Interrelations between Knowledge Management and Innovation Management

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Abstract. Theory of innovation appeared much more earlier than the concept of knowledge based society and knowledge management connected with it have been codified. Today both concepts are often used as supporting each other and sometimes even interchangeably. This paper tries to deeper analyze the interrelations between the two management disciplines and concepts used in them. Particularly, the paper concentrates on following issues: 1. the concepts of knowledge and innovation – differences, similarities, evolution of their interrelations over time; 2. "Open innovation" model and new challenges to the knowledge management. How to bridge both approaches; 3. The so called patent paradox – is the number of patents the best way to measure the intensity of innovation activity? In the conclusion, the paper tries to show how innovation management tools can help to improve the efficiency of knowledge management approaches in increasing the competitiveness of organizations and, on the other hand, how knowledge management.

Keywords: innovation, knowledge, innovation process management, knowledge management, open innovation, intellectual property protection – "patent paradox"

1 Introduction

Theory of innovation and innovation management is a relatively "old" discipline with increasing intensity of its development (both from the quantitative point of view – number of publications, and qualitative aspects – scope of the discipline, relevance to practice, etc.) during the second half of the 20th century. The conception of innovation has evolved significantly over the last 40 years. During the 1950s, innovation was considered to be a discrete development resulting from studies carried out by isolated researchers. Nowadays, innovation is no longer conceived as a specific result of individual actions, but more as a result of problem solving process, involving relationships between firms with different actors. The content of the innovation management has been shifted towards a diversified learning process, including learning-by- doing, learning-by-sharing, using an adapting internal and external sources of knowledge and improving the absorption capacity of firms.

These changes in innovation management area, the more holistic approach applied, helped to form some new bridges between the two disciplines and a potential for synergy effects has increased. However there still exist some differences between the two disciplines and the basic concepts used in them. The main objective of this paper is to analyze these differences and show how the analyzed disciplines can enrich each other and improve the framework for improving the performance and competitive abilities of organizations.

The structure of the paper is as follows: the second subchapter defines the concepts of innovation and knowledge, their classification and evolution of the theoretical approaches over time. The third subchapter deals with the recent model of an "open innovation" and new challenges to the knowledge management resulting from it. The fourth subchapter is devoted to the problem relevant for both disciplines – the role of patents in intellectual property protection and the question whether the number of patents can be the most relevant indicator of the intensity of innovation activity. The fifth part of the paper is actually a conclusion summarizing basic results and showing, how the more holistic approach in both disciplines increases the synergy potential.

2 The Concepts of Knowledge and Innovation, their Classification, Comparison of Innovation Management and Knowledge Management

Knowledge is an old concept with a long evolution. In mid 1990s it became the basic concept of a knowledge driven economy, for which at least two characteristics are typical: Firstly, knowledge is more quantitatively and qualitatively important than ever before. The knowledge economy can be said to be based on an efficient system of distribution and access to knowledge as a *sine qua non* condition for increasing the amount of innovative opportunities and economic performance in general. Knowledge is increasingly considered to be a commodity. It is packaged, bought and sold in ways and to levels never seen before. The degree of connectivity between knowledge agents has increased dramatically.

Secondly, applications of Information and communication technologies (ITC) are the drivers of the new economy. Advances in ITC have reduced the costs of many aspects of knowledge activities (e.g. knowledge gathering, storing, knowledge transfer, etc.).

Knowledge is always connected with people, individuals or groups and organizations (ev. networks of organizations). Nonaka and Takueshi [16] defined knowledge as "justified true belief" that increases organization's capacity for effective action. It includes facts, opinions, ideas, theories, principles, models, experience, values, contextual information, expert insight and intuition. It is relational in the sense that it depends upon the situation and people involved.

Knowledge can be classified according to different criteria. From the point-of-view of the *content of knowledge* or it usefullness we can distinguish declarative knowlege (of facts, objects – *know what*) and procedural knowledge (the way how cognitive and action processes are performed –*know how*). [18]. From the *knowledge holder* point-of-view we can distinguish individual or collective knowledge.

However, the most widespread categorization of knowledge is from the articulability of knowledge point-of-view – whether the knowledge holder is aware of his (her) knowledge and can articulate it to others. From this point of view we distinguish between *explicit and tacit, ev. implicit knowledge* [17]. The tacit dimension is based on experience, thinking, and feelings in a specific context, and is comprised of both cognitive and technical components. The explicit dimension of knowledge is articulated, codified, and communicated using symbols (Nonaka & Takeushi, 1995). Some authors use also the concept of *cultural knowlege. This refers to the "assumptions and beliefs that are used to describe, and explain reality, as well as the conventions and expectations that are used to assign value and*

significance to new information'' [,p.112). Cultural knowledge is not codified but is diffused over the ties and relationships that connect a group.

Knowledge management (KM) actually includes forming strategies and managing processes designed to identify, capture, structure, value, leverage, and share an organization's intellectual assets to enhance its performance and competitiveness. It is based on two critical activities: (1) Capture and documentation of individual explicit and tacit knowledge, and (2)

its dissemination within the organization.

Knowledge is either created within the organization or acquired from outside. Internal *knowledge creation* has been often compared with the idea generation (invention) stage in the innovation process. However, according to KM approach, the core of the knowledge creation process is not the research and inventing activity of an organization, but the conversion and interaction between its tacit and explicit knowledge - as described by the well-known SECI model [16].

Knowledge is the basis for innovation and in many aspects innovation depends on knowledge creation. From many definitions of innovation we can use the following definition by Urabe:

'Innovation consists of the generation of a new idea and its implementation into a new product,

process or service, leading to the dynamic growth of the national economy and the increase of employment as well as to a creation of pure profit for the innovative business enterprise. Innovation is never a one-time phenomenon, but a long and cumulative process of a great number of organizational decision-making processes, ranging from the phase of generation of a new idea to its implementation phase. New idea refers to the perception of a new customer need or a new way to produce. It is generated in the cumulative process of information-gathering, coupled with an ever-challenging entrepreneurial vision. Through the implementation process the new idea is developed and commercialized into a new marketable product or a new process with attendant cost reduction and increased productivity'' [21, p. 3].

We have to *distinguish between innovation and invention*. Invention is a new idea that is made manifest, and innovation, is ideas that are applied successfully in practice (commercially successful). It is clear that in some cases knowledge can correspond to the concept of invention and is not commercially used. However competition forces companies not only to accelerate knowledge creation and dissemination, but also to use it practically and learn from experience. The process of transforming knowledge into commercial results is an important condition of companies' survival and improving performance. This makes the innovation process and knowledge creation and transformation in many aspects similar.

However, differences between the concepts of innovation and knowledge (and resulting differences between innovation management and knowledge management) still exist. *Typology of innovation is different.* Usually *technological innovation* (new products, new components or linkages between components of products, new production methods, new services, erc,), *market innovation* (new distribution channels, changes in the marketing mix, enetering new markets, etc.) and *organizational innovation* (new organizational structure, new HR strategies, etc.) is distinguished. In practice, different types of innovation are combined.

Another criterion to classify innovation is the degree of novelty, where *radical* (or even breakthrough) innovations *and incremental* innovations are distinguished. Radical innovations are fundamental changes that represent revolutionary changes in technology (or services and the system of doing business). They represent clear departures from existing practice. *Incremental innovations* are minor, step-by-step changes in products and processes, where aesthetic or other subjective qualities of products and processes are changed.

All innovations are based on knowledge (sometimes many different types of knowledge, from different areas). For business innovation strategy two types of knowledge are the most important : the organization's capabilities in knowledge creation; and its knowledge about the market. This knowledge can be tacit, but innovation management deals mainly with explicit knowledge. Comparing innovation process with the mentioned Nonaka and Takeushi's SECI model, we can say that research, discoveries, involve primarily the creation and use of tacit knowledge through the processes of socialization and externalization. Practical implementation of new ideas and their transformation into commercial products and services is connected mainly with explicit knowledge that has been codified and formalized in practice through the processes of combination and internalization.

In performing radical innovations, companies thrive diversity, deviate from the established patterns, are crossing boundaries, and challenging and questioning established knowledge. True innovators are risk-takers. While knowledge management focuses, primarily, on learning from the past and on current good practices, in a sense it encourages harmonization around proven practices. innovation focuses on experimentation, prototyping, and the creation of the good practices of tomorrow.

Taking into account these differences between both concepts and management disciplines, isn't it too difficult to bridge the two approaches? Can we expect that implementing knowledge management across organizations, creating more logical and systematic knowledge processes in the daily work, learning from past experience, will simultaneously support fueling new ideas and radical (if necessary) innovations?

Practical experience shows that successful innovators are usually good also in implementing knowledge management techniques (or improving knowledge management systems can help them). On the other hand, innovation management techniques can help to improve the efficiency of knowledge management systems)

[8]. Achieving this synergy is closely connected with the business strategy that can hamper or support it. Reasons for this "synergy potential" are different:

First, real life innovation processes include both major and minor changes Radical innovations are followed by the sequence of incremental innovations that are very important for the sustainable growth of the company. Along the innovation time-line there are many routine management tasks where knowledge management tools can be effectively applied.

Moreover, knowledge management practices can help to shorten the time necessary to verify, whether the original decision on radical innovation was rational. Successful innovation is not about (or not only about), how much the company spends on innovation, but when and how it spends it. The company must *know* what the market demand is and what value can be created by the selected innovation option. Knowledge is important to take the decisions, but

learning-by-doing can help to modify original decisions and find the more effective ways of innovation strategy implementation.

Second, innovation process today is much more complex than it was regarded decades ago. The market is constantly changing, it is becoming more global and new competitors are emerging. In addition, technology complexity is increasing, product life-cycles are shortening and knowledge is consolidating as a crucial input. Key to adjust to these changes is in knowledge processes. As organizations grow, the existing knowledge is often interrupted and the knowledge flow fragments. However, through effective knowledge management, which has collaborative work teams (teams composed of members with creative thinking and new ideas generating ability, but also members that are able to learn from experience, systemize and share knowledge and improve knowledge systems) at the heart of its strategy, the knowledge flow restores. This restores the spiral of creating even more tacit and explicit knowledge, more new products and services, new ways of doing business are emerging.

3 Open Innovation Model and New Challenges to Knowledge Management

Traditional model of innovation was a *linear model*, called also "Traditional Phase Gate Model". Under this approach scientific research as the base of innovation is prioritized and the innovation project must pass through basic stages (invention – innovation – diffusion) of the innovation process and the "gatekeeper" at the end of each stage examines, whether the objectives of the stage were fully met. Only then the moving to the next stage is allowed. A feedback with later payers in the innovation process is not involved.

Figure 1



On the other hand, *the open innovation model* takes into account not only feedback between different layers in the innovation process within company (e.g. simultaneous engineering), but also inflows and outflows of knowledge between different organizations (suppliers, customers, research institutions, etc) to accelerate internal innovation, and expand

the markets for external use of innovation. This change offers novel ways to creating value. In this new model of open innovation, firms commercialize external (as well as internal) ideas by deploying outside (as well as in-house) pathways to the market.

Open innovation model is illustrated at the Figure l, taken from the paper by H. Chesbuough [11], theoretical "father" of this concept

Some often mentioned reasons and benefits of applying the open innovation approach include:

- Increased mobility of specialists
- New knowledge flows between companies
- New opportunities for spin-offs/ new licensing agreements
- Shortening research and production cycles
- Rise of a consumer as a co-creator
- Far greater scale, frequency, innovation potential than under closed system
- Stimulates transfer of people, capital, goods, services, ideas and knowledge
- Move to develop new forms of shared intellectual property
- Decreased risk of missing market opportunities.

However, there are also some new requirements on management and need to solve some additional problems, e.g.

- Need to identify trusted and dependable partners
- Need to discover and match relevant knowledge to solve specific industrial problems
- Need to transform fixed patterns and structure
- Need to integrate different methodologies and culture
- Need to maintain own identity with shared ownership, etc. [3]

An interesting tool for an open innovation approach was developed by the company Shell - the so called Gamechanger (GCh). This system makes possible to anybody in the organisation or from outside (external idea) to present his idea at the webpage. Subsequently, the idea is evaluated and , if accepted in the first round, moved forward to further evaluation and testing. Figure 2 illustrates the process of evaluating and approving internal ideas in the GCh system.

Figure 2



Source: Shell, GameChanger

Figure 3 and 4 illustrates the processing of external ideas.

Figure 3 and 4



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Source: Shell, GameChanger

GameChanger has been created as a place for "nurturing" innovative ideas. According to Bertherin [2] 10 percent of ideas that enter the Gamechanger, reached the stage of financing

and many of them were practically implemented in industry. Today more than 70 per cent of projects is solved in cooperation with universities or independent entrepreneurs. Both – ideas from the company itself as well as from "outside" are for the company Shell very valuable

Under open innovation approach, one of the main requirements for effective knowledge management **is** an organizational framework that supports the optimal acquisition and networking of knowledge. The knowledge-based structure can be one of such possibilities. The organization now appears as a network of individual knowledge domains. A *knowledge domain* is a social system based on common area of interest. It can be thought also as a virtual department enabling collective knowledge creation. Members of such an ":department" can be spread across different departments and locations, belonging also to different organizations. Such communities can include research staff at universities or the employees of customers and suppliers.

Knowledge-based network system is just one of the organizational forms that can be used to support knowledge management under open innovation paradigm. Legal forms of these communities can be different - sometimes strictly defined in agreements (e.g. about strategic alliances), sometimes very loose, based on more traditional ways of knowledge transfer.

However, there are also opponents of the open innovation concept arguing that this approach can be viewed as company's endeavor to profit from external knowledge without making heavy investment in internal long term research [5].

The key role is to be played by company's strategy. This strategy should determine which knowledge domains to set up and develop internally as core competencies and which to outsource. Another important strategic task is to set the knowledge goals for individual knowledge domains.

4. Intellectal Property Protection and "Patent Paradox"

Evaluating the innovation activity of countries is a rather demanding task. One of the most important indicators of innovation activity is patents. Number of patens as an important indicator is used also in rankings prepared by well-known institutions, such as CBG, WEF, WB, or EIS. However, to make the measurement more objective, other criteria are used as well.

Authors of the present paper try to argue *that "Too much effort for formal protection of intellectual property (patents) leads to a reduction of the commercial potential of the protected invention"*. In this connection, a question also arises: *Is the assessment of innovative activity by number of patents the right way to assess innovative activities?*

The most innovative companies of the world [26] are leaving the so-called traditional Closed Innovation Model (CIM), with its inventive and innovative activity more open to the world and moving towards the concept of so-called Open Innovation Model (OIM) [11]. Cooperation of different bodies in OIM is creating invention leads to a rapid research and development, reduced risk, reduced costs and so forth. Invention can then be placed on the market and thus transformed into innovation [20].

As explained above, it is necessary to perceive the difference between the concepts of innovation and invention. Innovation occurs - as the doyen of innovation theory J.A. Schumpeter says - by entering the market and thus differs from invention. Invention in the market may or may not be successfully marketed. Patents, licenses, inventions, as claimed by Professor Zeleny don't have any value unless they are successfully marketed. In addition to "supernormal profits", which according to Schumpeter innovation brings [21], the parties also benefit from the commercialization of knowledge, i.e. research of sales of other organizations.

The discussion of authorities is ongoing and the question *is whether to formally protect intellectual property or not*. Discussed was also the question whether patents can be considered as innovation. Similarly with issues of commercialization there is a conflict between authors, whilst one group argues that the formal way of protection of intellectual property improves and simplifies their marketability. The second group of authors disagrees and they see possible obstacles to commercialization and innovative activities, which patent protection can negate.

Authorities highlighting the formal protection of intellectual property are mainly members of academia, government and public institutions and organizations dealing with intellectual property protection [24], [27], [28], [15], [29], [30].

To support the intellectual property protection and reasons for motivation of organizations to protect their intellectual property, the authors say the following [29]:

- · Protect and maintain important competitive advantage
- · Ensure a return on invested funds
- · Appreciation rights through licensing
- Ensure the whole business model
- · Greater likelihood of success in litigation
- · Easier to obtain external capital
- · Corporate cooperation

The means of protection according to the authors support fair market innovations, eliminates the risks and ensures the balance between the number of subjects [31].

A survey conducted in 3000 German companies' shows that only 2/3 of companies questioned had their rights to intellectual property protection violated. (64% of patent infringement, 51% of the illegal copying of trade-marks). Financial loss is only 5% of their total turnover [27].

Cohen et al identified two main reasons why firms may be reluctant to protect intellectual property by formal means. The first is the high cost of acquiring and maintaining patents, and this reason is especially true for small businesses. The second reason is the possibility of disposal of the protected invention, with the availability of a detailed description creates a risk [4].

Prof. Haňka claims that many things are not the worth to patent. By patenting things it can be revealed more than it's "safe". At the same time it should be noted that the patent is so easy to bypass, so it is not worth it. It is better not to disclose and not to describe the invention in detail. Although there is no patent and no one knows how it's done [32].

In recent years, the number of patents has increased enormously. According to WIPO [24] in 1998-2008 the number of worldwide patent applications has increased for nearly 300%. This increase does not lead to increased innovation, as some authors believe, on the contrary, according to Hall and Ziedonis, who claim that the surge in patents does not correspond at all with commercial profits from patents which globally growth only slightly or stagnate. This phenomenon is called by authors the patent paradox [7]. Heller et al even argues that the enormous intellectual property protection in biomedical research has seen a reduction in innovation, thus reducing the number of useful products serving to improve the quality of human life. [10] A similar view on the formal intellectual property protection shares the chief technology officer (CTO) Royal Dutch Shell G. Schotman, who claims that it is important to think things through on what to protect, depending on how it intends to deal with that discovery. Formal instruments of intellectual property protection may complicate commercialization [19].

Košturiak and Zeleny agree that patents can't be considered as innovation, because innovation is directly related to the appreciation in the market, as argued by JA Schumpeter, but the number of patents should not be according to these authors used as the main evaluation criteria to compile rankings of innovative activities of firms or countries. The amount of patents is not indicative of the innovative activity entities, but of their inventive activity [14], [25]. Taking the application of inventions to the market, according to Kovac is only 38%; the new generation of products is only 10% [15]. At such high failure of inventions, it can easily refute claims of a strong correlation between the numbers of patents and innovations.

Results

The conducted research shows that the hypothesis: "Too much effort for formal protection of intellectual property (patents) leads to a reduction in the commercial potential of the protected invention" is true.

It is confirmed particularly by Heller's article, which was published in the prestigious magazine *Science* and in Scheffer's article. Both of these resources [10], [19] argue that the high bid to protect intellectual property through patents such as this leads to a reduction in innovation - that is, the present invention to market. It follows a negative correlation between the numbers of patents and numbers of innovations. This hypothesis is indirectly confirmed by the work of Hall and Ziedonis [7], who argue that in recent years the so-called patent paradox came to light, which means that the surge of patents does not correspond at all with commercial gain from patenting, which are growing only slightly or stagnate.

The hypothesis is also partly related to answer the research question: "Is the assessment of innovative activity by numbers of patents the right way to assess the innovative activities? '. First, it is important to define innovation as mentioned in Introduction of this work. It is clear that innovation and invention can not be used interchangeably [10], [25], [20]. Therefore patents can't be considered as innovation. Kovac points out the low success of inventions on the market (only 32%, the new generation of products is only 10%) [15], which also confirms the claim that the numbers of patents do not reflect the amount of innovation. It should also be taken into account the observed negative correlation between the numbers of patents and the numbers of innovations [11]. The benefit of patents is relatively accurate in their records and thus the proxy variable can easily be incorporated into rankings. The evaluation of innovation activities according to this indicator is therefore "very comfortable". To answer the research question: Patents can not be considered as an optimal indicator of innovative activity because

they reflect just part of the inventive activity that is formally protected, and this is only a fraction of the number of innovations.

Conclusion

Companies should consider when to resort to formal protection of intellectual property rights. Invention patent protection does not seem to be the best solution every time. A decision on further action to protect intellectual property rights should be taken to the broader context. It is necessary to consider how they will deal with inventiveness, in what time frame, what is the cost of protection, the cost of "bypass" of the patent and what the expected revenues from commercialization are. It is necessary to take note of the duration of the litigation in case of violation of a general law enforcement, which in the circumstances of our country (SR) is not exactly the best.

Organisations should be equally focused on developing the ability to commercialize knowledge. To gain competitive advantage through innovation and commercialize the knowledge generated through sales to other interested parties, is leading to further potential benefits of innovation-active firms. This discusses the concept of Open Innovation Model.

5. Concluding remarks

Knowledge Management and Innovation are today two key activities for companies to improve their performace and increase competitiveness. With the further development of a knowledge driven economy the need to make use of a synergy potential between knowledge management and innovation management will increase. Innovation is based on knowledge and knowledge management techniques can be helpful for innovation management.

Knowledge Management Practices (KMPs) within Innovation processes include a wide range of activities such as the writing and dissemination of technical reports, the secondment of R&D staff, and the use of information technologies. Knowledge management practices can be observed (they are tangible), best practices can be transferred from one organisation to another and can continuously contribute to innovation performance.

Innovation studies so far, have been particularly interested in exploring the firm-specific routines which create a distinctive organisational 'signature' in the manner a firm deploys knowledge to produce innovation. That means that the company's innovation strategy is dependent on its past development, accumulated body of knowledge, specific culture, standard approaches to knowledge deployment. Knowledge management techniques can help to accumulate, analyze, manage and disseminate the evolving "stock of knowledge" for a firm in three main areas [4]

Technology (developed within the company or outside);

Markets (the requirements of customers, their behaviour and the market opportunities which might be feasible in the future, current offerings and plans of competitors; regulatory and standards developments affecting all players);

Company processes (knowledge about internal administrative, technical and management operations through which the organisation identifies and delivers products and services).

This knowledge can directly contribute to the creation of novel business propositions.Of course, there are differences between companies and within companies and it isn't possible to suggest a universal solution. Each company has to understand the relationships between knowledge management and the innovation process in a particular company in order to help sustain long-term business success.

On the other hand, innovation management tools can be helpful in the knowledge creation and knowledge deployment process. Some innovation management tools are sufficiently standardized and their benefits are recognized in the market. E.g. some creativity development techniques (brainstorming, TRIZ, mind mapping, etc.) are actually used in both management disciplines. The same is true for some process improvement techniques and innovation project management techniques.

The process of innovation management is something that can be built into the culture of a firm. It can be promoted by using specialized techniques, and building a prevailing atmosphere of encouragement for new ideas. Practical experience shows how important it is to change attitudes and also how difficult this can be. The hierarchy within a company can hinder innovation Both management disciplines are interested in the issue how to encourage staff to share their acquired knowledge within the firm and reduce the resistance to change.

Some potential benefits of applying innovation management tools in a company include [8]: Increasing flexibility and efficiency;

Increasing productivity and reducing time to market.;

Facilitating teamwork;

Improving relationships with suppliers;

Eliminating redundant processes;

Reducing bureaucratic tasks (those that did not add value);

Increasing the market range of goods and services.

Improving relationships with employees.

Although theory and some practical examples point out the icreasing importance of the interrelation between knowledge management and innovation, it is not regarded as something obvious in business reality. Managers are often not aware of the existence and relevance of some innovation management tools and knowledge management techniques

Under knowledge-driven economy, the importance of social ingredients in explanation of innovation is increasing. Innovation can't be based solely on tangible forms of capital. Knowledge plays a more crucial role in fostering innovation. This increases the importance of interrelations between knowledge management and innovation management and demands on making use of their synergy potential.

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