EVALUATION OF THE USABILITY OF SELECTED INNOVATION CONCEPTS FOR MANAGING INNOVATION ACTIVITIES

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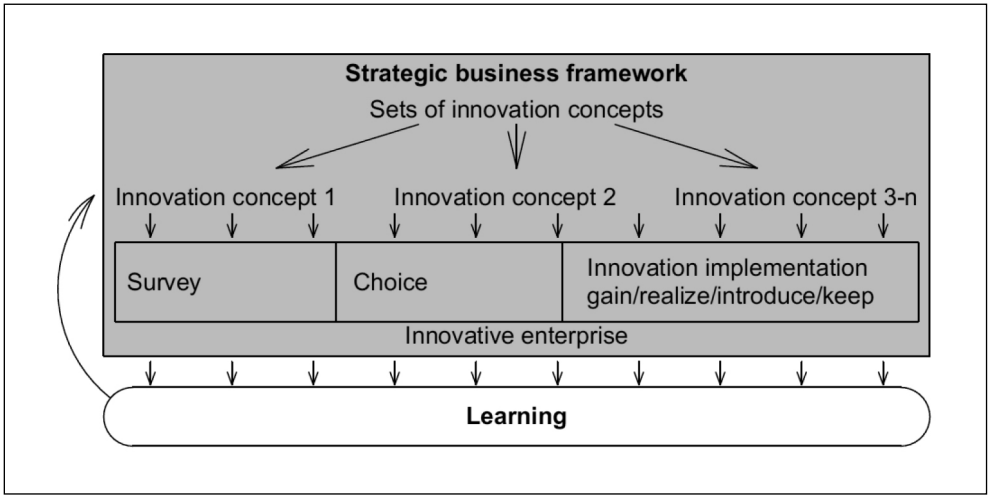
Introduction

In today's business world, the only constant is a change, so that the ability to learn, change and innovate plays an important role in business. Enterprises should actively create rules of the game and own future rather than passively react to changes (Mikoláš & Wozniaková, 2009; Merrill, 2015). Proactive behavior, seeking own way (Zelený, 2012) and creating innovator's DNA is important (Dyer et al., 2011). Innovation and own recipe (Pearl, 2011) for its implementation is a necessary prerequisite for successful business in the highly competitive business environment. For companies' future existence and development, innovations importance was recognized by a number of business owners and managers, who introduce changes and contribute to the creation of new trends in the business environment. Such enterprises become innovators in their field of operation. According to some authors (Košturiak & Chal´, 2008; Szabo et al., 2013), business success is not caused by optimization of existing products and processes, but by innovations. Innovations have become a key objective for many companies due to their impact on overall company performance (Lee, 2008).

It is obvious, that even if most managers recognize the importance of innovation and perform innovative activities, a significant number of them do not know how to manage their innovation activities (Tidd et al., 2005; Kraśnicka et al., 2016). Managers do not know how to proceed with the solution of innovative issues, how to innovate, and then how to evaluate effects (Hamel, 2006). From the previous statement following questions result: Is it possible to manage innovations? If innovations can be managed: how to approach it? Tidd and Bessant (2013) point out that innovation can be managed, but it is not easy. Innovation is a key business process that is linked to the renewal of what an enterprise offers how it is created and how it is delivered to the customer. This process includes a survey, choice, and implementation, which means transferring the potential of the new idea into innovations and introducing it on the internal or external market see Fig. 1. Implementation includes acquirement of knowledge resources, project realization under the condition of uncertainty, introducing innovations on the market and longer innovation usage. Last important activity is learning based on realized steps which result in the knowledge base, and that is why the ways of managing the innovation process improve. Simultaneously, this process is influenced by the factors related to a project and enterprise conditions that provide an important framework. It refers to a strategic framework for innovations, enterprise innovativeness, and link among a business and the key elements of its external environment. In this context, Tidd and Bessant (2013), Koráb and Koudelková (2014), Jáč et al. (2005) highlight significant factors such as enterprise size, branch, innovation type, phases of the innovation process and other stable or discontinued conditions.

Both in theory and practice, a high number of innovation concepts can be found, however, for managers, it is probably not easy to be knowledgeable in the innovation concepts or even to use them. The concepts have been understood as an abstraction representing the way of solving an innovation problem. Innovation concepts provide a necessary approach of the creators (authors) to the importance of selected aspects and to the way of solution, they offer. Fig. 1 shows the author´s approach to the positioning that the concrete concepts could have while managing innovation processes in a model of the innovation process according to Tidd and Bessant (2013). Realization of the

Fig. 1: The position of innovation concepts in innovation management in an enterprise



Source: extended approach according to Tidd and Bessant (2013)

innovation concepts results from a strategic business framework. Each concept should be used in a particular phase of the innovation process. It is important to gain knowledge from realized innovation process and to use acquired experiences.

The aim of the paper is to evaluate chosen innovation concepts regarding their possible use in business practice. For the evaluation of innovation concepts, qualitative analysis will be used. For that purpose, a group of experts with the author of this paper will determine concrete criteria and variants of usability of innovation concepts. For managers and their possibility of choosing the right innovation concept, decision-making model will be presented. The model results from Analytic Hierarchical Process with the use of determined criteria. Designed decision model can enable managers to orient quickly among the innovation concepts and simplify their choice of innovation concept for implementation in an enterprise. The model will be designed mainly for large enterprises from the manufacturing industry.

1. Theoretical Background

Set of ten innovation concepts was worked out on the basis of the Czech and foreign literature review, findings from consulting companies, results from research projects, research surveys, results from the Czech Statistical Office and experiences from business practice. Set of 10 innovation concepts was worked out based on searches, see Tab. 1.

The Concept of innovative performance measurement (I_1) describes the innovative performance as the ability of an enterprise to convert innovative inputs to outputs. The concept contains two ways of innovation evaluation. The first one (Šulák & Vacík, 2005; Žižlavský, 2014; Mlčoch, 2002; Banu, 2018) uses two groups of performance indicators – marketing and financially analytical that relate to the evaluation of basic and applied research results. Concrete specification of the indicators is missing. On the other hand breakeven point analysis has been carried out. It measures the time from the start of the work on product development until the product is marketed and generates profit. The second approach (Gupta & Trusko, 2014) recommends working out a portfolio of innovation metrics containing return on investment metrics, organizational metrics, and metrics in leadership, while each category contains input and output metrics. Metrics are more precisely specified, and by means of these metrics, specific calculations could be made.

Tab. 1: Set of 10 innovation concepts

Concept title	Concept Abbreviation	Determination according to following authors
Concept based on measurement of innovation performance	I_1	Šulák & Vacík, 2005; Gupta & Trusko, 2014; Žižlavský, 2014; Mlčoch, 2002; Banu, 2018
Concept Balanced Scorecard	I_2	Kaplan & Norton, 1996; 2000; 2004; 2006; 2008; Parmenter, 2015; Balanced Scorecard Institute, 2017
Concept based on the evaluation of innovations through investment efficiency indicators	I_3	Hauschildte, 2007; Prahalad & Krishnan, 2008; Pitra, 2006
Concept of value analysis	I_4	Miles, 1972; De Bonis et al., 2002; Vlček 1986; 2002; 2008; 2011)
Concept based on organizational readiness for innovation	I_5	Gupta & Trusko, 2014; Temel, 2014; Dobni, 2008
Concept based on determination of innovative potential	I_6	Kováč & Sabadka, 2004; Mikoláš et al., 2011; Kopčaj, 2007; Chester, 2017
Concept based on the creation of innovative radar	I_7	Sawhney et al., 2014
Concept based on the innovation index	I_8	Gupta & Trusko, 2014; Silverstein et al., 2012
Concept based on an innovative interactive panel	I_9	Gala et al., 2009; Few, 2006
Concept based on experience from corporate practice	I_{10}	Košturiak & Frolík, 2006; Košturiak & Chal´, 2008

Source: own

Concept Balanced Scorecard (I_2) belongs among the concepts commonly used in the strategic management of industrial enterprises (Kaplan & Norton, 1996; 2000; 2004; 2006; 2008; Parmenter, 2015; Balanced Scorecard Institute, 2017). The progressive steps of creating and implementing the BSC method are outlined in the concept. This method is suitable for management and business performance measurement. It contains four perspectives: financial perspective, customer perspective, business process perspective and learning and growth perspective. The value chain is beneficial for mapping and classification of business processes. Business process perspective is the most important perspective for innovation evaluation. The concept also brings difficulties to be considered when implementing the BSC method.

The Concept based on innovation evaluation with the use of efficiency indicators of investments (I_3) contains two approaches. The first one (Prahalad & Krishnan, 2008) evaluates innovations at the level of the inventive part of the innovation process (evaluates the shift towards knowledge) and at the level of innovation (economic benefits resulting from a new product and savings in the case of process innovation). The second approach (Pitra, 2006; Hauschildt, 2007) is more concrete. For innovation evaluation, three groups of indicators are used. The first group of indicators is used for assessing the competitiveness of a company, the second one is focused on business management, and the third one evaluates financial effects from investments.

The purpose of the Concept of value analysis (I_4) is to search for and design an improved

solution or new solution for the analyzed object in order to increase its efficiency (Miles, 1972; De Bonis et al., 2002; Vlček, 1986; 2002; 2008; 2011). Value analysis found its place in innovation processes in manufacturing, in the rationalization and modernization of products in mechanical engineering, in the electrical and consumer industries. Regarding nature of the problem solved, the value analysis can be applied so as to improve and streamline existing situation (rationalization or corrective character of value analysis), while creating completely new objects (production character of value analysis) and searching for more efficient use of given or newly created objects. The concept includes the methodological process of realizing the value analysis in seven stages: an object selection, a collection of information, functional analysis, the creation of ideas, elaboration, and evaluation of proposals, designing an optimal variant, discussion, and approval of the project. The focus of value analysis is in the implementation of the function-cost analysis and the calculation of the relative effective value.

The Concept of organizational readiness for innovation (I_5) contains identification of the relationship between climate and organizational readiness for innovation through analysis. The approaches to analysis were outlined by the company The Creative Problem Solving and company PA Consulting Group (Gupta & Trusko, 2014) and authors (Temel, 2014; Dobni, 2008). The analysis is based on determined factors (criteria). These factors differ in particular approaches, and concrete indicators are missing.

Innovation potential Concept (I_6) determines the difference between what exists now and what could exist or can happen in the future. Concept contains a determination of innovation potential from two views. The first point of view (Mikoláš et al., 2011; Kopčaj, 2007; Chester, 2017) describes the potential by its characteristics in terms of technology, material equipment and use of progressive materials, economics, and finance, business, and marketing, research and development, social and management. Diagnostic technique GM-TREND (Mikoláš et al., 2011) was worked out for the purpose of enterprise potential evaluation. The second view (Kováč & Sabadka, 2004) results from the assumption that the innovation potential is an internal characteristic. The model for assessing the innovation potential consists of ten modules. For each module, an area of evaluation is defined, including defined metrics that do not take the form of specific indicators but the form of the above-suggested measurement methods.

The concept based on innovation radar (I_7) results from the determination of innovation standing on three pillars: originality, holistic view, and outputs for customers (Sawhney et al., 2014). Innovation radar reflects the visual profile of contemporary innovation strategy of a company through 12 factors. These factors are evaluated using an online questionnaire. The factors do not have the form of indicators. Innovation radar has already been tested at the sample of American companies.

The concept using innovation index (I_8) is based on the set of chosen factors, commonly used for the evaluation of enterprise innovation activities (Gupta & Trusko, 2014; Silverstein et al., 2012). Two approaches to innovation index creation are outlined. The methodology of the first one uses financial results and expert evaluation of the company. The methodology is used for the evaluation of businesses and their mutual comparison in the sector. The second approach focuses on the creation of an innovation index at the firm's level. Defined inputs and outputs for measurements (not in the form of indicators) are the basis for this approach. The innovation process is defined by the 4 P model (Prepare, Perform, Perfect, Progress). It enables us to use innovation measurement by SIPOC model (Supplier, Input, Process, Output, Customer). It appears that the innovation index can be used when measuring innovation at different levels (sector level, business level, company level).

The concept of the innovative interactive panel (I_9) refers more to the graphical representation of effective management of innovation effort including evaluation of achieved results through monitored indicator tables, analytical charts including controls (Gala et al., 2009; Few, 2006). It uses a graphic representation of defined indicators for measurement, which can also be used in the area of innovation.

The concept based on business practice (I_{10}) describes an approach to innovation management and measurement created and implemented by the important innovator in the field of hospital beds (Košturiak & Frolík,

2006; Košturiak & Chal´, 2008). Frolík is the owner and top manager in Linet Company that belongs to the innovation leaders in the market with hospital beds. It is a company that does not copy the practices of the best companies in the industry but has developed its own approach to innovation based on a creative approach to problem-solving. For innovation measurement, this company uses two groups of metrics. This concept is applied in Linet Company and is focused on permanent seeking for balance between What to do? and How to do it? It means looking for a balance between standardization – productivity and permanent improvement – innovation realization. Metrics are determined only in general without concrete indicators.

A literature review of chosen innovation concepts showed the following findings. Each innovation concept is different in the area of focusing on innovation problem and way of detailization. It is worth noting that concrete innovation concepts are not at the same level of usability in practice, some of them need to be better specified for application in business. Concepts contained a solution of innovation problems in the area of innovation potential, organizational readiness for innovation and achieved a level of innovation climate or the actual implementation of the innovation process and the evaluation of the effects from the implemented innovations. The elaboration of the presented concepts either takes the form of a general framework or a specific framework with progressive implementation steps. Defined approaches to the evaluation of the effects of implemented innovations are either in the form of specific innovative metrics defined through indicators or are only outlined approaches. Some of the presented concepts have already been applied in corporate practice, and some other concepts were used by consultancy firms, and they have own experiences in their application. Innovation concepts have own problem areas: the process of innovation creation, the risk of implementing innovations and an evaluation of the effects of the implemented innovations.

2. Research Methodology

2.1 Innovations Concepts

Selection of the concepts presented in this paper reflects the level of reached research findings at the time of the paper submitting. Thus, ten innovation concepts (see Tab. 1) were determined: Concept based on measurement of innovation performance (I_1), Concept Balanced Scorecard (I_2), Concept based on the evaluation of innovations through investment efficiency indicators (I_3), Concept of value analysis (I_4), Concept based on organizational readiness for innovation (I_5), Concept based on determination of innovative potential (I_6), Concept based on the creation of an innovative radar (I_7), Concept based on the innovation index (I_8), Concept based on an innovative interactive panel (I_9), Concept based on experience from corporate practice (I_{10}).

2.2 Criteria Creation for Innovation Concepts Evaluation

According to Fotr and Švecová (2010) criterion is understood as an element of evaluation of innovation concepts with regard to their usability in an enterprise. On the basis of experts discussion (3+3 persons), a list of 8 criteria was elaborated to evaluate innovation concepts. Criteria were mainly assessed according to their use (operability), the tightness of the links among the individual criteria (independence) and whether they are not elaborated (non-redundancy).

The list of criteria for evaluation of innovation concepts is organized according to their importance, and logical continuity. The resulting set of criteria presented in Tab. 2 is an outcome of the process of executive decisions when choosing the concept of innovation to solve the innovative problem. For criteria C_1, C_2 and C_4, the rated object can be categorized into certain defined categories, and for these criteria, the scale is defined by the categories indicated by letters A through E. On the other hand, criteria C_3, C_5, C_6, C_7, C_8 evaluate an object by expressing a certain intensity of the rating on a given scale from 1 to 5.

At the same time, the criteria that directly influence the selection of the concepts of innovation itself in the innovation management process have been examined in detail, concretely company size and branch according to CZ-NACE. For that purpose results from the Czech Statistical Office, results from the university research project (Ludvík & Peterková, 2013) and findings from Tidd and Bessant (2013) were used. It means that the selection of innovation concepts relates to the enterprises with the number of employees from 250 to 999 and operating in section C – Manufacturing according to classification CZ-NACE.

Tab. 2: List of 8 criteria for evaluation of innovation concepts

Final criteria for evaluation of innovation concepts	Rating scale
C_1 – a type of innovation problem	A – problem-solving during the invention-creation, B – problem-solving during innovation creation, C – problem-solving during innovation diffusion
C_2 – the subject of realized innovation	A – product, B – process, C – marketing, D – organization, E – cannot be determined
C_3 – applicability of the concept of innovation in practice	1 – very low, 2 – low, 3 – medium, 4 – high, 5 – very high
C_4 – the use of innovation concept regarding the time of realization of an innovation project	A – before the implementation of an innovative project – ex-ante, B – during the implementation of the innovation project – innovation cycle, C – after completion of the innovation project – ex-post
C_5 – usability of the concept of innovation in an enterprise	1 – very low, 2 – low, 3 – medium, 4 – high, 5 – very high
C_6 – the level of elaboration of the concept of innovation into management levels	1 – very low, 2 – low, 3 – medium, 4 – high, 5 – very high
C_7 – determination of innovation metrics and their form	1 – very low, 2 – low, 3 – medium, 4 – high, 5 – very high
C_8 – savings resulting from the training of existing employees when implementing the concept of innovation	1 – very low, 2 – low, 3 – medium, 4 – high, 5 – very high

Source: own

2.3 Qualitative Aanalysis of Innovation Concepts by the Expert Group

Qualitative analysis was carried out on ten concepts of innovation based on expert group discussion (Maxwell, 2013). The expert group of 6 experts was composed of three academics and three industry experts. The expert group established a final number of 8 criteria, which were applied with the help of the researcher for the evaluation of the innovation concepts and subsequently for the definition of 10 variants of the use of the innovation concepts. Evaluation is the result of the consensus of the individual members of the expert group.

2.4 Decision Process Based on AHP

Analytic Hierarchy Process (AHP) developed by Saaty (1980) provides a framework for making effective decisions in complex decision situations while helping to simplify and speed up the decision-making process. It represents a linear decomposition method that provides an objective mathematical procedure for the inevitable subjective and personal determination of individual or group preferences in decision-making (Saaty & Peniwati, 2012). A typical multiple criteria analysis of variants according to Saaty and Peniwati (2012) has following levels: level 1 – the purpose of the evaluation, which may be the arrangement of the variants, level 2 – evaluation of criteria (evaluation of the importance of the criterion), level 3 – considered variants (variants ranking).

The AHP method is based on pair-wise comparisons to determine priorities. The partial goal of AHP is to reduce the number of scale dimensions to one. The author of the method identified seven pillars of the AHP method (Saaty & Vargas, 2001, p. 27-28): proportional scales, proportionality and normalized ratio scales, reciprocal pairing, sensitivity to the principal eigenvector, homogeneity and clustering, synthesis expandable to dependence and feedback, retention and reversal, group assessment and decision making.

The process of the hierarchical analytic process is determined by the following steps:

- Determining the weights of the criteria using the Saaty method (quantitative

pair-wise comparison) and determining the order of the individual criteria based on the calculated weights w_i according to the formula (1), checking the consistency of the matrix pair comparison (2).

- Assessing each variant on based on the Saaty scale preferences (1-9) in each criterion and calculating the weights by means of the geometric mean of the lines (2) and then verifying the consistency of the paired comparison (3).
- Creating an AHP matrix, the weights of the criteria and weights of each variant in the relevant criteria.
- Calculating the final score (the weighted sum of each criterion weights and the weights of the respective variants) and determining the order of the variants.

For determination of weights, we can use Saaty's method of quantitative pair-wise comparison based on the matrix **S** = (s_{ij}), where $i, j = 1, 2, \ldots, k$. The s_{ij} elements of the pair-wise matrix represent estimated relative weights of the *i-th* and *j-th* criterion (Ishizaka & Labib, 2011):

$$s_{ij} \approx \frac{w_i}{w_j};\ i, j = 1, 2, \ldots, k. \qquad (1)$$

Pair-wise comparison of the criteria determines the dimension of the preference, which is expressed by a certain number of points from Saaty's scale: "1", *i* and *j* are equal, "3", *i* is slightly preferred to *j*, "5", *i* is strongly preferred before *j*, "7", *i* is very strongly preferred to *j*, "9", *i* is absolutely preferred to is given to *j*, values 2, 4, 6 and 8 are left to evaluate the intermediate stages.

Ishizaka & Labib (2011) states that the decision making is performed using pair-wise comparisons of a set of items (criteria) $f_1, f_2, \ldots, f_k$. By comparing these items with each other the matrix $\boldsymbol{S} = (s_{ij})$ is created, where $i, j = 1, 2, \ldots, k$. It is now necessary to derive the weight of these items (criteria) from the pair-wise comparison matrix. The vector of their values is denoted by $v = (w_1, w_2, \ldots, w_k)$. Pair-wise comparison matrix ***S*** contains quantified information about the relationship of the individual pairs of items illustrated in Fig. 2. The element s_{ij} of this matrix can be interpreted as the ratio of the importance of the elements f_i and f_j. The elements on the diagonal have assigned value $s_{ii} = 1$ (the criterion is equivalent to itself). The matrix S is reciprocal, i.e. must apply that $s_{ij} = 1/s_{ij}$ for all *I*,j.

In practice, the most commonly used method of weights determination is to use the row geometric mean method (RGMM). This solution is based on a calculation of the geometric mean of individual rows from the decision matrix (multiplying the elements of the individual rows of this matrix and determining the *k* root of these sums). By normalizing these row geometric means (by dividing them by the sum of these geometric means), we obtain the criterion weights w_i (Ishizaka & Labib, 2011) – see Eq. 2.

Fig. 2: General outlook of the Saaty matrix

	f_1	f_2	K	f_k
f_1	1	s_{12}	K	s_{1k}
f_2	$1/s_{12}$	1		s_{2k}
M	M			
f_k	$1/s_{1k}$	$1/s_{2k}$	K	1

Source: Ishizaka and Labib (2011)

$$w_i = \frac{\left[\prod_{j=1}^{k} s_{ij}\right]^{1/k}}{\sum_{i=1}^{k}\left[\prod_{j=1}^{k} s_{ij}\right]^{1/k}} \quad \text{for } i = 1,\ldots, k. \qquad (2)$$

The consistency of pair-wise matrices is checked as a part of the process of determination of weight by the Saaty method. Consistency should be checked before the weights determination with the aim to figure out whether the matrix is sufficiently consistent. Escobar et al. (2004) studied the consistency scale and presented their own geometric consistency index (GCI) calculation as opposed to the original Saaty consistency ratio (Saaty & Peniwati, 2012). The GCI was specifically created for the use of RGMM method of weights determination. The GCI is calculated as follows (Escobar et al., 2004):

$$GCI = \frac{2}{(n-1)(n-2)} \sum_{j \geq i} \left(\log(s_{ij}) - \log \frac{w_i}{w_j} \right)^2, \qquad (3)$$

where n represents a number of criteria, w_i/w_j is Ratio of approximate weights. Approximate threshold values for consistency assessment were set by Escobar et al. (2004) as follows: GCI_{max} for n = 1.2 is 0.31; for n = 3 is 0.3147; for n = 4 is 0.3526 and for n > 4 is 0.37.

3. Findings

3.1 Evaluation of the Use of Innovation Concepts by Selected Criteria

For qualitative evaluation of the usability of innovation concepts (I_1 to I_{10}) see Tab. 1. Each concept was evaluated by the criteria (C_1, C_2, C_3, C_4,C_5, C_6, C_7, C_8), see Tab. 2. The expert group with the help of the author of the paper determined the ratings according to the proposed rating scale. Results were marked with a cross; not reaching the level was not marked, see Tab. 3.

Tab. 3 provides variants of using 10 concepts (V_1, V_2…..V_{10}) on the basis of 8 criteria.

V_1 – concept usability based on innovation performance measurement (I_1): solution of problems in the innovation process in the creation and when spreading the innovations → the subject of the implemented innovation can be product, process, marketing, organization → applicability of the concept in practice is very low → utilization during the implementation of the innovation project → usability of the concept in an enterprise is average → elaboration of the concept into four management levels of control → developed evaluation system with rating

Tab. 3: Evaluation of the use of innovation concepts by 8 criteria

Concepts	Criteria for evaluation																																		Variants
	C_1			C_2					C_3					C_4			C_5					C_6					C_7					C_8					
	A	B	C	A	B	C	D	E	1	2	3	4	5	A	B	C	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	
I_1			x	x	x	x	x			x						x			x							x				x				x		V_1
I_2		x	x	x	x	x	x						x	x		x				x						x				x		x				V_2
I_3	x		x	x	x	x	x			x						x			x							x				x				x		V_3
I_4	x	x	x	x	x	x	x						x	x	x	x					x					x				x		x				V_4
I_5	x							x					x	x					x				x						x			x				V_5
I_6	x			x	x	x	x						x	x						x						x				x			x			V_6
I_7			x					x		x					x	x		x								x				x		x				V_7
I_8			x					x		x					x	x			x							x				x			x			V_8
I_9			x					x		x						x		x					x				x					x				V_9
I_{10}		x	x	x	x	x	x						x		x	x			x							x				x			x			V_{10}

Source: own

factors up to the level of specific indicators → the savings from training of existing staff is high.

V_2 – usability of the concept of the method BSC (I_2): Solution of problems in the innovation process in the creation and when spreading the innovations → the subject of the implemented innovation can be product, process, marketing, organization → applicability of the concept in practice is very high → the use before the implementation of the innovation project itself and the completion of the innovation project → usability of the concept in an enterprise is high → elaboration of the concept into four levels of management → developed evaluation system with evaluation factors up to the level of specific indicators → the savings from training of existing employees are low.

V_3 – usability of the concept based on evaluation of innovations through investment efficiency indicators (I_3): Solving problems in the innovation process when creating inventions and spreading innovations → the subject of the implemented innovation can be product, process, marketing, organization → applicability of the concept in practice is very low → use before the implementation of an innovative project and after the completion of the innovation project → usability of the concept in an enterprise is average → elaboration of the concept into four levels of management → developed evaluation system with evaluation factors up to the level of specific indicators → the savings from training of existing employees are high.

V_4 – usability of the concept based on value analysis (I_4): Solution of problems in the innovation process in the creation of invention, innovation, and dissemination of innovation → the subject of the implemented innovation can be product, process, marketing, organization → applicability of the concept in practice is very high (experience from a number of enterprises) → use before the implementation of the innovation project , during the implementation of the innovation project and after the completion of the innovation project → usability of the concept in an enterprise is very high → the elaboration of the concept into four levels of management → the developed evaluation system with evaluation factors up to the level of specific indicators → the savings from training of existing employees are low.

V_5 – concept based on organizational readiness for innovation (I_5): Solving problems in the innovation process when creating inventions → the subject of the implemented innovation cannot be determined → applicability of the concept in practice is very high (experience of consultancy firms) → the use before the implementation of the innovation project itself → usability of the concept in an enterprise is average → the elaboration of the concept into two levels of control → rating system with assessment factors → the savings from training of existing employees are low.

V_6 – concept based on the determination of innovation potential (I_6): Solving problems in the innovation process when creating inventions → the subject of the implemented innovation can be product, process, marketing, organization → applicability of the concept in practice is very high → use before the implementation of the innovation project → usability of the concept in an enterprise is high → the elaboration of the concept into four levels of management → developed evaluation system with rating factors → the savings from training of existing staff is low.

V_7 – concept based on creation of innovation radar (I_7): Problem solving related to the assessment of the innovation process within the diffusion of innovation → the subject of the implemented innovation cannot be determined → applicability of the concept in practice is very low → the use during the implementation of the innovation project and the completion of the innovation project → usability of the concept in an enterprise is low → the elaboration of the concept into four levels management → developed evaluation system with assessment factors → the savings from training of existing employees is very low.

V_8 – concept based on innovation index (I_8): Solution of problems related to the assessment of the innovation process in the area of evaluation of innovation benefits → the subject of the implemented innovation cannot be determined → applicability of the concept in practice is very low → the use during the implementation of the innovation project and the completion of the innovation project → usability of the concept in an enterprise is average → the elaboration of the concept to four levels of management → developed evaluation system with rating factors up to indicator level → the savings from training of existing employees are low.

V_9 – concept based on innovation interactive panel (I_9): Solving the problems related to the

monitoring of results in the area of evaluation of innovation benefits → the subject of the implemented innovation cannot be determined → applicability of the concept in practice is very low → the use after the completion of the innovation project → usability of the concept in an enterprise is low → the elaboration of the concept into two levels of control → general characteristics of rating → the savings from training of existing employees are very low.

V_{10} – concept based on the experiences from a business practice (I_{10}): Solution of problems in the innovation process in the creation of innovation and within the diffusion of innovation → the subject of the implemented innovation can be product, process, marketing, organization → applicability of the concept in practice is very high → use during the implementation of the innovation project and after completion of the innovation project → usability of the concept in an enterprise is average → the elaboration of the concept into four levels of management → a developed evaluation system with evaluation factors up to the level of specific indicators → the savings from the training of existing employees are low.

3.2 Selection of the Innovation Concept Based on Decision Model AHP

In the case of 5 criteria (from the original 8) which were selected by the expert group, it is possible to determine the order of importance. Then for the selection of innovation concept (from I_1 to I_{10}), it is possible to create a decision-making model based on AHP. Selected criteria for evaluation of innovation concepts, see

Tab. 4: Chosen criteria for applications in decision models

Criteria for evaluation of innovation concepts	Determined rating scale	New order and criterion designation
C_3 – applicability of the concept of innovation in practice	1 – very low, 2 – low, 3 – average, 4 – high, 5 – very high	C_1
C_5 – usability of the concept of innovation in an enterprise	1 – very low, 2 – low, 3 – average, 4 – high, 5 – very high	C_2
C_6 – the level of elaboration of the concept of innovation into management levels	1 – very low, 2 – low, 3 – average, 4 – high, 5 – very high	C_3
C_7 – determination of innovation metrics and their form	1 – very low, 2 – low, 3 – average, 4 – high, 5 – very high	C_4
C_8 – savings resulting from the training of existing employees when implementing the concept of innovation	1 – very low, 2 – low, 3 – average, 4 – high, 5 – very high	C_5

Source: own

Tab. 5: Determination of the weights of the criteria using the Saaty matrix

Criterion	C_1	C_2	C_3	C_4	C_5	Row Geometric Mean	Weight (w_i)	Order
C_1	1	2	8	8	8	4.000	0.504	1
C_2	1/2	1	6	6	6	2.551	0.321	2
C_3	1/8	1/6	1	1/2	3	0.500	0.063	3
C_4	1/8	1/6	2	1	1/2	0.461	0.058	4
C_5	1/8	1/6	1/3	2	1	0.425	0.054	5

Source: own

Tab. 6: Assessment of innovation concepts based on Saaty scale preferences in criterion C_1

Concepts	I_1	I_2	I_3	I_4	I_5	I_6	I_7	I_8	I_9	I_{10}	GEOMEAN	Weights
I_1	1	1/7	1	1/7	1/7	1/7	1	1	1	1/7	0.378	0.025
I_2	7	1	7	1	3	3	7	7	7	1	3.296	0.217
I_3	1	1/7	1	1/7	1/7	1/7	1	1	1	1/7	0.378	0.025
I_4	7	1	7	1	1	1	7	7	7	1	2.646	0.174
I_5	7	1/3	7	1	1	1	7	7	7	1	2.370	0.156
I_6	7	1/3	7	1	1	1	7	7	7	1	2.370	0.156
I_7	1	1/7	1	1/7	1/7	1/7	1	1	1	1/7	0.378	0.025
I_8	1	1/7	1	1/7	1/7	1/7	1	1	1	1/7	0.378	0.025
I_9	1	1/7	1	1/7	1/7	1/7	1	1	1	1/7	0.378	0.025
I_{10}	7	1	7	1	1	1	7	7	7	1	2.646	0.174
Sum											15.218	1

Source: own

Geometric consistency index GCI (2.3) is 0.047 < 0.37, matrix of pair comparison is consistent.

Tab. 7: Assessment of innovation concepts based on Saaty scale preferences in criterion C_2

Concepts	I_1	I_2	I_3	I_4	I_5	I_6	I_7	I_8	I_9	I_{10}	GEOMEAN	Weights
I_1	1	1/5	1	1/7	1	1/5	5	1	5	1	0.823	0.053
I_2	5	1	5	1/5	5	1	7	5	7	5	2.809	0.180
I_3	1	1/5	1	1/7	1	1/5	5	1	5	1	0.823	0.053
I_4	7	5	7	1	7	5	7	7	7	7	5.387	0.345
I_5	1	1/5	1	1/7	1	1/5	5	1	5	1	0.823	0.053
I_6	5	1	5	1/5	5	1	7	5	7	5	2.809	0.180
I_7	1/5	1/7	1/5	1/7	1/5	1/7	1	1/5	1	1/5	0.249	0.016
I_8	1	1/5	1	1/7	1	1/5	5	1	5	1	0.823	0.053
I_9	1/5	1/7	1/5	1/7	1/5	1/7	1	1/5	1	1/5	0.249	0.016
I_{10}	1	1/5	1	1/7	1	1/5	5	1	5	1	0.823	0.053
Sum											15.621	1

Source: own

Geometric consistency index GCI (2.3) is 0.236 < 0.37, matrix of pair comparison is consistent.

Tab. 4, have the nature of the maximization criteria, that is, the best variants according to this criterion have the highest values.

Before the application of the AHP method, the authors of the present research determined the weights of the individual criteria using the Saaty method and author also determine the order of each criterion based on the calculated weights w_i according to the formula (1). The created Saaty matrix, see Tab. 5, is the result of the consensus of the expert group of (3+3) who have agreed on the evaluation of the paired comparison in Tab. 5 with the assistance of the authors of the present research.

Control of the consistency of the Saaty pair-wise comparison matrix (see Tab. 5) was provided with the help of consistency index GCI. Geometrical consistency index GCI was

Tab. 8: Assessment of innovation concepts based on Saaty scale preferences in criterion C_3

Concepts	I_1	I_2	I_3	I_4	I_5	I_6	I_7	I_8	I_9	I_{10}	GEOMEAN	Weights
I_1	I_2	I_3	I_4	I_5	I_6	I_7	I_8	I9	I_{10}	1	1.476	0.121
I_2	1	1	1	1	7	1	1	1	7	1	1.476	0.121
I_3	1	1	1	1	7	1	1	1	7	1	1.476	0.121
I_4	1	1	1	1	7	1	1	1	7	1	1.476	0.121
I_5	1/7	1/7	1/7	1/7	1	1/7	1/7	1/7	1	1/7	0.211	0.017
I_6	1	1	1	1	7	1	1	1	7	1	1.476	0.121
I_7	1	1	1	1	7	1	1	1	7	1	1.476	0.121
I_8	1	1	1	1	7	1	1	1	7	1	1.476	0.121
I_9	1/7	1/7	1/7	1/7	1	1/7	1/7	1/7	1	1/7	0.211	0.017
I_{10}	1	1	1	1	7	1	1	1	7	1	1.476	0.121
Sum											1.228	1

Source: own

Geometric consistency index GCI (2.3) is 2.19-32 < 0.37, matrix of pair comparison is consistent.

Tab. 9: Assessment of innovation concepts based on Saaty scale preferences in criterion C_4

Concepts	I_1	I_2	I_3	I_4	I_5	I_6	I_7	I_8	I_9	I_{10}	GEOMEAN	Weights
I_1	1	1	1	1	5	5	5	1	9	1	2.019	0.148
I_2	1	1	1	1	5	5	5	1	9	1	2.019	0.148
I_3	1	1	1	1	5	5	5	1	9	1	2.019	0.148
I_4	1	1	1	1	5	5	5	1	9	1	2.019	0.148
I_5	1/5	1/5	1/5	1/5	1	1	1	1/5	7	1/5	0.463	0.034
I_6	1/5	1/5	1/5	1/5	1	1	1	1/5	7	1/5	0.463	0.034
I_7	1/5	1/5	1/5	1/5	1	1	1	1/5	7	1/5	0.463	0.034
I_8	1	1	1	1	5	5	5	1	9	1	2.019	0.148
I_9	1/9	1/9	1/9	1/9	1/7	1/7	1/7	1/9	1	1/9	0.149	0.011
I_{10}	1	1	1	1	5	5	5	1	9	1	2.019	0.148
Sum											13.650	1

Source: own

Geometric consistency index GCI (2.3) is 0.092 < 0.37, matrix of pair comparison is consistent.

calculated (3), and its value is 0.37 which refers to the limit value for the 5 criteria. The calculations made when applying the AHP method are performed in MS Excel.

The decision-making model based on AHP method was used to organize 10 concepts of innovation based on the preference assessment of individual concepts within a given criterion. Then each innovation concept variant was assessed on the basis of Saaty scale (1 to 9) in criterion C_1 – applicability of the concept of innovation in practice, see Tab. 6, in criterion C_2 – usability of the concept of innovation in an enterprise, see Tab. 7, in criterion C_3 – the level of elaboration of the concept of innovation into management levels, see Tab. 8, in criterion C_4 – determination of innovation metrics and their form, see Tab. 9. In criterion C_5 – savings

Tab. 10: Assessment of innovation concepts based on Saaty scale preferences in criterion C_5

Concepts	I_1	I_2	I_3	I_4	I_5	I_6	I_7	I_8	I_9	I_{10}	GEOMEAN	Weights
I_1	1	5	1	5	1/3	5	9	5	9	5	3.11	0.213
I_2	1/5	1	1/7	1	5	1	5	1	5	1	1.14	0.078
I_3	1	5	1	7	5	7	9	5	9	5	4.36	0.298
I_4	1/5	1	1/7	1	1/5	1	5	1	5	1	0.82	0.056
I_5	3	1/5	1/5	5	1	5	7	5	7	5	2.27	0.156
I_6	1/5	1	1/7	1	1/5	1	5	1	5	1	0.82	0.056
I_7	1/9	1/5	1/9	1/5	1/7	1/5	1	1/3	1	1/3	0.26	0.018
I_8	1/5	1	1/5	1	1/5	1	3	1	3	1	0.77	0.053
I_9	1/9	1/5	1/9	1/5	1/7	1/5	1	1/3	1	1/5	0.25	0.017
I_{10}	1/5	1	1/5	1	1/5	1	3	1	5	1	0.81	0.055
Sum											14.61	1

Source: own

Geometric consistency index GCI (2.3) is 0.369 < 0.37, matrix of pair comparison is consistent.

Tab. 11: Matrix AHP

Criteria		C_1	C_2	C_3	C_4	C_5
Criteria weights		0.504	0.321	0.063	0.058	0.054
Concepts	I_1	0.025	0.053	0.121	0.148	0.213
	I_2	0.217	0.180	0.121	0.148	0.078
	I_3	0.025	0.053	0.121	0.148	0.298
	I_4	0.174	0.345	0.121	0.148	0.056
	I_5	0.156	0.053	0.017	0.034	0.156
	I_6	0.156	0.180	0.121	0.034	0.056
	I_7	0.025	0.016	0.121	0.034	0.018
	I_8	0.025	0.053	0.121	0.148	0.053
	I_9	0.025	0.016	0.017	0.011	0.017
	I_{10}	0.174	0.053	0.121	0.148	0.055

Source: own

Tab. 12: Final order of innovation concept

Innovation concepts (variants)	I_1	I_2	I_3	I_4	I_5	I_6	I_7	I_8	I_9	I_{10}
Resulting score	0.057	0.187	0.062	0.218	0.107	0.149	0.028	0.048	0.020	0.124
Order	7	2	6	1	5	3	9	8	10	4

Source: own

resulting from the training of existing employees when implementing the concept of innovation, see Tab. 10.

At the same time, the preferences of the concepts were calculated using the geometric mean of rows (2) and the consistency of the matrix pair comparisons was checked using the GCI consistency geometric index (3).

AHP matrix was created to represent a matrix of criteria weights and the proportion is belonging to innovation concepts (variants) in the relevant criteria, see Tab. 11.

Finally, the resulting score (the weighted sum of criteria weights and the proportion the respective variants) has been calculated, and the order of the variants is shown in Tab. 12.

4. Discussion

On the one hand, the solution of the research problem was accomplished by realizing a qualitative analysis through a group of experts (3+3 persons) with the assistance of the researcher and on the other hand by creating decision model based on the Analytic Hierarchical Process method (AHP).

Set of ten innovation concepts was created – see Tab. 1. This set cannot be considered as a final number of existing innovation concepts. The created set reflects the researcher's findings and available resources that represented fundamental knowledge background at the time of finalizing this paper. At the same time, the use of concepts of innovation in the management of innovations in the enterprise is outlined in Fig. 1.

Regarding the use of innovation concepts in business practice, the set of criteria for the concepts evaluation was created. In order to ensure objectivity while determining criteria, an expert group of three experts from business practice and three experts from the academic sphere was established. Verification of validity of particular criteria was a difficult part of the research. Final criteria are in Tab. 2 and are as follows: C_1 – type of innovation problem, C_2 – subject of realized innovation, C_3 – applicability of the concept of innovation in practice, C_4 – the use of innovation concept regarding the time of realization of innovation project, C_5 – usability of the concept of innovation in an enterprise, C_6 – level of elaboration of the concept of innovation into management levels, C_7 – determination of innovation metrics and their form, C_8 – savings resulting from training of existing employees when implementing the concept of innovation.

All ten innovation concepts (I_1 to I_{10}) were evaluated through qualitative analysis with 8 criteria (C_1 to C_8) chosen by the expert group. Gained results were elaborated in the matrix, see Tab. 3. The result of the process of evaluation was represented by 10 variants (V_1 to V_{10}) of the use of the innovation concepts. Each variant was described by: type of innovation problem, subject of realized innovation, applicability of the concept of innovation in practice, using the concept of innovation with regard to the time of the implementation of the innovation project, applicability of the concept of innovation in an enterprise, level of elaboration of the concept of innovation into management levels, determination of innovation metrics and their form, savings resulting from training of existing employees when implementing the concept of innovation. Determined variants are suitable for large enterprises from manufacturing branch (according to CZ-NACE section C) with the number of employees from 250 to 999.

In case of 5 criteria (from the total number of 8) chosen by the expert group, it was possible to determine the level of importance so that the author could use the decision-making model. The expert group set a new order of 5 criteria: C_1 – applicability of the concept of innovation in practice, C_2 – usability of the concept of innovation in an enterprise, C_3 – level of elaboration of the concept of innovation into management levels, C_4 – determination of innovation metrics and their form, C_5 – savings resulting from training of existing employees when implementing the concept of innovation. In case of both decisions making models, innovation concepts were assessed on the basis of 5 criteria with the weights resulting from the use of the Saaty method. The consistency of the matched pair matrix was controlled with the use of the GCI consistency index.

The decision-making model based on Analytic Hierarchical Process (AHP) was created on the basis of evaluation of preference of each concept under the framework of a given criterion. Method application is more difficult but more complex. The application of the decision-making model brought following order of the concepts: 1. The concept of value analysis (I_4), 2. Concept Balanced Scorecard (I_2), 3. Concept based on the determination of innovative potential (I_6), 4. Concept based on experience from corporate practice (I_{10}), 5. Concept based on organizational readiness

for innovations (I_5), 6. Concept based on the evaluation of innovations through investment efficiency indicators (I_3), 7. Concept based on the measurement of innovation performance (I_1), 8. Concept based on the innovation index (I_8), 9. Concept based on the creation of innovative radar (I_7) and 10. Concept based on an innovative interactive panel (I_9).

The proposed decision model allows managers to orient quickly among concepts of innovation and make an informed choice about a concrete concept of innovation for business application. The application of the proposed models is particularly suited for large companies and for those involved in the manufacturing industry. At the same time, the presented steps for implementing decision model might be a guide for managers to create their own decision model when changing criteria or evaluating a set of innovation concepts.

Business managers should also take into account that, although there are common issues that can be confronted with a number of innovative solution concepts, each business must find its own solution. It is not enough to duplicate innovation concepts from competitors, but it is necessary to adapt them to suit specific conditions of the company. Our study results support hypotheses derived from all of the theoretical explanations, indicating that the realization of the innovation concepts is a result of a strategic business framework.

Conclusion

We believe that this study is a promising contribution to developing a better understanding of the evaluation of the usability of selected innovation concepts for managing innovation activities. It not only identifies selected innovation concepts as an important prerequisites for successful business in the contemporary competitive business environment but it also tries to provide new insights into the usability of these concepts.

This paper was intended to present findings of chosen innovation concepts. It introduces the evaluation of their usability in business practice. Research findings are applicable mainly to large enterprises from the manufacturing industry.

The set of ten innovation concepts was proposed. For the evaluation of innovation concepts, a qualitative analysis was used. A group of 6 experts together with one of the authors of the paper determined 8 criteria. The research results in establishing ten variants of innovation concepts regarding the type of innovation problem, subject of realized innovation, level of verification of innovation concept in practice, the use of innovation concept regarding the time of realization of innovation project, applicability of innovation concept in practice, level of elaboration of the concept of innovation into management levels, innovation metrics and their form, savings resulting from training of existing employees when implementing the concept of innovation.

The paper also introduced a decision-making model that enables managers to choose a workable and suitable innovation concept. The model is based on 10 innovation concepts with 5 criteria. Managers can apply decision-making model based on the AHP method.

This paper was supported by the Operational Programme Education for Competitiveness – Project No. CZ.1.07/2.3.00/20.0296. Also, this paper was supported by the Ministry of Education, Youth and Sports Czech Republic within the Institutional Support for Long-term Development of a Research Organization in 2017.

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Abstract

EVALUATION OF THE USABILITY OF SELECTED INNOVATION CONCEPTS FOR MANAGING INNOVATION ACTIVITIES

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A significant number of enterprise owners and managers realize an importance of innovations for the future existence of their business and its development. It appears that in theory and business practice a number of innovation concepts can be found, however for managers and business owners it is difficult to be knowledgeable in innovation concepts in order to use them in practice. Innovation concepts represent solutions outline, which react to the business ability to innovate. Each innovation concept is different in the area of focusing on innovation problem and way of detailization. Chosen innovation concepts can be applied when solving following problems: Identifying the innovation potential, organizational readiness for innovation and achieved levels of innovation climate, or the actual implementation of the innovation process and the evaluation of innovation. It is worth noting that concrete innovation concepts are not at the same level of usability in practice, some of them need to be better specified for application in business. A set of innovation concepts was created and evaluated the usability of individual concepts in the enterprise. The evaluation was carried out by qualitative analysis using selected criteria, which were determined by an expert group with the assistance of the researcher. Variants of usability of innovation concepts were defined subsequently. At the same time, decision-making model based on the Analytic Hierarchical Process was designed and applied in order to classify innovation concepts. Decision-making model can be used by managers for the purpose of innovations management while choosing the concept of innovation.

Key Words: *Innovation concept, managing innovations, decision model, the AHP method, Czech Republic.*

JEL Classification: *M1, O32.*

DOI: *10.15240/tul/001/2018-4-010*