway. The extent to which this can be filled by the innovation remains open in this phase.

The project proposals which are considered best are chosen and innovation projects are started for proof-of-concept and prototype development. At Gate 2 the project is re-evaluated based on the criteria of Gate 1 and additional variables such as market potential. At the end of the inventive phase in the innovation process the company may have a list of many projects that senior management would like to complete. Each project may (or may not) possibly require different degrees of innovation. If current funding will support only a few projects, then how does a company decide which of the twenty projects to work on first? This is the project selection and prioritization process.

At this early stage the investment appraisal methods are still not applied since they require much more detailed information on the time of occurrence of input values. The estimate is limited to a basic comparison of investment costs and the revenue and growth potential of the market addressed, augmented by risk-related statements. The cost sheet is to provide an idea of the financial and organisational expenses to be expected.

Demanding a lot of financial precision about a promising project, particularly during the embryonic stages of experimentation, is highly counterproductive. Rather than making a quick decision about an idea at a very early stage, the goal should be to create an extremely fast iterative cycle that allows prospective innovators to get started, quickly test whether their

hypotheses are valid or invalid, see what they learn from their experimentation and rapidly iterate that learning.

At the end of this applied R&D stage the product is finally developed physically. The result of this stage is a tested prototype. Apart from technical and qualitative aspects it is important to involve the customers or users for feedback in order to better understand their unmet and unspoken needs and problems and benefits sought in the innovation. Economic data and plans, e.g. production and marketing plans, are reviewed. Based on this in Gate 2 the product is tested again for overall operability. This includes testing the product in the market. Cooper (2008) suggests field trials, pre tests or test markets in order to assess customers' reactions and calculate approximate market share or revenues.

Choosing the right projects is only half of the way to ensure a company's long-term competitiveness. Even if the right innovation projects are selected it remains important to assess whether the execution of every single project is successful. More precisely companies face the challenge of measuring the performance of innovation projects.

Therefore the planning phase is used to prepare and develop innovation concepts. These concepts build the framework for the values to be considered in this phase. Forecast, potential revenues from products and services and OPEX form the basis for the calculation. Depending on the nature and design of the innovation, revenues can be broken down into detailed reference values such as customer groups or sub-segments.

Gate 3 assesses the product a last time before its launch. In order to assure performance of innovation projects a number of tools can be applied such as milestone trend analysis, project reporting, project status analysis or cost trend analysis. Another tool which can be applied is target costing. This strategic cost management allows the entire life cycle of product and influencing the performance of innovation project in the early stages of product development to be considered (e.g. Sakurai, 1989).

The specified product concepts are launched on the market using traditional marketing tools and on the basis of the product launch processes in the commercialization phase. At Gate 4 the product is assessed once more. Actual performance is compared to forecasts. Internal accounting provides cost and service allocation and forecasts as basic information for this phase.

The innovation profitability analysis focuses on individual products, service offers, product bundles, dedicated customer segments and sales areas in this phase. There is already a clear idea of production costs and willingness to pay, enabling detailed data to be recorded. As the data pool improves, the relationship between innovation and origin of cost gradually becomes clearer. Specifically the level of detail and the specific nature of the data make it easier to allocate innovations. Cost accounting becomes increasingly helpful and offers more precise information, especially with regard to OPEX and the determination of flat rates.

Company accounting and the company's planning systems provide a wide range of tools in this phase with which both cost and revenue-related planning and control can be achieved. In the measurement, the project-induced revenues must be compared with capital expenditure over time. Data for the forecast revenues and investment costs should be agreed with the product owners. For interconnected and network products this is difficult since there are generally several product owners. Financial mathematics provides above all the net present value method as a dynamic investment appraisal method (Ryan & Ryan, 2002). Under this method, payments received and made over the product life-cycle are compared and discounted to their present value. Corporate earnings and innovation risk are controlled using the specified interest rate.

Within Gate 5 there should of course be a post implementation review which investigates the causes of the problems in the implemented innovation, not to seek out the culprit in terms of the poor decisions, but so that in future in a similar innovation process can

discover and avoid similar problems. The post-implementation review thus becomes a key element in control feedback, which makes possible the incorporation of the results into further projects, so becoming also the first ex-ante input in future projects. We can therefore see the post-implementation review as a learning process, the results of which translate into the success of further innovation projects and so also into the future prosperity of the business.

Conclusion

The paper is based on current knowledge in the area of innovation management and management control and on specific conditions in today's business environment. It summarises the issues of managing and measuring the performance of the innovation process. This work builds on knowledge from significant professional authors, summarises it and tries to develop it further.

The paper continues research activities and publications carried out within long-term empirical research carried out in Czech manufacturing industry in 2009-2015. It was necessary to study the individual definitions, processes and means of measuring and managing innovation performance as available in the current state of scientific thinking. This review phase was oriented to the study of especially foreign and Czech professional literature as found in books, articles in journals, information servers and the databases of libraries, universities and other organisations.

Based on the theoretical review presented and the empirical findings from primary research, major implications relevant to academics and practitioners stem from this study. The work has implications for the field of business performance measurement. Research has outlined a number of metrics; various methods and performance measurement frameworks for innovation process evaluation that exist in Czech manufacturing companies.

On the basis of this literature review and an empirical study in Czech manufacturing industry, a management control system approach to innovation performance measurement suitable for Czech business environment called the Innovation Scorecard was proposed. This paper dealt with evaluation of innovation in five phases of the innovation process based on a modified stage gate model. Moreover, at each gate the Innovation Scorecard framework provides a set of factors and for each factor a set of inspiration metrics to choose from or be inspired by (see *Appendix 1*).

From a managerial viewpoint the Innovation Scorecard may provide useful guidelines for focusing attention and expending resources during the entire innovation process. It is argued that the informed use of evaluation metrics as guideposts for increased managerial attention and the identification of problems may help management to prevent drop-and-go-errors in their innovation efforts. Managers may compare and contrast findings from this study with their own innovation practices and, by doing so, enrich the knowledge pool upon which they draw to make well-informed decisions.

In addition, this study has created a basis for further research in the field of innovation performance measurement and management control. An extensive theory about innovation management and performance measurement has been reviewed in this study. Moreover, the literature overview has been completed by primary research in Czech manufacturing industry. Therefore it could serve as guideline for case studies or further research.

However the benefits need to be assessed in a purely realistic manner. The proposed methodology is not an all-powerful guide which would lead to the problem-free innovation performance management in all circumstances. It identifies and highlights potentially problematic areas and shows managers all that they should take into account when managing innovation. It is also only one of many possible approaches, given how extensive economics has become and the wide availability of its results.

Acknowledgement

This paper was supported by research project no. FP-S-15-2877 *The Selected Questions of Financial Management* from the Internal Grant Agency at Brno University of Technology.

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