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Process of inventions creation management

INTRODUCTION

The strategic orientation define phase is in many enterprises a narrow place so enterprises, which are able to react very fast gain the big competitive head start. From practical view it is known that about innovation processes are deficient analytical methods on the problem solution, but important are also psychological aspects needed for the innovation culture creation in the enterprise. Very important is also to develop employment's creativity and potential, without which is not created any invention or innovation solution. Small and medium sized enterprises (SMEs) are considered as so called "spine of innovation potential" in actual Europe. According to IPA Slovakia company research [IPA, 2009] inconvenient innovation process models are applied in these enterprises, what signalizes a need for modeling them. Causes of non-success in the innovation field of SMEs already rest in unsystematic solutions and wrong decisions of employees and management in the first innovation process phase – the process of inventions creation. These things cause that within our realised research was formulated the scientific problem as the process of inventions creation system dynamics monitoring in SMEs.

The main aim of this research was to propose the process of inventions dynamics creation model for SMEs as a tool for unsystematic innovation impulses arrestment process, which increments inventions creation. This paper is written within solving of the project VEGA¹, which is aimed at innovation processes of SMEs during economic recession.

PROCESS OF INVENTION CREATION AS A PART OF INNOVATION PROCESS

Today it is very important exactly to change strategies, because of safeguard future by manage of sustainable changes in the enterprise's environment and infrastructure. Enterprise has to learn change, leave with it and use it to bring in

¹ VEGA 1/0425/10 Causal process innovation models of SMEs during economic recession.

that, what market needs in the right place at the right time. This ability is according to Čimo and Mariaš [Čimo, Mariaš, 2006] often connected with the name „FIT enterprise“:

- **F** (Flexibility),
- **I** (Innovation),
- **T** (Time).

For SMEs in actual time it is important to rivet mainly on the innovations and innovation processes. In innovation definitions is mostly concerned characteristic of innovation process, enterprise's activities conduced to positive changes or product, service, process and system as a result of innovation process. The concept of innovation is in our point of view considered as output of innovation process as a new value for the customer and enterprise, which it has implemented.

The founder of the innovation theory, Schumpeter, divided invention from innovation and later enlarged innovation on “commercialization of new product or process” [Nauwelaers, Wintjes, 2008, s. 3–4]. Interconnection of knowledge and inspiration according to Sabadka and Lešková [Sabadka, Lešková, 2002], Tidd et al. [Tidd, Bessant, Pavitt, 2007] define the innovation process as the process of innovation from impulse identification to the invention implementation in form of innovation. Following Figure1 consists of four phases of sequential impulse conversion.

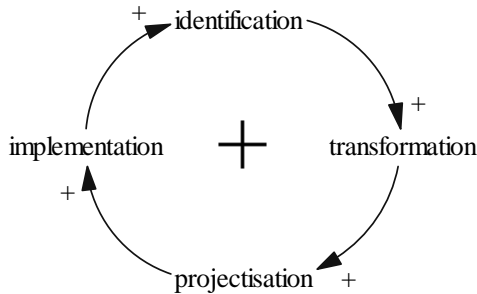


Figure 1. The innovation process reinforcing loop

Resource: Authors.

To every of introduced four phases belongs certain output. The innovation process consists from 4I:

1. **Impulse** – the motive of invention existing in concrete information, which can come from internal or external enterprise's environment.
2. **Invention** – the realizable innovation idea created of filed impulses transformation.
3. **Integration** – the prepared innovation prototype or project intended on implementation.

4. **Innovation** – the product, process, system as a new value for the customer and enterprise, which has implemented that.

The process of inventions creation funnel begins with many potential internal and external resources continues of the captured impulses depending on enterprise's innovation preparedness, consequently the filed impulses as the result of the captured impulses processing and follows into certain amount of inventions, from which could create and then implement innovations. In many cases but give out to wrong interpretation of the captured impulses and thereby to their loss, deficient transformation on inventions what causes quite lower amount of inventions. The process of inventions creation does not habituate to be a research object. In our point of view it is very important part of the innovation process, because this phase is its start, which should be planned and manage systematically because of other consequent innovation process phases. The basic premise of commercial business success in conditions of global market is already innovation management², which is dynamic factor connected with theory and practice of business management.

AIM AND METHODOLOGY

Following the formulation of the scientific problem was the main aim of our research to propose the process of inventions creation model for SMEs, given the interest to contribute by own proposals, respectively recommendations to improve their innovation process.

In the period 2008–2011 in order to identify the variables of the innovation process realised three surveys were:

1. Personal managed interviews and observation (November 2008).
2. Questionnaire survey no. 1 (March – April 2010).
3. Questionnaire survey no. 2 (February – March 2011).

The first survey using personal managed interviews was realized in three large companies of Prešov Autonomous Region. Its aim was to identify variables of the innovation process as a basis for creating questions for a questionnaire survey and gaining inspiration for drawing up the causal model for SMEs. The objective of on-line questionnaire of survey no. 1 was collecting information from the field of innovation potential utilization and innovation management in companies in order to test the clarity of the questions generated by the personal experiences of a personal structured interview, and to obtain additional information on the course of the innovation process. Randomly selected repre-

² Innovation management is understood as synonym of innovation process managing.

sented 0.06% of the enterprises of investigated region. At the first survey participated together 77 questioned enterprises, including 58 small (75%), 13 medium sized (17%) and 6 large enterprises (8%). Confirmation of the need to model the process of inventions creation and its detailed examination in order to identify its key variables of SMEs was the aim of questionnaire survey no. 2. A sample of 130 SMEs operating in Košice and Prešov Autonomous Region (43% micro, 34% of small and medium 23%) was obtained by filtering out correctly completed questionnaires from 142 the total collected. Both samples of on-line questionnaire surveys are so considered as relevant to identify the key variables of the proposed model.

For the creation of the proposed model were used causal relations of identified variables defined by other authors with the use of logical research methods to detect causal relationships based on self-knowledge gained by studying literature and carrying out own investigations. In order of elements and links between them they have worked without any problems, just need to reach their logical arrangement. As a tool for solving the identified scientific problem we chose a causal model of researched process of inventions creation, whereas the linear model cannot adequately explain the operation, respectively principles of the innovation process as accurately evaluated [Kim , Choi, 2009].

Dynamic and systematic thinking is believed to explain the behavioural pattern of problems as a lapse of time rather than to detect the cause of the problem for a specific time. Appropriate representation of the proposed mental model is a causal loop diagram CLD, which helps to understand and communicate interactions determining the dynamics of the system. The links between the identified variables in the model are labeled as follows [*Catalina Foothills...*, 2003]:

1. “+” – both variables move in the same direction. If the first variable increases, the second variable will be greater than it would have been otherwise; a decrease in the first causes the second to be less than it would have otherwise been.
2. “-“ – two variables change in the opposite direction. If the first variable increases, the second will be less than it would have been otherwise; a decrease in the first variable causes the second to be greater than it would have been otherwise.

Cycles in the causal model can be amplified up to limits or offset the balance. This kind of model thus serves to express the tendency of system behaviour or its stabilization, when is pursued its dynamics. A CLD may be reinforcing and grow, or shrink, until acted upon by a limiting force or balancing and move toward, return to, or oscillate around a particular condition. Reinforcing loops are marked with a “+” in the centre; balancing loops are indicated with a “-“ in the centre. Two short commas represent very important time delay.

RESULTS

Common operation programmes collect research capacities and help to achieve results, which should not achieve countries of European Union individually. Innovation activities (as result of R&D) are in EU motive power of economics development, develop possibilities of future competitiveness in form of new knowledge, increase effectiveness and fighting power of economics mainly through SMEs. On the basis of information overview about pro-innovation environments, which were obtained from regional innovation strategies and own survey results was possible to identify some groups of factors, which influence enterprise innovation activity. In some cases or opposite situations can be negative factors of environment threats, but also opportunities for given business unit [Mizla, Pešáková, 2011].

The object of modeling was the process of inventions creation as the first part of the innovation process. The basic process of inventions creation reinforcing loop as well as its outputs is shown in Figure 2.

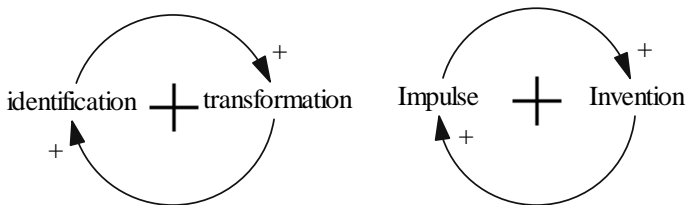


Figure 2. The process of inventions creation reinforcing loops

Resource: Authors.

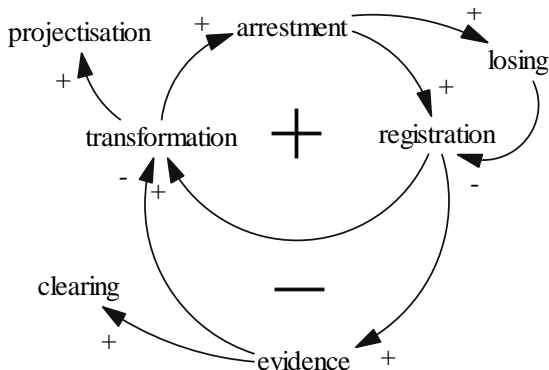


Figure 3. The process of inventions creation flows / reinforcing & balancing loop

Resource: Authors.

The first phase of the innovation process (identification) is divided because of the detailed examination on the base of information from secondary and primary sources (personal interviews) to the sub processes: arrestment, losing, registration, evidence, clearing of impulses, projectisation of inventions as is shown in Figure 3. The sub processes are inherently related to impulses, which in the process of inventions creation acquire higher forms of their transformation.

Based on primary and secondary sources (personal managed interviews) have been identified outcomes of the process of inventions creation (Figure 4), which are stock variables. The first three of them represent different stages of the researched process funnel:

1. **Captured impulses** – the number of impulses gained by their arrestment from internal and external resources.
2. **Registered impulses** – the amount of well-interpreted³ and subsequently registered or registered impulses recorded in the business evidence.
3. **Inventions** – the amount of viable innovative ideas generated by the transformation of registered impulses.
4. **Outdated impulses** – the number of registered impulses stored in the evidence that are not transformed into the inventions.

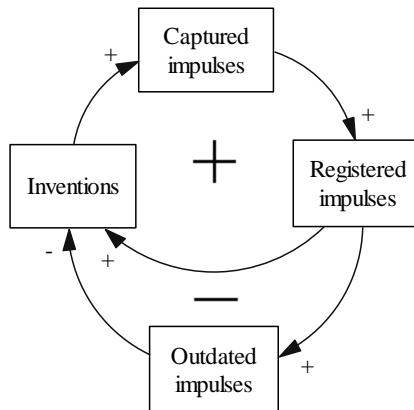


Figure 4. The process of inventions creation stocks / reinforcing & balancing loop

Resource: Authors.

Identified variables affecting the process of inventions creation can be characterized as follows:

- **company size** (by employees),
- **innovation team** – the number of qualified employees intended by management to achieve the enterprise's innovation objectives.

³ Understood, respectively consciously in terms of viable innovation.

- **internal information resources of impulses** – the amount of used internal resources of impulses types (journals and books, in-house network or the Intranet, changes in business processes, etc.),
- **management and other employees** – human resources outside the innovation team as an internal resources of impulses,
- **internal resources of impulses** – the number of internal information and human resources of impulses used by enterprise,
- **external resources of impulses** – the amount of used external resources of impulses (legislation, exhibitions and trade fairs, conferences, workshops, seminars, different types of networks, the Internet, customers, benchmarking, etc.),
- **inventions as internal resources of impulses** – the amount of impulses resources transformed from created inventions,
- **resources of impulses** – the amount of internal and external resources of impulses, among which we count to 1% generated inventions as an internal resource of impulses,
- **creative methods** – the rate of use of creative methods and techniques in the creation of inventions,
- **interpretation** – the degree of understanding or awareness of the captured impulse,
- **innovation potential of enterprise** – the participation rate on impulses arrestment of other human resources outside the innovation team members,
- **innovation team member potential** – the expected number of captured impulses by member of innovation team depending on his motivation, skills and knowledge,
- **need for impulses arrestment** – the amount of impulses needed to capture on the innovation team member to achieve the planned amount of captured impulses,
- **utilized potential of innovation team** – the number of impulses captured by an innovation team,
- **reaction time of employees** – the time elapsed from the call to capture impulses with respect to the innovation objectives to the employees reaction in the form of captured impulses,
- **registration time** – the scheduled time that elapses from the captured impulse to its registration (save in the records or evidence)
- **time of evidence** – the scheduled time that elapses from the registration of the impulse to its clearing from the evidence,
- **duration of transformation** – the scheduled time that elapses from the registration of the impulse to its transformation to the invention.

Causal portrayal of identified variables in the form of CLD is the proposed model of inventions creation for SMEs (Figure 5) designed on the base of these assumptions:

- the increasing size of the enterprise (by employees) increases the amount of captured impulses,

- the compilation of innovation team earmarking of human resources with the aim to manage the process of inventions creation,
- the process of registration aim is to achieve nearly the same amount of impulses recorded by staff captured in a certain period of time,
- at the registration process of captured impulses has positive impact their complete interpretation in terms of awareness of the objectives and strategies of enterprise has positive impact,
- the utilization of creative methods and longer duration of registered impulses transformation supports the establishment of viable inventions,
- inventions serve as a further internal resource of impulses and thus positively influence the impulses arrestment,
- the number of inventions defines a need to capture additional impulses from the business environment.

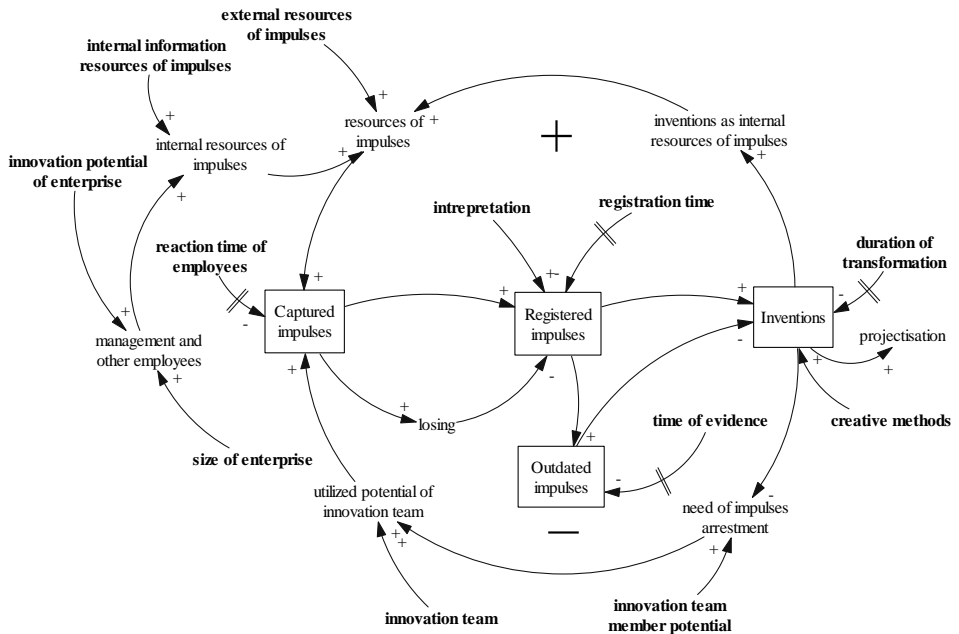


Figure 5. The process of inventions creation mental model

Resource: Authors.

The described mental model reflects a causal dependence of selected variables on the process of inventions creation within the entire innovation process. The modeled process consists of a reinforcing (positive) cycle, and simultaneously of a balancing (negative) cycle. The first of them is formed by a process of inventions creation, at the end of which a transfer of created inventions occurs

in the form of a feedback. The feedback has a form of an auxiliary variable – inventions as internal resources of impulses influence the amount of impulses resources. They represent one of the key variables that are the driving force behind the process of inventions creation. To maintain the balance of the dynamic system, it is necessary to include also a negative feedback of the process of inventions creation. The introduced relation is an inevitable part of the balancing cycle, which consists of two auxiliary variables: the need for impulses arrestment and the utilized potential of innovation team.

CONCLUSION

Successful enterprises are about systematic process of the innovation impulses recognition and collection. They use a various concepts of impulses detection as for example the early recognition and the careful environment monitoring systems. Comparison and critical evaluation of theoretical approaches and also primary and secondary data analysis were the bases for processing of the practical innovation management implementation proposal. The main aim of research described in this paper was from introduced reasons to propose a process of inventions creation model for SMEs, what was reached. Methodology of the proposed model modeling provided despite of limitations its key variables identification based on the real process of inventions creation in surveyed enterprises. The aim of the future research should be further modeling of others innovation process phases and their key variables assessment. These should represent amount of integrations (innovation projects) as accumulation variable and amount of the implemented innovations as innovation process expected output consistent with the proposed innovation process cycle.

LITERATURE

- Catalina Foothills School District. 2003. *Tips for Using System Dynamics Tools*. [online]. 2003. [cit. 2010.01.30]. Dostupné na internete: <<http://www.clexchange.org/ftp/documents/Implementation/IM200312TipsUsingSDTools.pdf>>.
- Čimo, J., Mariaš, M., 2006. *Inovačný manažment*. Bratislava : GeoPARNAS, 2006, ISBN 80-969555-7-8.
- IPA Slovakia. 2009. [online]. 2009. [cit. 2009.07.22]. Dostupné na internete: <http://www.ipaslovakia.sk/udalost_view.aspx?id_u=201>.
- Kim, S. W., Choi K., 2009. *A Dynamic Analysis of Technological Innovation Using System Dynamics*. Abstract Number: 011–0622. In: *POMS 20th Annual Conference*, Florida, 2009. [online] [cit. 2010.02.10]. Dostupné na internete:<<http://www.pomsmeetings.org/ConfProceedings/011/FullPapers/011-0622.pdf>>.

- Mizla, M., Pešáková, P. 2011. *Factors of pro-innovation environment in Slovak and Polish business units*. [In] *Nierówności społeczne a wzrost gospodarczy – Uwarunkowania sprawnego działania w przedsiębiorstwie i regionie*. 2011, Rzeszów : Uniwersytet Rzeszowski, č. 20, ISSN 1898-5084, ISBN 978-83-7338-667-9.
- Nauwelaers, C., Wintjes, R., 2008. *Innovation Policy in Europe : Measurement and Strategy*. Cheltenham, Northampton : Edward Elgar Publishing, 2008, ISBN 978 1 84542 759 7.
- Sabadka D., Lešková, A., 2002. *Inovačný proces a riadenie inovácií v podniku*. In *Transfer inovácií* [online]. 2002, č. 5, [cit. 2009.06.08]. Dostupné na internete: <<http://www.sjf.tuke.sk/transferinovacii/pages/archiv/transfer/5-2002/pdf/49-51.pdf>>. ISBN 80-7099-952-7.
- Tidd J., Bessant J., Pavitt K., 2007. *Řízení inovací : Zavádění technologických, tržních a organizačních změn*. Brno : Computer Press. 2007. ISBN 978-80-251-1466-7.

Zarządzanie procesem powstawania inwencji

Streszczenie

Podstawą nowoczesnych koncepcji menedżerskich jest podejście procesowe. Jednakże mało firm wykorzystuje innowacje zarządcze oraz innowacje procesowe, które są związane z podejściem procesowym. Fazę powstania nowych inwencji, z którą największy problem ma sektor MSP reprezentują procesy związane z wyłapywaniem ewidencją oraz transformacją innowacyjnych impulsów. W związku z tym uwagę należy skupiać już na pierwszej fazie procesu powstania nowych inwencji w celu zwiększenia wykorzystania potencjału innowacyjnego, co w konsekwencji prowadzi do sukcesu innowacji. Celem badania przedstawionego w niniejszym artykule było zaprezentowanie monitoringu procesu dynamiki powstawania inwencji w formie projektu modelu przyczynowo-skutkowego dla sektora MSP.

Summary

The new managerial conceptions are based on the process approach, but only a few enterprises is trying to use the management innovation and related process innovation. The process of inventions creation phase is represented by processes connected with impulses capture, recording, evidence and transformation, with which have small and medium sized enterprises bigger or smaller problems. Therefore is not needed to forget that their attention should be centred on the primary phase of the innovation process. These enterprises could have better possibilities to use their innovation potential on the creation of new inventions and so gain higher possibilities on more successful innovation implementation. The research published in this article was realised for the purpose the process of inventions creation system dynamics monitoring in form of the causal model proposal for small and medium sized enterprises.