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Open innovation as an effective tool for knowledge management of the company

Doctoral thesis

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Study program: Systems Engineering and Informatics

Field of study: Information and Knowledge Management

Hradec Králové 2020

Declaration

I declare that I have worked on my doctoral thesis by myself using only the literature and sources quoted below in the bibliography.

Hradec Králové, March 2020 Ing. Pavla Matulová, Ph.D.

Acknowledgement

I wish to express my sincere gratitude to my supervisor, doc. Mgr. et Ing. Petra Marešová, Ph.D. for being so affable, patient and supportive, for her positive and kind approach and also for her valuable advice she was providing me during the whole process of research.

I would also like to thank for consultations and valuable opinions regarding my thesis to prof. Ing. Kamil Kuča, Ph.D. and prof. Ing. Ondřej Krejcar, Ph.D.
Also, I would like to thank my family for all the support.

Abstract

Innovations are an integral part of corporate strategies and corporate vision, and strategies for their fulfilment are the cornerstone for assessing the innovation capacity of the economy. Working with information to power the growth and innovation aspirations of companies, a great emphasis is placed on the size and achieved market position of companies and also on the specifics of individual fields. Innovation is extremely dependent on the availability of knowledge and knowledge management, and therefore the complexity created by knowledge management tools plays an important role in the successful implementation of innovations.

Open innovation is an important concept for any organisation or company, no matter how small or large it is. Open innovation involves a collaborative approach, whereby firms integrate external knowledge and expertise into their innovation processes. The aim of this work is to propose an evaluation model of innovation use in business practice with a focus on open innovation. The model will be based on management as a discipline specifying work with explicit and tacit knowledge, as they are the key to innovation. Methodological approaches to modelling include retrospective analysis, qualitative and quantitative surveys in the private sector in the Czech Republic, multi-criteria decision-making and interviews with business innovation managers. The target users of this model are primarily firms in the secondary public sector. The proposed model will both allow the evaluation of quality benefits and contribute to the expansion of the possible methods used in knowledge management.

Keywords: open innovation, knowledge management, innovation drivers, evaluation model of innovation

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1 Introduction

Innovation is a complex and multi-factorial challenge. It is commonly accepted that innovation is vital to economic growth, to the formation of new industries and to the tackling of societal challenges. The paradigm of open innovation is based on the idea that it is not always necessary for an enterprise to work on innovation single-handedly. In practice, this approach has led to an acceleration of the innovation process and its higher efficiency, as has already been proven abroad mainly by examples of large corporations. However, in the Czech Republic, this is a relatively new topic, which has not yet been given as much space as abroad.

Open innovation works with knowledge and with effective knowledge management, so it is clear that mapping this phenomenon must be linked to this topic. Knowledge management has recently emerged as a discipline in its own right and, given its newness, is probably still developing its theoretical base. Furthermore, knowledge management plays an important supporting function by providing a coordinating mechanism to enhance open innovation segments. The first basic driver for the role of knowledge management in innovation in today's business environment is to create, build and maintain a competitive advantage through the utilisation of knowledge and through collaboration practices. This work is focused on empirical support for the role of knowledge management, open innovation approach and innovation capacity within firms. Furthermore, the positioning of knowledge management as a part of the open innovation mechanism is also an important contribution to our thinking on this topic.

The aim of this work is to propose an evaluation model of innovation use in business practice with a focus on open innovation. The model will be based on knowledge management as a discipline specifying work with explicit and tacit knowledge as a key factor to innovation.

Methodological approaches to modelling include retrospective analysis, qualitative and quantitative surveys in the private sector in the Czech Republic, multi-criteria decision-making and interviews with business innovation managers. The proposed model will both allow the evaluation of quality benefits and contribute to the expansion of the possible methods used in knowledge management.

The thesis is structured into nine main chapters. The first chapter introduces the overall focus of the work. In the second chapter, called Theoretical framework, key terms related to open

innovation, knowledge management and innovation are defined, and a theoretical overview is provided. The following chapter defines the objectives and methods of the work, which includes qualitative research, quantitative analysis, expert interviews and selected methods of statistical data processing. The fourth chapter is focused on multicriterial analysis. The fifth chapter summarizes the analysed experience from the previous two chapters and proposes a model which is the aim of this work. Chapter six analyses innovation activity of companies in the Czech Republic. Chapter seven describes the case studies and verifies an evaluation model of innovation use in business practice with a focus on open innovation. In Chapter eight is described the software modelling of the OPENSEC-IN process evaluation model and chapter nine brings a summary of fulfilment of the dissertation´s goals than is following practical and theoretical benefits in the chapter ten and eleven is the conclusion, where is outlined the main goal and a proposal for follow-up research in the topic of the dissertation.

2 Theoretical framework

2.1 Key concepts

Innovation

Innovation has been defined in various manners throughout literature. Chen et al. (2004) expand on the concept by calling it the entrance of a new set of important elements that inform the production process or influence the production system. Innovation capital is the competence of not only implementing but also organizing research and development aspects of the business, which eventually lead to new products and technology geared at catering to the needs of the customer. It has to do with the fresh product, technology, market, material and more that come into play. Cardinal et al. (2001) explain that the process of innovation covers the physical, technical, and knowledge-oriented activities that are key in creating the development routines for the goods or product in question. Herkema (2003) says that it is the process of developing knowledge that is geared at developing new information and skills, aiming to creating viable commercial solutions. IT is a process which holds knowledge in extreme importance because it is further assimilated and shared with the goal of developing knowledge that is fresh and embodies services and goods. Herkema (2003) further explain that it is the process through which an idea or behaviour is brought into an organisation, which previously was alien to the organisation in question. This innovation could be an altogether new service or good or technology that the organisation is willing to adapt or adopt. The change that the firm experiences can be incremental and take place through several steps or be entirely abrupt and come off as a radical modification of processes. Innovation is a process through which change takes place to make room for interventions and discoveries that will augment existing processes and outcomes – this can be true for goods, processes, products, and more (Gloer & Terziovski, 2004). Radical and incremental modification have been set apart from one another by the authors. Incremental setups have line extensions that impact products that already exist. They do not need substantial modification of existing practices and can often lead to an augmentation of the processes that are already in place. On the other hand, a radical innovation will mean the firm would have to start from scratch because existing competences would be entirely destroyed. It required new skills and practices to be put into place, making older knowledge and skills redundant. This could prove to be a risk for the business because it can be tricky to commercialize a radical change. Nevertheless, a radical switch is thought to be substantially

important when it comes to long term success because it brings on new age or more current approaches and helps the company come up to the speed of the market.

Open Innovation

The main idea behind this is the innovation process, which needs to be opening one. A common definition explains it as the "the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and to expand the markets for external use of innovation" (Chesbrough et al., 2006, p. 1).

"Open innovation is usually contrasted with closed innovation, supposedly its predecessor, where companies generate their own innovation ideas, and then develop, build, market, distribute, service, finance, and support them on their own" (Chesbrough, 2003a, p. 20). On the other hand, the reality is that only a handful of firms go for a fully closed innovation method, and it is imperative that the process of innovation be more open because of the many developments both within and outside the arena of innovation itself.

A simple search through Google Scholar on the subject returned over two million results. Chesbrough's 2003 book on the subject has more than 1,800 citations. Several different disciplines have demonstrated a substantial interest in the subject as well, including sociology, economics, cultural anthropology. When we talk about innovation as a revolution, we mostly see that it is more of an evolutionary process. This is the case with open innovations as well. Chesbrough's publications caused a revolution when they were first released, i.e. Chesbrough (2003a, 2003b, 2003c), helped it become fairly obvious that the crux of them matter dates back by a large margin. Neither using the input of outsiders to improve internal innovation processes, nor searching for outside commercialization opportunities for what has been developed internally is new. Most of these activities have been implemented by many companies over many decades. In an extensive literature review, Dahlander and Gann (2010) found many references to concepts such as absorptive capacity, complementary assets and the exploration.

Knowledge Management

Macintosh (1996) defines this as "Knowledge management includes identifying and analysing available and required knowledge and then planning and controlling actions to develop knowledge assets to achieve business goals." Hujňák (1999) further outlines it as "Knowledge Management is a strategic application of the intellectual capital of the

organisation, based on the recognized experience and knowledge of the organisation's staff and relevant information resources inside and outside the organisation, and the knowledgeable impact of knowledge on the organisation's performance and profitability." Liebowitz (2003) also elaborated on the same, by saying that it has to do with intangible assets. To put it simply, it has to do with the ideal methods through which knowledge can be executed externally and internally. O´Dell (1996) explains it as something that "focuses on systematic approaches to finding, understanding and using knowledge to create value."

Knowledge

Woolfl (1990) explain that knowledge is essentially organized data or information that is geared towards fixing a set of issues. Wiig (1993) further says that it is "Knowledge contains truths and beliefs, perspectives and concepts, judgments and expectations, methodologies and know-how."

Types of Knowledge

Bures (2006) has split the topic into different parts. Knowledge, according to him, can be tacit, implicit, or explicit. Explicit knowledge is essentially documented and is easy to transfer because of its concrete structure. On the other hand, implicit knowledge, as the name implies, has to do with subjective information which can be converted into something more explicit at any time. Knowledge that is unformulated exists in the minds of the person working on something but can prove difficult to turn into something more concrete or formal.

Objective Knowledge

The typical manner through which tacit knowledge is defined is to put it in comparison with objective knowledge. This can then be communicated from the person who possesses it to another. The method of communication can be symbolic and the receiver then has the same information as the original communication (Winter, 1987). This puts forth that objective knowledge can be deconstructed into two aspects, the first being the objective knowledge's communicability and the second being its possession (Sobol & Lei, 1994). The authors further argue that "such knowledge is not specific or idiosyncratic to the firm or person possessing it" (p. 170). This knowledge can be shared. This definition is widely used throughout the literature to define objective knowledge. However, despite this agreement about what objective knowledge is, there is an abundance of terms used to refer to it: articulated knowledge (Hedlund,1994), articulable knowledge (Winter, 1987), explicit

knowledge (Nonaka, 1991), verbal knowledge (Corsini, 1987) and declarative knowledge (Kogut & Zander,1992). It is important to be aware of these various synonyms because it helps us in deciphering and understanding authors' ideas and arguments. Defining objective knowledge is a way of highlighting what tacit knowledge is not. In what follows, we concentrate on what tacit knowledge is.

Tacit Knowledge

Before outlining the nature of tacit knowledge, it should be noted that a large majority of authors that write about tacit knowledge refer to Polanyi (1962, 1966,1976) who introduced the concept. Polanyi describes tacit knowledge as follows: " I shall reconsider human knowledge by starting from the fact that we can know more than we can tell' (1966, p. 4) or we have a power to know more than we can tell (1976, p. 336). One of the characteristics of tacit knowledge is that it is difficult to write down, to formalize (Nonaka, 1991). People that possess tacit knowledge cannot explain the decision rules that underlie their performance: the aim of a skilful performance is achieved by the observance of a set of rules which are not known as such to the person following them (Polanyi, 1962, p. 49). Another characteristic of tacit knowledge is that it is personal knowledge. Sternberg (1994) and Nonaka (1991) argue that tacit knowledge has a cognitive dimension, in the sense that it is scripted. For them, tacit knowledge consists of mental models that individuals follow in certain situations. These are deeply embedded in the individuals and tend to be taken for granted." Ravetz (1971) suggests that:" tacit knowledge becomes so embedded in the individual that it seems entirely natural. This is a reason why it cannot be expressed and why it is attached to the knower." Another feature of tacit knowledge is that it is practical (Sternberg, 1994) and that it describes a process. If, like some authors (Amit & Shoemaker, 1993; Grant, 1991; Rao, 1994) we were to make a distinction between resources, i.e. inputs into the production process, and capabilities, i.e. processes by which the resources are utilized, rather than use the generic term of resource (meaning both) it would be appropriate to use the term capability rather than resource when referring to tacit knowledge. In this respect, it is similar to know-how (Kogut & Zander, 1992; Nonaka, 1991). Nonaka (1991) saying that:" know-how may be used as a synonym for tacit knowledge because 'tacit knowledge consists partly of technical skills – the kind of informal, hard-to-pin down skills captured in the term know-how."

Start Ups

One popular definition has been put forth by Ewing Marion Kauffman Foundation (Morelix et al., 2015) which explains: "Start-up businesses here are defined as employer firms less than one-year-old employing at least one person besides the owner." On the other hand, NESTA (Dee et al., 2015) explains it as "young, innovative, growth-oriented business (employees/revenue/customers) in search of a sustainable and scalable business

Gazelles

Birch (e.g., Birch et al. 1995, p. 46) defines them as "A business establishment which has achieved a minimum of 20% sales growth each year over the interval, starting from a base-year revenue of at least $100 000." Hence, the definition is based on firms growing at least at a particular pace (e.g., that firms exhibit a certain annual growth rate or more for a certain number of years). Another way is to use a high-growth threshold and define Gazelles as the x% fastest growing firms. Recently, the Organisation for Economic Cooperation and Development (OECD; Ahmad 2006) proposed defining high-growth enterprises as enterprises with an average employment growth rate exceeding 20% p.a. over a 3-year period and with ten or more employees at the beginning of the period. They also proposed that the term Gazelle should only apply to young high-growth firms, or more specifically to enterprises less than 5 years old and with an average employment growth rate exceeding 20% p.a. over a 3-year period and with ten or more employees at the beginning of the period. Consequently, the literature is quite disparate.

Aspiration

Form come from Latin word „aspirare" in a broader sociological interpretation, expresses a specific form of orientation of the subject emotionally tied to the achievement of a certain object, transformations. From the socio-psychological point of view, this is an issue of aspiration level, which is based on the distinction between the level of performance, success and expectation, ie its own level of point a. The distance between point a. and actual performance is relatively constant for the same subject, but varies appreciably with each subject depending on its psychological and sociological characteristics. It depends in particular on the image of the subject, on himself and on the degree of his/her self-confidence, on the characteristics of the groups to which he/she belongs, on the nature of society and the characteristics of the social subculture and society-wide culture. For example, research results confirm that members of the Western Civilization and members of

some other societies are characterized by a strong willingness to learn and achieve better results and improve their own performance. The importance of the problem of aspiration level is therefore one of the issues of activity motivation. The origins of the issue of aspiration are associated with a study by F. Hoppe (1930) and in particular with the works of K. Lewin and his school members. The results of the aspiration level research were summarized by K. Lewin, T. Dembo, L. Festinger, and PS Sears in 1944. based on the so-called aspiration level theory, J. W. Atkinson (1964) developed a general theory of performance motivation. The sociological line of elaboration of the issue is not limited to the context of performance motivations, but understands aspiration as a specific psychosocial process comparable to similar processes such as needs, interests, desires (values), values or ideas. Chombart de Lauwe examines the evolution and influences of aspiration in a number of his works in connection with the total of these processes, which makes it possible to emphasize the subject - people, activity, communication between people, the growth of awareness, the spiritual life of people. The subjectivity of people is not excluded from the objective or material context; it is situated in the mutual interaction between experience and institutional systems, but it is understood as the decisive measure of the matter and as the main source of progressive sociological changes. According to Chombart, the subjectivity of people, and in particular aspirations, is the main operator in the psycho-socio-cultural dynamics that mediates this progressive change. Chombart de Lauwe emphasizes the specificity of individual psychosocial processes, avoiding the tendency to eliminate differences between them or reduce them to mere analytical distinctions. Needs are characterized by two necessities: life (biological), and soc. severity. Attention is paid to deviations or separation between perceived needs of disadvantaged strata and interpretation of needs by power centres. In the definition of interests, he shares the common distinction: interests in subjective aspects distinguishes them from interests in an objective sense, that are looking for benefits and profits that can be gained from a certain situation, activity, alliance, market.

Knowledge intensity

The concept of knowledge intensity reflects the extent to which a firm depends on the knowledge inherent in its activities and outputs as a source of competitive advantage (Autio et al., 2000). Knowledge intensity can be considered a characteristic feature of an organisation as a complex technical-economic-social system (Bureš, 2011) and it is therefore appropriate to model and monitor it.

Knowledge-intensive organisations are firms whose main activity is based on the employment of knowledge (Starbuck, 1992; Alvesson, 1995; Nurmi, 1998). Moreover, not only their activities are based on knowledge, but also their survival depends on their ability to mobilize and synthesize knowledge (Alvesson, 1995; Nurmi, 1998; Robertson et al., 2003). Knowledge processes are strategic value creation processes for knowledge-intensive firms (Larsen, 2001; Lowendahl et al., 2001; MorrisandEmpson, 1998). Indeed, a lot of sources discuss that knowledge creation (e.g., Larsen, 2001), intra-firm knowledge sharing (e.g., Robertson et al., 2003; Willoughby and Galvin, 2005; Taminiau et al., 2009), external knowledge and knowledge storage and documentation e.g., (Donaldson, 2001; Robertson et al., 2003) are critical for these firms. Drucker (2004) considers knowledge to be a key means of production. However, there was still no consensus on their definition. At present, most opinions are so fragmented that two or more definitions are difficult to combine. Knowledge intensity can be perceived and examined at many levels (Bureš & Čech, 2007). Each author and research team is focused on a different concept. Moreover, each of them views the issue from a different angle. Most of the resources are represented by the levels of the individual, profession, society and industry. Lin et al. (2012) states that knowledge intensity affects the performance of organisations at the level of human capital. Equally important are Communities of Practice. Van Winkelen and McKenzie (2011) pointed out that the knowledge domain should be promoted and promoted in order to increase motivation and employee interest. Esposto and Abbott (2011) examine the knowledge intensity at the level of the professions and focus in particular on changes in their knowledge intensity. The conclusions of their examination confirm that the knowledge intensity has been increasing in the long term. In addition to these perspectives, knowledge intensity can be perceived in relation to the organisation's capital structure (Thornhill, Gellatly, & Riding, 2004). It is equally possible to relate it to products. The knowledge intensity of products changes in sequence their life cycle. The intensity of services is changing in connection with these changes. Overall, knowledge-intensive industries are associated with higher average salaries, regardless of gender. Furthermore, they identified differences in occupations that are associated with a considerable degree of hierarchical organisational structure. Autio, Sapienza and Almeida (2000) define knowledge intensity as the degree to which a company relies on knowledge inseparable from its activities and outputs.

Mind Mapping

The means of representing ideas in diagrams with node-link assemblies has been termed concept mapping (Novak & Gowin, 1984), knowledge mapping (O'Donnell, Dansereau, & Hall, 2002), and mind mapping (Buzan, 1995). Nesbit and Adesope (2006) defined:" mind mapping as a concept map as a type of graphic organizer that is distinguished by the use of labelled nodes denoting concepts and links denoting relationships among concepts. Typically, when used in an instructional setting, students who complete a concept map place concepts or ideas in ovals (or any shape), organize the ovals in some type of logical manner that shows the relationship among them (which may or may not be hierarchical), and connect the concepts to one another with lines that might or might not be labelled." Conceptual mapping is a technique used to visualize relationships between different concepts. A concept map is a diagram showing the relationship between concepts. Terms arranged in a kind of hierarchical branched structure - at the top of the map are general terms that are linked by lines to more specific terms found at the lower levels of the map. From one concept, "branches" grow into terms in the lower parts of the map, from them again grow branches into terms in the lower levels of the map, etc. So visually we see a kind of inverted tree. Lines between terms are named to capture the relationship between terms as closely as possible. In addition, "branches of concept maps" can be interconnected by means of so-called cross-connections - connection a line from one branch to another from a line and describe this relationship.

Conceptual model

Representation of the structure of the reality segment. The conceptual model reflects reality using objects and their properties on a logical level and selecting entities and attributes for object description. In terms of the form of description and the elements used, it is based on the already established practice of E-R models (an entity–relationship model) or class diagrams. It is therefore a graphical representation of the structure of entities or classes and the relationships between them (Kaluža & Kalužová, 2012).

Conceptual modelling - phase of data or object analysis using models based on application domain objects. The ER model is based on the understanding of the world as a set of basic objects - entities and relationships between them (Silberschatz, Abraham, Korth, & Sudarshan 2002). Conceptual model in database modelling: It leads to a formal description of the user application. The result is conceptual schemas (independent of later

use of the database schema). Other common conceptual models: Conceptual Model Information: In computer science, conceptual models can be understood as part of applied logic (e.g., a conceptual model of information).

2.2 Knowledge management tools and methods

Knowledge management is not one single discipline. Rather it is an integration of numerous endeavours and fields of study. Knowledge management requires certain organizing principles and a general framework which will help us to classify different activities types and functions, which are needed to the work implying knowledge, both inside and outside of an organisation. These general frameworks are to be found in form of theories and models for knowledge management. We can find in the specialized literature many models regarding knowledge management. From all these models is in this chapter identified certain models that have potential to be very well applied in almost any type of economical organisation.

2.2.1 Nonaka and Takeuchi SECI model

This model was obtained after the research regarding the success of some Japanese corporations, about obtaining creativity and innovation. They claimed that:" this success did not come from a mechanical processing of some objective knowledge, but from elements extremely subjective (metaphors and symbols). Knowledge creation begins always at the individual level. Starting from this personal knowledge, mostly tacit, we will obtain organisational knowledge." The availability on every company level represents the essence of Nonaka model (Nonaka, 1995). Knowledge creation takes place as a continuum in all the compartments of the organisation. According to Nonaka and Takeuchi model: "there are four modes to convert knowledge, which represents the engine of the whole process to create knowledge" (Nonaka & Takeuchi, 1995). Next figure presents the stages involved in the process of knowledge creation.

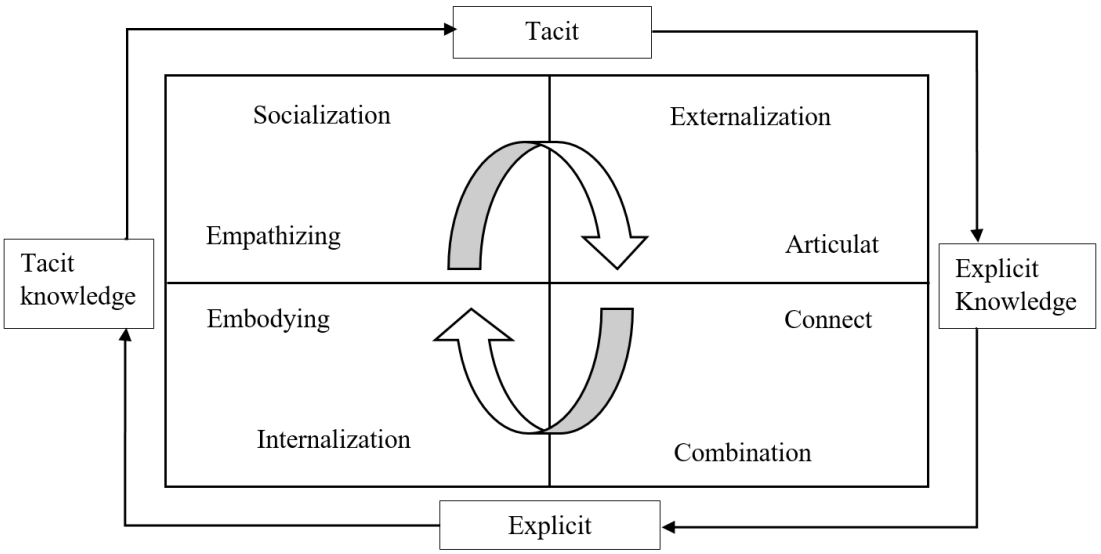

Fig. 1 SECI model – Takeuchi Knowledge conversion in Nonaka-Takeuchi model

Source: (Nonaka & Takeuchi, 1995)

Socializations means that knowledge when shared has to do with interactions on a social level. It has to do with a mutual exchange in the simplest form, a shared understanding that exists in an instinctual state. The main benefit of this can also become the biggest issue because knowledge will never stop being tacit and this leads to a lack of documentation.

2.2.2 Nonaka and Takeuchi knowledge spiral

The spiral process is closely related to the transformation of explicit and tacit knowledge. Thus, knowledge creation can be described by a spiral process composed of interactions between tacit and explicit knowledge. Thus, this process leads to the emergence of new knowledge (Nonaka & Takeuchi, 1995). Interactions between these two types of knowledge allow you to specify four conversion processes. The SECI model describes a dynamic process in which both types of knowledge - explicit and tacit - are exchanged and transformed. Within the SECI model, the realization of the process of creating new knowledge and the use of this knowledge is subject to the possibility of formalizing knowledge.

Figure 2 presents the way in which the organisations articulates, organize and systematize individual tacit knowledge. We consider that the most difficult steps in knowledge spiral are those which imply a change in knowledge type: externalization and internalization. We need ways to represent a consistent, systematic and logic understanding, without contradictions.

Nonaka and Takeuchi describe the conditions which allow the creation of organisational knowledge (Sven & Henrik, 2003):

1. Intention: expressed by the organisation will to fulfil its purposes (formulating strategies in business context).
2. Autonomy: the situation when individuals are acting autonomous, according to some minimum specifications, being implied in teams with self-organizing capabilities.
3. Fluctuations and creative chaos: specific condition which stimulates the interaction between the organisation and the extern environment.
4. Redundancy: the existence of information which exceeds the operational requests of organisational members.
5. Variety: internal diversity which offers to every employee rapid access to a variety of informatin.

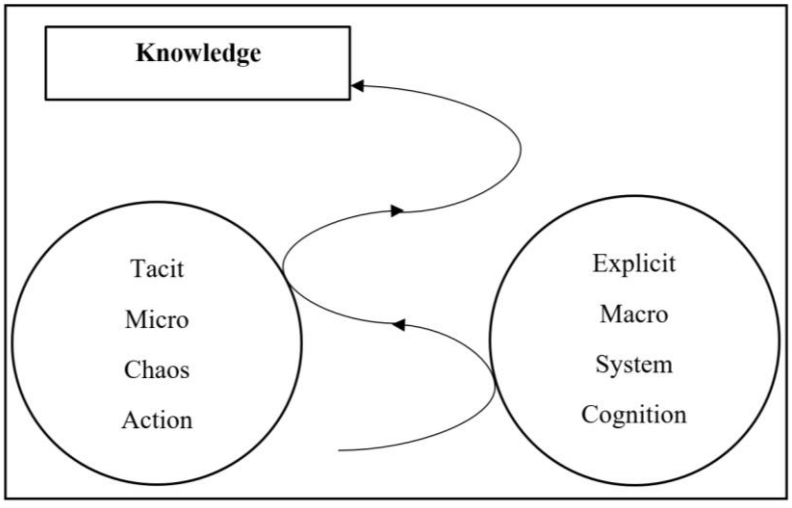

Fig. 2 Spiral process of knowledge creation, according to Nonaka, Toyama and Konno, 2000

Source: Nonaka, Toyama and Konno, 2000

2.2.3 Model ba

The concept of *ba* was originally proposed by Kitaro Nishida, the most influential Japanese philosopher of the twentieth-century, who combined western Anglo-European philosophy with Asian sources of thought. Ikujiro Nonaka adapted his theories, especially the *Ontology of Consciousness*, *Theory of Universals* and *Logic of Space* to elaborate the SECI model of knowledge creation, a well-known and well-used model in management theory and practice. According to Nonaka knowledge creation is a spiralling process of interactions between explicit and tacit (implicit) knowledge. The interactions between explicit and tacit knowledge lead to the creation of new knowledge.

The concept ba is an extension of the SECI model, which has already become relatively "recognized" among the professional community (Nonaka & Konno, 1998). A knowledge-based view of companies perceives a company as a knowledge-generating entity. The ability of companies to create and exploit knowledge is one of the most important sources of competitive advantage. According to Nonaka, Toyama and Konna (2000), organisations are able to innovate their products, processes and service and improve their existing more efficiently. Nonaka (2000) mentions that knowledge is formed by dynamic interaction between individuals or between individuals and their environments. Ba is a context shared by those who interact. Within this context, knowledge is created, shared and used (Augier, Shariq, & Morten, 2001).

Ba can be translated approximately as space indeed; it can be seen as a shared space in which relationships arise. This interpretation of ba is particularly important in terms of knowledge creation. This space can take various forms. The boundary ba is very volatile because it is given by the current place and time. Nonaka et al. (2000b) This space can be a physical space (such as an office or open space or workplace that is open and shared by multiple employees), virtual (such as email or teleconferencing), mental (such as shared experiences, ideas or ideals), or a combination. It is specific to other interpersonal interactions, precisely because it is linked to the concept of knowledge creation. ba represents a platform where it is possible to improve, develop and work with individual and group knowledge. Space can be at the level of an individual, workgroup, project team, informal group, meeting, email conversation, or in contact with customers (Nonaka & Konno, 1998). Looking at the original concept of the Japanese philosopher Nishida, it is indeed considered to be a common space providing the foundation for knowledge creation, and thus a platform for individuals to

empathize with the shared space of the entire organisation. This creates knowledge through interaction (Nonaka & Konno, 2005). Thanks to these interactions with others and with the environment, both space itself and the single-person grow (Nonaka & Konno, 2005). There are four types of space ba. The concept ba unites the physical, virtual and mental space. The existence of *ba* at many levels allows the creation of a higher ba, the so-called basho. The principle is relatively simple, when the team represents indeed for individuals, organisations for the team, market environment for the organisation. It is essential for the creation of knowledge, and this creative process is multiplied when these ba spaces merge and connect to form basho (Nonaka & Konno, 1998).

Kostiainen (2002) states that learning to work in individual spaces requires practice. Each space has specific characteristics and has different requirements for individuals, groups and entire organisations. In addition, it is associated with certain skills - such as communication, interpretation or organisational skills. As mentioned, four types of ba are defined that correspond to the four stages of the SECI model. Each type describes how to convert knowledge. Senge emphasizes team learning as an important discipline, based on dialogue, "the ability of team members to put aside all assumptions and initiate a genuine" shared thinking" (2007, 27). A learning organisation is a very important concept that highlights the dynamism of organisations as systems in which continuous improvement and learning is desirable (Senge, 2007). In this context, it is appropriate to analyse the organisational processes that are solved within the individual spaces. It is necessary to constantly learn and improve for the development networks of organisations or other entities. A knowledge-based development network strengthens competitiveness and improves the quality of their development processes, as Kostiainen (2002) has shown in urban regions. These conclusions can be applied in parallel to clusters, associations and similar groupings. In addition, this type of network supports the emergence of a learning organisation within the company. Subrt et al. (2010) mention that indeed it is a space in which knowledge is shared, created and used. Indeed, it provides energy, quality and a place where individual conversions can be made and move along the knowledge spiral. It shows conversion processes in relation to space *ba.*

2.2.4 Choo model

It is a very good model to manage knowledge based on elements used to create new senses for an optimized decision inference. Choo model centres on how informational elements are

selected and introduced in company actions. This actions results from the concentration and absorption of information coming from the external environment in every cycle, illustrated in figure 3:

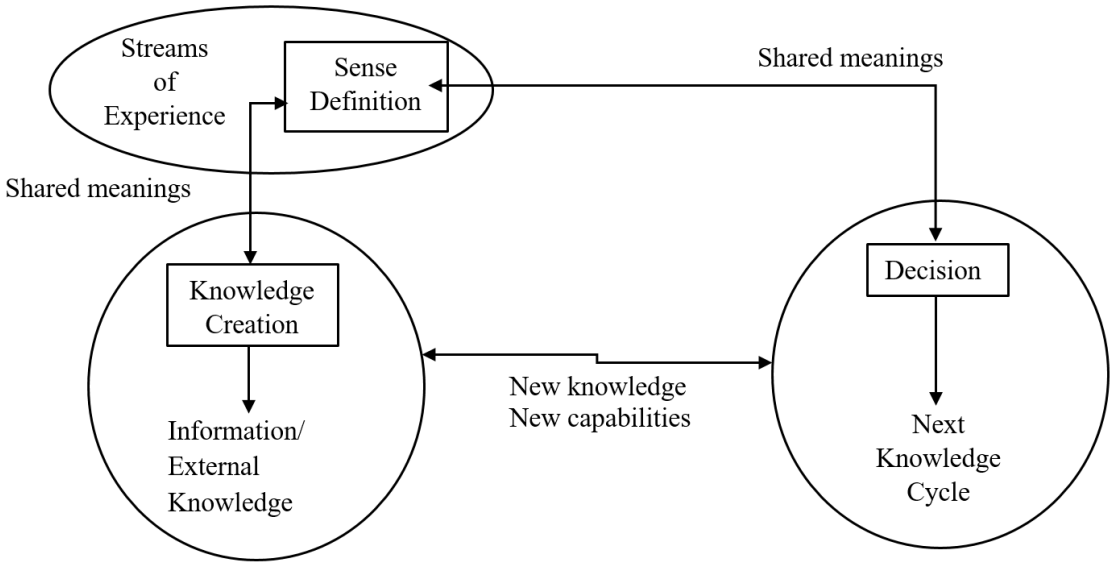

Fig. 3 CHOO knowledge management model

Source: Choo, 1998

During the identification phase we will define priorities which are used for information filtering. At individual level, common interpretations will be built from the exchange of information pieces, combined with previous experiences. Weick proposed a theory:" Chaos can be transformed in clear processes by sharing individual interpretations. We have identified four processes described by Choo model: Changing the environment - it is external for the organisation, having the possibility to disturb information flow between participants. Selection and keeping - when people try to interpret what have been observed. This is the process which refers the creation of organisational memory which will contain those experiences finalized with success. This memory can be reused in the future for new interpretations in order to unify them into a coherent organisational vision."

Knowledge creation can be perceived as a transformation of personal experiences into knowledge through dialog and sharing. Elements of this model can be found in important theories like: game theory, economic behaviour and chaos theory. The capacity of human mind to formulate and solve complex problems it is quite small compared to the problem dimensions, of which solutions are necessary for a rational behaviour. As a consequence, the persons who are confronted with ambiguous purposes and fuzzy methods to combine actions

will try to fulfil those purposes which take a medium amount of time by using resources which are under their control (Choo, 1998). Usually, when our mind is confronted with a world of great complexity, it will build a simple mental model and will act according to it. We found a strong element of Choo model in the holistic approach of key processes regarding knowledge management, with extension to decision areas, which often miss in knowledge management models (Cristea & Capatina, 2009).

2.2.5 Boisot model

This model is based on the concept of informational asset which is different from a physical asset The efficiency of informational assets transfer is largely dependent on senders and receivers, which have to share same codification scheme or language. Knowledge will also have a context in which it can be described (Boisot, 1999). Thus, it results that both the sender and receiver will have to share the context besides codification scheme. Boisot proposed: "three key points, which forms together a conceptual framework known as i-space. Boisot model (i-space) can be visualized as a cube having the following dimensions: coded – un-coded, abstract – concrete, diffused – undiffused."

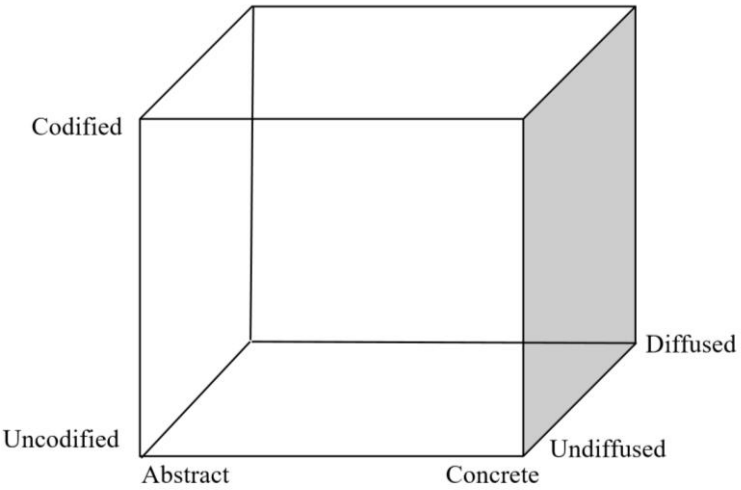

Fig. 4 Boisot I - Space model Boisot

Source: Boisot, 1999

Data is structured and understood through different codification and abstract processes. Codification refers to the creation of some categories – lesser the number of categories, more abstract the codification scheme will be. Boisot model implies that in many situations the context loss because of the codification can lead also to the loss of important knowledge.

This content needs a shared context in order to be interpreted and it requires face to face interactions (similar to socialization phase from Nonaka model).

2.3 Methods for the measurement of knowledge and aspiration to innovation in a company

Measuring knowledge and evaluating the state of innovation in the company has its roots in the concept of social sciences, in which models for the subsequent management of social processes are created, or for their prediction. In the context of management research, two basic categories of measurement indicators are mentioned: hard and soft metrics. Hard metrics, i.e. objectively measurable indicators, track the development of business goals, activities and processes. They are easy to measure and can usually be converted into financial statements. These are their basic characteristics. Soft metrics are used to measure and evaluate the level of individual processes or functional areas of an enterprise, using an audit method, i.e. through expert evaluations, questionnaire surveys or interviews with competent employee. They are designed in accordance with the purpose of use, e.g. to assess the achievement of specific objectives in a given area. Metrics can be further subdivided into result metrics that target metrics to achieve goals when examining organisations and performance metrics that focus on performance measurement and support (Molnár, 2001). Among other things, the company management tries to determine the success and effectiveness of projects and the overall performance of the organisation. The ability to measure the benefits of working with knowledge is important to managers because it provides valuable feedback. The aim of this chapter is not to provide a list of practically used methods for innovation in the company. The following table gives an overview of selected methods in order from those that are very often used in the literature to less known methods. Given that the method and model of evaluation of innovations in a holistic concept is not published yet in the literature, there are methods that focus on measuring the potential of development of companies but do not work directly with the concept of innovation capacity, but for example with the concept of intellectual capital, strengths or weakness.

Tab. 1 Methods with potential measurement of innovation

Methods with potential measurement of innovation	**Authors who recommend the method for knowledge management, all methods were also check for possibility of measurement of innovation**
SWOT	(Albert Humphrey)
Patent data in place of R&D data methods	(Griliches, 1990)
SMEmPOWER	(The CoachCom 2020 consortium: Innovayt SA (DK) (Coordinator), Platinn - Association Plateforme pour l'Innovation (CH))
Scandia Navigator	(Truneček, 2004), (Mládková, 2005), (Bontis, 2000), (Dalkir, 2005), (Bennet, 2001), (Kankanhalli, 2004), (Boyett, 2001), (Maier, 2007), (BEI Consulting, 2003)
Value Chain Scorecard	(Truneček, 2004), (Mládková, 2005)
Total Value Creation (TVC)	(Truneček, 2004), (Mládková, 2005)
Intangible Assets Monitor (IAM)	(Truneček, 2004), (Mládková, 2005), (Bontis, 2000) (Bennet, 2001), (Kankanhalli, 2004), (Boyett, 2001), (Maier, 2007), (Boughzala, Ermine, 2004), (BEI Consulting, 2003)
Patent data in place of R&D data methods	(Griliches 1990)
Tobin ratio	(Truneček, 2004), (Mládková, 2005), (Maier 2007), (Grossman, MCcarthy, 2005)
VAIP – Value Added Intellectual Potential	(Truneček, 2004), (Mládková, 2005)
Knowledge intensity	(Truneček, 2004), (Mládková, 2005)

Strategical stakeholders system PM Atkinson, Waterhouse	(Šiška, 2005)
Measuring based on TQM	(Šiška, 2005)
Scorecard by CIMA	(Mládková, 2005)
IC index	(Bontis, 2000), (Bennet, 2001), (Kankanhalli, 2004), (Maier, 2007), (Boughzala, Ermine, 2004), (BEI Consulting, 2003), (Grossman, MCcarthy, 2005)
Technology brooker	(Bontis 2000)
Balanced Scorecard (BSC)	(Dalkir, 2005), (Bennet, 2001), (Truneček, 2004), (Mládková, 2005), (Kankanhalli, 2004), (Boyett, 2001), (Maier, 2007), (Bergeron, 2003), (Boughzala, Ermine, 2004), (BEI Consulting, 2003), (Graef, 1997)
The House of Quality Method	(Dalkir, 2005), (Kankanhalli, 2004)
Time Value	(Beregeron, 2003)
Incremental Value	(Bergeron, 2003)
Knowledge Management Assessment Tool (KMAT)	(Boughzala, Ermine, 2004), (Eirma, 1999), (Grossman, MCcarthy, 2005), (Dalkir, 2005)
Knowledge Maturity Model	(Boughzala, Ermine, 2004), (Ermine, 1999)
Dynamic Value of Intangible Capital	(Boughzala, Ermine, 2004), (Bonfour, 2000)
Cost Benefit Analysis (CBA)	(BEI Consulting, 2003), (Phusavat, 2007), (Diraby et al., 2005), (Völkel, 2008), (Sassone, 1988), (Foltýnová, 2007), (SCFM, 2008), (Layard, Glaister, 1994), (Ochrana, 2001), (Sieber, 2004)

Source: author´s own work

2.4 Analysis of the current state of knowledge

A heightened understanding of the elements – be it in terms of the state, region or firm – is the main aspect under discussion in much of the policy, research and practice that exists (European Commission, 2014). This link between the environment of the firm, predisposition for innovation, validate that innovation results in better competitive benefits when the aspects of the microenvironment of the company's activities are properly articulated through a system instead of every single element operating in an isolated manner (Rivotti, 2015). When this is verified, innovation is also more frequent and better managed (Dodgson et al., 2008). This is especially important in small countries and small companies whose resources are scarce to nurture R&D. The open innovation phenomenon has developed from a small club of innovation practitioners, mostly active in high-tech industries, to a widely discussed and implemented innovation practice. Simultaneously, a small community of management researchers has recently developed into an established research field. Once a field grows rapidly there is a danger that it may become a short-term fashion. This special issue reports on recent research evidence to further develop the open innovation research field. The implications and trends that underpin open innovation are actively discussed in terms of strategic, organisational, behavioural, knowledge, legal and business perspectives.

The increasing complexity of products and services, shorter life cycles, and rapidly changing market demands require new or different capabilities and management practices to successfully develop innovations and sustain a company's competitive advantage. These capabilities include enabling the company to learn from and about its environment (Lawson & Samson, 2001). The important role of the search for and integration of external knowledge in a corporate's innovation success has been widely acknowledged (Stefan & Bengtsson, 2017). Elmquist, Fredberg and Ollila (2009), Gianiodis, Ellis and Sec-chi (2010), Huizingh (2011), and Giannopoulou, Yström and Ollila (2011), amongst others, have provided overviews. Whereas some authors consider the concept of open innovation (Chesbrough, 2003; Chesbrough, 2012; Gassmann, Enkel & Chesbrough, 2010) very promising, others raise criticism with respect to its conceptual ambiguity (Dahlander & Gann, 2010), lack of clarification regarding the parties primarily involved in such processes (Huizingh, 2011), and the collaboration partners' influence on the company's innovation performance (Brettel & Cleven, 2011; Stefan & Bengtsson, 2017). Potential disadvantages of open innovation

include loss of control, increased managerial and organisational complexity, and, consequently, increased costs (Manzini, Lazzarotti & Pellegrini, 2017).

The paradigm of open innovation is based on the idea that it is not always necessary for an enterprise to work on innovation itself. In practice, this approach has led to an acceleration of the innovation process and its higher efficiency, as has already been proven abroad mainly by examples of large corporations. However, this is a relatively new topic in the Czech Republic, which is not yet given as much space as abroad. Open innovation works with knowledge and with effective knowledge management, so it is clear that mapping this phenomenon must be linking to knowledge management. Knowledge management has recently emerged as a discipline in its own right and, given its newness, is probably still developing its theoretical base. Further, knowledge management plays an important supporting function by providing a coordinating mechanism to enhance the open innovation segments. The first basic driver for knowledge management role in innovation in today's business environment is to create, build and maintain competitive advantage through utilisation of knowledge and through collaboration practices. A typical feature of knowledge management is multidisciplinary. And multidisciplinarity is a key issue in an open innovation as well. If we combine several companies of the same focus together, we get to meet rather competitors who will be very cautious about communicating their ideas. But we will connect companies from different disciplines, in some cases even very distantly related, to get very interesting results leading to product or process innovation.

3 Aims and methods of the dissertation

3.1 Objectives

The aim of this work is to propose an evaluation model of innovation use in business practice with a focus on open innovation. The model will be based on management as a discipline specifying work with explicit and tacit knowledge, as these are the key to innovation. Sub-steps to address the above goal are:

- Literature research in relation to models and methodologies of knowledge management and possible methods of innovation evaluation as a basis for determining the framework of the proposed model.
- Multi-criteria analysis of variants for the selection of a specific methodological approach to knowledge management.
- A questionnaire survey focused on an analysis of innovation activity, innovation barriers and motivation of stakeholders for the implementation of innovation strategy among Czech companies.
- Statistic evaluation.
- A synthesis of knowledge and a proposal of an evaluation model of innovation use in business practice with a focus on open innovation.
- Evaluation of and feedback on the proposed solution from the company.
- Case study.
- Software modelling.

The proposed model will allow to find answers to the following research questions using relevant research methods, see table 2.

Tab. 2 Questions and corresponding research methods

Question	Methods
I. What key knowledge or knowledge management approaches can be used for open innovation in business?	• Literature research • Multi-criteria analysis • Scoring method • Pool of experts
II. What key flows, segments and vectors of innovation through an appropriate knowledge model influence open innovation?	• Literature research • Correlation to models and methodologies of knowledge management • Multi-criteria analysis • Questionnaires • In-depth interviews • Statistic evaluation: Advanced statistical methods and Excel and SPSS • Case study
III. What is the current state of open innovation in enterprises?	• Literature research • Questionnaires • In-depth interviews
IV. Is it possible to design a model and methodology of effective evaluation of open innovations which would reflect the character of the business environment and take into account critical points and vector segments?	• Literature research • Correlation to models and methodologies of knowledge management • Multi-criteria analysis • Questionnaires • In-depth interviews • Statistic evaluation: Advanced statistical methods and Excel and SPSS • Case study • A synthesis of the above-mentioned findings I.–III.

Source: author´s own work

A synthesis of the above-mentioned findings will provide an answer to the question: “Is it possible to design such a model and methodology of effective evaluation of open innovations which would reflect the character of the business environment within the European business territory?” In order to obtain the above-mentioned partial materials for the model creation, quantitative and qualitative research, an analysis of statistical data and expert interviews with key subjects of the innovation strategy of companies were chosen with respect to the used methods. Advanced statistical methods and Excel and SPSS were used for the data obtained.

3.2 Methods

This work uses the following main methods: synthesis of knowledge, a qualitative research represented by a sophisticated questionnaire and multi-criteria analysis. Qualitative research works with diverse data sources and enables a wide range of methods to be used to find and process data. However, it is more time-consuming and the results are more difficult to interpret (Hendl, 1997). Research takes place in the field, where information and opinions are obtained from respondents through direct contact with them. Structured questionnaire interviews are a sophisticated concept of these surveys. Subsequently, the obtained data are classified in a way that allows their statistical analysis.

3.2.1 Multi-criteria analysis

The theory of multi-criteria decision-making deals with situations where the decision maker evaluates the consequences of the choice according to several criteria. These are quantitative criteria, which are usually expressed in natural scales (referred to also as numerical criteria). Another option are qualitative criteria, when an appropriate scale is introduced, e.g., introducing a classification scale and at the same time defining the direction of better evaluation, i.e., whether the maximum or minimum value is better (falling or rising values) (Skulinova, 2005). If a set of permissible variants (alternatives) is specified implicitly by a set of constraint conditions that the decision alternatives have to meet, it is a vector optimization. If the set of permissible variants is final (given in the form of a final list), it is a complex of evaluation of alternatives or the role of multi-criteria evaluation of variants.

A comprehensive evaluation of alternatives (variants) is usually understood to be a decision-making process characterized by one rational decision maker and a final set of variants, which are assessed by the decision maker according to several criteria in order to determine

the optimal variant. In the decision-making theory, for example, the following procedure is used in principle (Skulinova, 2005):

- Identification of alternatives.
- Choice of criteria.
- Assessing the impact of individual alternatives in relation to individual criteria.
- Determining the weight of the criteria.
- Assessing alternatives.

In the thesis will be used scoring methods and deep expertise based on expeert pool.

Scoring method

In this method, it is assumed that the user is able to quantitatively evaluate the importance of the criteria using a certain number of points. With this method, the evaluator assigns each point of each variation to a given criterion a certain number of points from the selected scale, the better the value of the criterion, the greater the score for the variation in question. The number of degrees on the scale depends on the evaluator's resolution, which may not be the same for all criteria. However, the maximum (or minimum) number of points assigned to the best (or worst) value of a criterion must be the same for all criteria. In doing so, it is not excluded that in the case of a partial evaluation according to any criterion, no variant will reach this extreme number of points (it may be a hypothetically determined number). A special case of the scoring method is the allocation of 100 points (also called Metfessel allocation). The advantage here is a finer resolution of the weights of individual criteria and an easy calculation of standardized weights. The disadvantage, however, is the need to constantly check the sum of the points assigned to each criterion, which must be equal to 100. To determine the weights of the individual criteria for selecting the method for evaluating the benefits of knowledge management, the method of allocating 100 points - the so-called Metfessel allocation (special case of the scoring method) is chosen. The weighting of the criteria is shown in the following table number 2, 3.

Pool of experts

As the selection of criteria and determination of their impact is rather subjective issue, were the criteria consulted with an expert board. The pool of experts included entrepreneurs of important industry fields focusing on innovative entrepreneurship (7experts), experts and

consultants from the South Moravian Innovation Centre (4 experts) and the academics (4 experts). The total number of the pool of experts involved into consultation on the multi-criteria analysis were 15 members. To the selection of the experts, several principles were applied. It was based on a purpose selection. Experts from the Innovation Centre had to meet several criteria, in particular at least 5 years of consulting experience with a focus on innovation and increase of innovation potential in companies. Furthermore, they had to be currently involved in the process of consulting activities at high-tech companies. Experts coming of commercial field had to meet the focus of the pool of companies on which the research was targeted and actively participate in the implementation of the company innovations. The sampling method was included in the involvement of company experts. A method of selecting respondents also referred to as a chain or reference sample, is a type of the selection in which not all units or groups of units have the same chance of being selected for the sample. The selection process begins with individuals who are known to meet the criteria. Subsequently, they are asked to nominate other persons who meet the criteria in the interview and to allow researchers to contact them. These individuals are then interviewed and the process could be repeated. Thus, the sample grows by connecting to social contacts. Because it is difficult to involved experts of these group selected sampling method was very suitable. The academic´s background was the field of knowledge management, business and economics. The principle of volunteering was applied to all expert groups. The work with experts was based on individual interview.

3.2.2 Methodological basis and conception of the questionnaire survey

The methodology of interviewing companies was based on a methodology which was developed by Swiss experts on innovation and innovation management, a methodology known as SMEmPOWER. The methodology was established in Switzerland in 2005 and has been applied to more than 2000 companies in its 14 years of existence. The method was then included in the European Commission programs (Horizon 2020) and later in the South Moravian region in the Czech Republic. SMEmPOWER stands for an effective business innovation evaluating and coaching system. Initiated in 2005 as a European project with a specific focus on research intensive SMEs, today it targets the business innovation system of SMEs in general. This includes traditional companies as well as fast-growing high-tech firms. The methodological base is the result of a stepwise development process. In 2002, canton Western Switzerland decided to focus their Regional Innovation Strategy on the untapped innovation potentials of SMEs. There was evidence that almost half of the SMEs

innovation projects were not implemented successfully, notably due to internal shortfalls. In contrast to the traditional supply-minded innovation policy, the regional choice centred clearly on a need- and demand-driven approach. Motivated by positive feedback from enthusiastic SMEs, the project team initiated the international SMEmPOWER community by the end of the project in 2008. The mission of this community was to further develop and to disseminate proactive approach. Since then, SMEmPOWER progressed towards a transferrable and scalable system with implementations in Platinn (Western Switzerland), JIC (Brno region of the Czech Republic) and by the SME Instrument (European Union). The SMEmPOWER methodology helped the EASME (the European Commission Agency responsible for the management of the SME Instrument initiative) in the development of their business innovation coaching offered to the beneficiaries of the Horizon 2020 SME Instrument. Meanwhile, over 1700 screening innovation activities implying over 1200 SMEs, 400 coaches and 300 KAMs in 85 countries are managed by the SMEmPOWER system. These business innovation challenges have typical patterns in different life cycle transitions. The life cycle model helps to address the business innovation challenges in their context.

Transitions in the business life cycle tend to affect many aspects of the business innovation system. A holistic and systemic analytical frame is provided with the business innovation model. This model distinguishes between the business innovation value drivers and the critical resources related to them. A mutual understanding of SME business innovation dynamics is a prerequisite for collaboration and sharing between stakeholders.

For this reason, SMEmPOWER promotes the following three methodological building blocks:

I. Life Cycle model

II. Business Innovation model

III. Subject-Object model

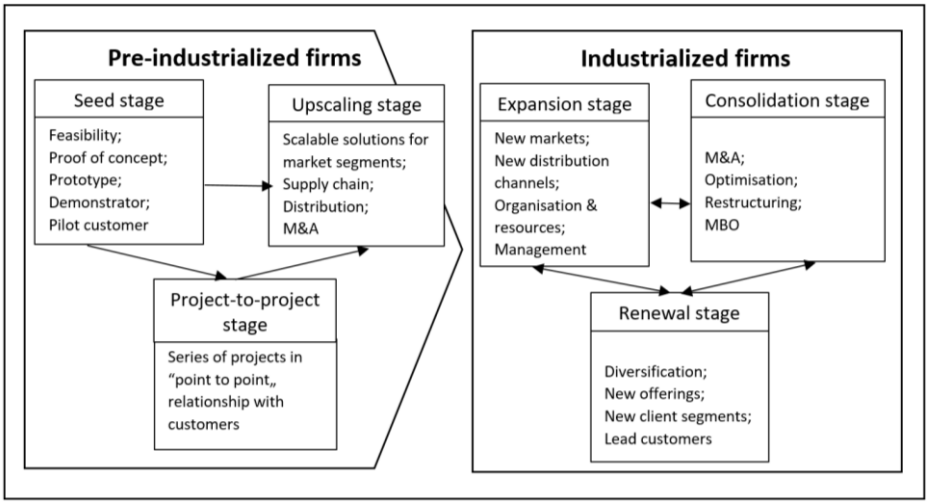

Fig. 5 Life cycle model based on hundreds of companies undergoing innovation potential screening over the last 10 years

Source: The platform of innovation in Western Switzerland

3.2.3 Statistical methods

After importing the data obtained from surveys and in-depth interviews into IBM SPSS Statistics, the data was processed and analysed using the following methods. A correlation analysis shows the statistical dependence of two quantitative variables (measures the relationship of two variables). Two variables are correlated if certain values of one variable tend to coincide with certain values of the other variable (Hendl, 2009). The Bonferroni test was used to determine which groups differ. The use of the Bonferroni procedure is relatively conservative, which means that it is relatively difficult to achieve statistical significance when it is used. The aim of the correlation analysis is to determine the strength of linear dependence between variables. The initial idea of the dependence of the X and Y characters can be obtained by looking at these n units for n statistical units and using the scatter plot for the data. It is a diagram in which each pair of observations (xi, yi) is represented as a point in a rectangular coordinate system, where the scale of the X and the vertical scales of the Y character are located on the horizontal axis. The points drawn are then a set from which to trace the characteristic features of both characters.

3.2.4 Software modelling

The standard Program Business Process Model and Notation (BPMN) Business Process Model and Notation (BPMN) is a graphical notation (a set of graphical objects and rules by which they are linked) to model business processes using process diagrams. BPMN is also a

ratified standard of the International Organisation for Standardization as ISO / IEC 19510: 2013. BPMN has been developing in the field of process modelling since 2004. After several versions, the BPMN 2.0.2 version has been introduced since 2014. Currently, BPMN documentation is so well elaborated that patterns are being developed to address standard situations that may arise during process management. The standard Business Process Model and Notation program was used to design the OPENSEC-IN process evaluation model. This part of the work captures the conceptual model, including software processing and a graphical notation of model business processes in the area of the open innovation potential of companies.

4 Selection of a knowledge management framework – multi-criteria analysis

Choice of criteria and impact assessment of individual alternatives in relation to these criteria

In practice, there are several different ways to select appropriate criteria and determine their weight. Basically, the following three ways could be mentioned (Korviny, 2005).

a) The design of the criteria and its weights is a matter of the only expert who will probably also himself calculate and sort the variants by any of the methods of multi-criteria decision making.

b) A group of experts is involved in determining the weighting of criteria and, where appropriate, selecting criteria. The result can then be obtained, for example, by a selected group of experts and selecting a relevant criterion for solving the given decision problem and determining their mutual percentage importance.

c) There is also the amount of the selected group of experts to send questionnaires with draft criteria into which they give their opinion on the importance of each criterion. In this case, the criteria and the determination of their weights is set in frame of dissertation work by the author of the present work.

Identifying alternatives

Based on literature research and the focus of the work on the possibility of interconnecting the open innovation model with the knowledge management four relevant models of knowledge management were found. The following alternatives were taken:

- SECI model Nonaka – Takeuchi.
- Knowledge spiral.
- "Choo" model.
- Boisot model.

As the selection of criteria and determination of their impact is rather subjective issue, were the criteria consulted with an expert board. The pool of experts included entrepreneurs of important industry fields focusing on innovative entrepreneurship (7experts), experts and consultants from the South Moravian Innovation Centre (4 experts) and the academics (4 experts). The total number of the pool of experts involved into consultation on the multi-criteria analysis were 15 members. To the selection of the experts, several principles were applied. It was based on a purpose selection. Experts from the Innovation Centre had to meet several criteria, in particular at least 5 years of consulting experience with a focus on innovation and increase of innovation potential in companies. Furthermore, they had to be currently involved in the process of consulting activities at high-tech companies. Experts coming of commercial field had to meet the focus of the pool of companies on which the research was targeted and actively participate in the implementation of the company innovations. The sampling method was included in the involvement of company experts. A method of selecting respondents also referred to as a chain or reference sample, is a type of the selection in which not all units or groups of units have the same chance of being selected for the sample. The selection process begins with individuals who are known to meet the criteria. Subsequently, they are asked to nominate other persons who meet the criteria in the interview and to allow researchers to contact them. These individuals are then interviewed and the process could be repeated. Thus, the sample grows by connecting to social contacts. Because it is difficult to involved experts of these group selected sampling method was very suitable. The academic´s background was the field of knowledge management, business and economics. The principle of volunteering was applied to all expert groups. The work with experts was based on individual interview.

Selection of criteria

Following criteria were selected:

C1: Ability of the model to reflect the specifics of the innovation potential of the company - the most important criterion

C2: Simplicity and Clarity of the Model

C3: Interconnection of model with literature

C4: Quantitative Result of Model Segments

C5: Model Case Study Availability

These are qualitative and maximizing criteria. They are all rated with a five-point scale, in which the maximum score is the best score

Decision matrix

The following table shows the evaluation of methods by selected criteria.

Tab. 3 The evaluation of methods by selected criteria

	C1	C2	C3	C4	C5
Choo	4	4	4	3	3
Boisot	4	3	3	4	3
Seci	5	4	4	2	4
Knowledge intensity	3	5	4	2	3

Source: author´s own work

Tab. 4 Assessment Criteria Rating Scales

	C1	C2	C3	C4	C5
scale	35	25	10	15	25
Norm scale	0.35	0.25	0.10	0.15	0.25

Source: author´s own work

Tab. 5 Assessment Criteria Rating Scales Result – methods TOPSIS, ORESTE, PROMETHE

	TOPSIS method		ORESTE method		PROMETHE method	
	Distance from nadir (relative index)	ri values	ri values	Order	Net flow	Order
Choo	0.462634	50	50	2	0.002583	2
Boisot	0.442539	58	58	4	0.002975	1
Seci	0.622606	44.50	44.50	1	-0.00313	4
Knowledge intensity	0.368844	57.50	57.50 ri values	3	-0.00243 Net flow	3 Order

Source: author´s own work

Tab. 6 Assessment Criteria Rating Scales Result – method TOPSIS

	Choo	Boisot	Seci	Knowledge intensity	Effectivity of alternatives
Choo	--	0	0	0	Non effective
Boisot	0	--	0	0	Non effective
Seci	0	0	--	1	Effective
Knowledge inten-	0	0	0	--	Non effective

Source: author´s own work

Evaluation of alternatives. A large number of methods have been developed over the years to support decision-making. With their help, the user should be able to select the most appropriate option for solving the problem or obtain a preferential arrangement of the options and on the basis of this to justify their decision. The methods differ from each other in the situations in which they are used, the number of criteria, the methods of calculation and the demands placed on the solver.

Multicriterial analysis tasks can be classified, for example, by the goal of the solution at:

- Tasks whose aim is to select one variation marked as compromise.
- Tasks whose aim is the complete arrangement (quasi-ordering) of variants.
- Tasks that aim to divide a variety of options into effective and inefficient.

Choosing a method for evaluating the benefits of knowledge management belongs to a group where the choice is one of the options. This selection can be based on initial cardinal or ordinal information. For methods requiring ordinal information, it is necessary to determine the order of importance of criteria and the order of variants according to individual criteria. Methods based on cardinal information require the value of criteria in the form of weights and the value of different variants in the form of a criterion matrix with cardinal values. The choice of method for evaluating the benefits of knowledge management will be based on cardinal methods. There are three basic approaches to evaluating variants in this way (Kalčevová, 2008):

- Maximizing benefits.
- Minimizing the distance from a fictitious variation.
- Preference sessions.

Maximizing benefits. The principle of maximizing the benefit lies in the fact that we determine the benefit from the interval <0 to each variant; 1>. The more appropriate the option, the higher the utility value. For example, the weighted sum method is included in this category. Minimizing distance from a fictitious variant. The fictitious variant is either the best (ideal) option, derived from the best criteria, or the worst (basal) option, determined by the worst criteria. In the first place, the preferential arrangement of variants is the least distant from the best variant or the most remote from the worst variant. The TOPSIS method is a representative of these methods. The TOPSIS method searches for a compromise variant and arranges all variants according to suitability - the distance from the ideal (the best theoretically possible variants).

Preference-based evaluation

The basic information for determining the preferential arrangement of variants is the results of pairwise comparison of these variants with respect to the individual evaluation criteria. Due to its nature, this group of methods is suitable for evaluating variants in a set of qualitative criteria, resp. in situations with a mixed set of criteria where qualitative criteria prevail. The result is not a numerical overall assessment of the variations, but only a breakdown of the set of evaluated variants into several indifferent classes and preferential arrangements of these classes. Variants included in each indifferent class can be considered equivalent to the whole set of criteria.

This group includes methods (Kalčevová, 2008):

- AGREPREF method.
- ELECTRE method class (ELECTRE I., ELECTRE III.).
- PROMETHEE method class (PROMETHEE I., PROMETHEE II.).
- MAPPAC.

The above-mentioned methods, based on input information, are used as a tool to support decision-making on the method for assessing the benefits of knowledge management. The specific calculation is performed using MS Excel for manual processing of the scoring method and MCA Scythe for the method of linear partial functions benefit (weighted sum), TOPSIS and ELECTRE I, AGREPREF, MAPPAC and PROMETHE.

For the overall evaluation of all used methods of multi-criteria evaluation of variants, a clear table is used in which the results of individual methods are captured. The order of advantage of given decision options, determined by one of the methods of multi-criteria evaluation of variants, depends mainly on the weights of individual criteria and on the method used. The table 4 clearly shows that the first order appears in the first order, which is represented by the SECI model.

5 Analysis of innovation activity among companies in the Czech Republic

An important prerequisite for a systemic approach to innovation is a profound knowledge of the situation and needs of different groups of companies and other actors in the innovation ecosystem. Without this knowledge, sophisticated support tools cannot be set up well, with a high degree of thematic focus and addressability common to them. The most important factor of the structured research among companies were their selection and Selection criteria for in depth interviews.

5.1 Selection of sample companies

The main unit of analysis was company. The company is a unit in which strategic knowledge is created about the future shape of markets and customer behaviour, the steps of competitors and emerging business opportunities. It is also by far the most frequent linking of these market competencies to technical expertise and technology, whether internal or external. Therefore, the proposed solution pays great attention to the overall direction and strategy of companies, including the forces that shape their market position. It is therefore a comprehensive evaluation of innovation processes in companies. Based on this, it focuses in more detail on selected aspects of innovation processes that bring the information needed to focus the tools of innovation policy (e.g. forms and barriers to external R&D cooperation).

One of the main questions of the whole methodology is the way of selecting companies for collecting primary data. The proposed solution is based on the distinction of two basic types of phenomena according to the distribution of their frequency size characteristics (Hampl, 1998). The size characteristics of most phenomena concentrate to a different degree around the average. According to the size characteristics, the sets of these phenomena correspond to a unimodal symmetric frequency distribution. The basic feature of a set of complex phenomena is their extremely asymmetric distribution of frequencies according to size of characteristics. The knowledge intensity at the company level is measured by the ratio of own R&D expenditure to output.

The principle of "many minims - low maxims" is the starting point for the methodology for analysing innovation capacity. In every economy, the number of companies with radical innovation capacity is several orders of magnitude lower than the total number of companies. This principle is illustrated, for example, by the following statistics: There are about 400000

entrepreneurial entities registered in the Czech Republic, of which only 3000 are carrying out their own R&D activities; 50% of total business expenditure on R&D in the Czech Republic. It follows that if the main attention is paid to innovations, the important input of which is R&D results, it is necessary to focus attention on a relatively small part of the economy measured by the number of companies.

Innovation capacity is also defined by the ability to establish itself on the world markets. In the field of exports, the principle of "many minims - low maxims" also acts. By combining the criteria of export performance with the knowledge intensity, a set of export firms are identified that seek higher technical innovation orders. By parameterizing the criteria of export performance and knowledge intensity and their application to different fields or size categories of companies it is possible to define a set of relevant companies for collecting primary data. The specific set of parameters must necessarily reflect the specific evaluation questions to which the evaluation of the innovation capacity is to be answered.

The results of the verification analyses showed that a relatively small part of companies selected in this way has a significant development effect for the whole economy. The selective set of companies for the analysis of innovation capacity must therefore include in particular the largest companies according to absolute and relative R&D capacities. Furthermore, fast-growing companies based on their export growth and competitive advantage of their own R&D capacity for innovation. A key criterion is also overall entrepreneurial and innovative aspirations. Firms aspiring. The basis of the research activity for the work was a structured basis for interviews.

The author of the present work personally conducted a survey and visited 50 companies. The two-hour interview was only possible with the owner of the company; in the case of foreign companies it was possible to implement the interview with the CEO or general manager. In both cases, the key criterion was that the director/owner is the head master of the company's innovation strategy. Three main criteria have been set for the selection of companies, which are described below.

5.2 Selection criteria for in-depth interviews

It was a multi-criteria selection for in depth interviews. The first criterion was the knowledge intensity of the company; this criterion was given by the minimum amount of investment in own research or development activities depending on the performance of the company. In 2015, 419 444 trading companies were registered in the Czech Republic. There were 2 391 R&D workplaces. 629 of R&D workplaces invested more than CZK 10 million in R&D. 82 R&D workplaces reported R&D expenditures over CZK 100 million. [3]. The resulting interview sample was designed to include companies with relatively high R&D expenditures for the company's total turnover. The reason for the emphasis on the knowledge intensity of companies is the fact that the critical capacity of financial, technical and other R&D capacities largely determines the company's innovation capacity in the area of higher order innovation. However, this does not mean that insufficient attention is paid to innovations that do not require their own R&D. Another criterion was active involvement in R&D projects in the last 3 years (national subsidies, innovative vouchers, creative vouchers, ministry of industry projects, etc.).

Another criterion was classification according to the Classification of Economic Activities (CZ-NACE). This criterion was based on core industries for the CR economy according to NACE classification. The following selection criteria were applied:

- The company’s knowledge intensity, measured by the minimum volume of investments in its own research or development activities.
- The company's performance, emphasis was placed on rapidly growing technological smes.
- Active involvement in r&d projects over the last 3 years.
- Category according to the classification of economic activities (nace); the key sectors for the czech economy according to the nace classification were selected (fig. 6).

The Statistical Classification of Economic Activities in the European Community, commonly referred to as NACE (for the French term "nomenclature statistique des activités économiques dans la Communauté européenne"), is the industry standard classification system used in the European Union.

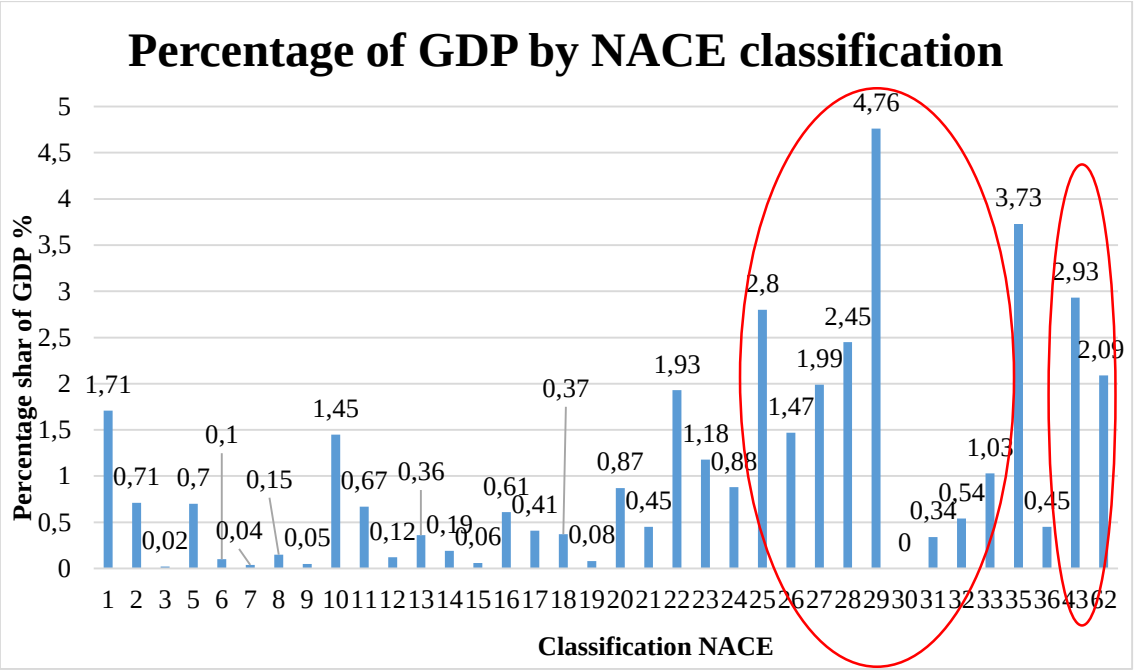

Fig. 6 Structure of GDP added-value creation. Selected 28: mechanical engineering, 26: electronics, 29: automotive, 25: metalworking, 43 building industry, 62: IT

Source: author´s own work based on data obtained from Czech Statistical Office

5.3 Methods and variables used

Data was processed and analysed using correlation and The Bonferroni test. The following variables were tracked:

- Exporting the company in % of total turnover.
- Expenditure on research activities % of turnover. The company's own resources for research activities in % to all resources.
- Subsidies for R&D % of total R&D expenditure, it was monitored how many % of R&D expenditures in the last 3 years increased.
- Ownership structure, Czech, Mixed (share of foreign owners below 50%), Foreign
- Position in the corporate structure A- without branches, B- parent company, C- subsidiary.
- Innovation types that have been introduced to the market in the past 2 years, A- Product Innovation, B-Process, C-Innovation Business Management Method.

- Company strategy: A - Expansion, B - Stabilization after previous growth, C - Defensive (keeping position in response to market decline).
- The meaning of the outputs of the owning R&D: A - essential, B - large, C – partial.
- Attitudes towards perception of barriers A - yes, perceives barriers; N-no.
- Strategy: strategic advantages does the company A aims at - offering something that no one else can do (product uniqueness) - radical innovation - changing parameters, B - Offering in a way that no one else can (unique delivery), C- Handling something difficult to manage (technical complexity / uniqueness), D.

5.4 Analysis results

The research is focused on the association between the size of the company and the frequency of participation in the Open innovation. Companies were divided into three groups according to the number of employees: 1–10, 11–50 and 50–250 employees. Companies with 1–10 employees most frequently used the open innovation model, in the role of presenters of solutions to larger companies. Companies with 50–250 employees were most often the beneficiaries. For the depth interwiews was used the questionare, see the attachement II.

Research question focuses on identifying the major barriers to the implementation of the innovation process. Although technology management was thought to be the major barrier in implementing the innovation process in Industry 4.0, this assumption is found to be a myth. The lack of highly motivated people with the necessary technical and business experience was found to be the main factor hindering the implementation of the innovation process. Secondly, the educational system is inadequately responsive to long-term societal and technological changes and thereby the new needs of companies. The market competencies of most of the companies were found to be less developed in technical competency to foster the adaptation of knowledge transfer. Smaller companies with a critical size were required to achieve a critical size to be capable of being global leaders in the development of new generic technologies. Few companies were able to invest in large innovative projects with global impact and scope. These companies are at the forefront of the development of generic technologies. It is not possible for other companies to enter this innovation. Lastly, the need for a stable, predictable and motivating business environment is also found to be a barrier to the implementation of the innovation process. All these

information is based on own obtain data, we tried to map out the most significant barriers in the innovation process in companies.

Research examines the factors that largely affect the implementation of the innovation strategies within these companies. Aspiration of innovation leadership is the major factor that affects the implementation of the innovation strategies, the correlation between these is very high. The goal of the innovation is to gain a strategic advantage and the strategic benefits.

5.4.1 R & D investment and the aspirations to lead the market

This captured the correlation between R & D investment rate and the aspirations to lead the market. Several major categories according to the attitude to innovation strategic tools were found to be determinate. There can be described by these main groups: the group of companies, which offer something that no one else can (product uniqueness) focused on radical innovation and changing parameters in the market, listed in the table 6 as A; a second group of companies are focused on offering in a way that no one else can provide: unique delivery; listed in the Table 1 as B, another group claim that their strategic tool is a technical complexity/uniqueness; listed in the table 6 as C the next group, listed in the table 6 as D, is focused mainly on gaining an advantage by being the first on the market or focused on the right timing. An interesting mind set was observed in the so-called “smart follower” group, (see table 6 letter E). This group observes innovation by their competitors and smartly implements these innovations in their market/technology.

The remaining companies were divided into groups that focused on differentiating (G in the table 1) a new factor of competition and on diversification (taking advantage of existing know-how in a different market). A very interesting result was that the perspective based on strategy gained the most interesting competitive advantage, the so-called smart follower. These companies invest 4× to 5× more in R&D and use open innovation in a very smart way.

The results indicate the association between the aspiration for innovation leadership and expenditure on research and development. There is a significant correlation between expenditure on open innovation and aspiration, which could be described as the aspiration of using existing know-how in another market - diversification.

Tab. 7 Correlation between the R&D investment rate and aspirations to lead the market

Aspiration of Innovation Leadership	Mean	N	Std. Deviation
A	5.5000	8	4.62879
B	12.0000	1	
C	3.2857	7	1.49714
D	4.6500	6	4.61031
E	3.0000	6	1.78885
F	4.3250	8	2.86394
G	6.2000	11	6.70298
Total	4.8447	47	4.44061

Source: author´s own work

A - product uniqueness - radical innovation - changing parameters; B - offering in a way that no one else can (unique delivery); C - technical complexity/uniqueness; D - right timing; E - smart follower; F - differentiate (a new factor of competition); G - diversification.

5.4.2 Areas of investment within the company to foster innovation

Based on obtaining own data from the questionnaire survey the expenditure and the areas of investment were investigated. Company investment (expenditure) that helped to foster innovation was categorized, such as: product innovation, process innovation and strategic management. It was found that most of the companies invested in R&D - focused on innovation of the technology processes (table 8). According obtain data most companies were focused on product innovation. The distinction between processes and products innovation was clarified but it may be less clear, if the production, delivery and consumption of services can would be offered at the same time. We could summarize, that innovation, which involves significantly progressed characteristics of the service is a product innovation.

And significantly improved skills, methods, formulas for performing the service is a process innovation. In some cases, there are implemented both the characteristics of the service, the methods, skills equipment and companies use combination of process and product innovation. In our research we divided firms into groups according the type of more significant type of innovation. Third groups were focusing on innovation in strategic innovation. Focusing on this type of innovation requires a certain awareness of the company's management and according to our survey, this type is devoted to the smallest group of companies.

Tab. 8 Areas of investment within the company to foster innovation

Kind of Innovation	Mean	N	Std. Deviation
Product innovation	4.6769	26	3.70722
Process innovation	5.2714	14	5.82586
Strategic management	4.6143	7	4.44613
Total	4.8447	47	4.44061

Source: author´s own work

Based on the strategy, respondents were divided into three main groups. Firstly, those who followed the expansion strategy, second those that focused on stabilization after previous growth. The last group was categorized as a defensive strategy (keeping a position in response to a decreasing market), (table 9).

Tab. 9 Types of business strategies

Strategy	Mean	N	Std. Deviation
Expansion strategy	5.1700	30	4.07508
Stabilization Strategy	4.2706	17	5.10340
Defensive strategy	0	0	0
Total	4.8447	47	4.44061

Source: author´s own work

5.4.3 Correlation between the R&D investment rate and the company's strategy

The impact of the innovation was also measured. Here we have attempted to capture the correlation between the R&D investment rate and the company's strategy from the point of

view of whether the firm is targeting expense or stabilization (for example, after previous growth or generational change) the stabilization strategy has been relatively well represented and defensive strategy (losing market share). The group with "Expansion Strategy" invested the most in R&D, almost 1% more than the others (table 10).

Tab. 10 Correlation between the R&D investment rate and the company's strategy

Impact	Mean	N	Std. Deviation
Expansion strategy	4.3882	34	3.77301
Stabilization Strategy	6.0385	13	5.85727
Total	4.8447	47	4.44061

Source: author´s own work

The research focused on tracking R&D expenditure according to how the companies perceive barriers to innovation, as it was expected companies that do not see significant barriers invest more in their own research (table 11).

Tab. 11 Barriers to innovation

Barriers	Mean	N	Std. Deviation
No significant barriers to implementation of innovation	3.8875	32	2.92770
Significant barriers to implementation of innovation	7.3889	9	6.97790
Significant barriers to a specific field	6.1333	6	5.55506
Total	4.8447	47	4.44061

Source: author´s own work

5.4.4 Correlation of chosen variables

When monitoring the relationship between the export rate of a firm and investment in research and development, a statistically significant correlation was found. This result confirms that exports (in particular to demanding markets such as the USA and Japan and to a large extent to the Czech Republic and Germany), are a significant stimulus for investment in their R&D activities and support global business and innovation ambitions.

Factors such as the export rate and the number of collectively employed workers are also related to the degree of innovation introduced by the company into the production process. The analysis shows that companies with foreign capital are trying to invest more than Czech companies. This result could be affected by the fact that research among firms that have a research centre in the Czech Republic.

Assigning to Research Questions:

1. How is the company export rate related to how the company invests in its own research and development?
2. How is the level of university-level employees correlated with the amount of R&D expenditures?
3. Does the rate of university employees affect the rate of export?
4. How does the ownership structure of the company relate to access to its own R&D activities?
5. Is the level of R&D investment affected by the type of innovation that the company targets?

Tab. 12 Correlation of variables

Header Monitored variables		Expenditure	Export	University Employee	Firms Source	Subsidies	Last 3Years Increasing
Expenditure	Pearson Correlation	1	0.289 *	0.378 **	0.277	−0.277	0.265
	Sig. (2-tailed)		0.049	0.009	0.059	0.059	0.071
	N	47	47	47	47	47	47
Export	Pearson Correlation	0.289 *	1	0.368 *	0.050	−0.050	−0.234
	Sig. (2-tailed)	0.049		0.011	0.737	0.737	0.113
	N	47	47	47	47	47	47
University Employee	Pearson Correlation	0.378 **	0.368 *	1	−0.117	0.117	0.079
	Sig. (2-tailed)	0.009	0.011		0.432	0.432	0.599
	N	47	47	47	47	47	47
Firms Source RD	Pearson Correlation	0.277	0.050	−0.117	1	−1.000 **	−0.048
	Sig. (2-tailed)	0.059	0.737	0.432		0.000	0.751
	N	47	47	47	47	47	47
Last 3years Increasing	Pearson Correlation	0.265	−0.234	0.079	−0.048	0.048	1
	Sig. (2-tailed)	0.071	0.113	0.599	0.751	0.751	
	N	47	47	47	47	47	47

*. Correlation is significant at the 0.05 level (2-tailed). **. Correlation is significant at the 0.01 level (2-tailed)

Source: author´s own work

When observing the correlation between the company export rate and how the company invests in its own research and development, a statistically significant correlation can be observed. In the case of growth of one quantity, the second quantity grows. In this case, the correlation value is 0.289.

This result confirms that export (specially to demanding markets such as the USA, Japan and to a large extent determining Germany) is a strong stimulus for investment in its own R&D activities and promotes global business and innovation ambitions.

There is a clear correlation between R&D expenditures and how many university employees the company has, the correlation value is 0.378. The third statistically significant correlation that occurred is between export and the number of university employees with a value of 0.368. It can therefore be assumed that factors such as the rate of export and the number of university employees are also related to the degree of innovation the company introduces into the production process.

In the case of ownership structure monitoring, it is interesting to see to what extent the ownership structure affects access to own R&D. An interesting finding is that companies with foreign capital are trying to invest more than purely Czech ones. In part, this finding can disprove the claim that the Czech Republic would be a factory. This finding is probably due to the fact that in the South Moravian Region, where I conducted research, are foreign companies that have their development centre in the Czech Republic, not just production. When tracking what kind of innovation prevails, there is a link between the level of investment in own R & D activities for product innovation firms and less for those focusing on process innovation. In research, the sense of innovation has been extended to process and strategic innovation in management. In research, the term innovation was not understood in a narrow technical direction, but in the broadest sense, thanks to structured interviews, a qualitative approach, it was possible to explain this issue and to unite the terminology in a terminological way. When tracking the value chain (according to GPN Global production networks: A - integrator, B - Tier 1, C - Tier 2), C - tier 2 is the least invested, B - tier 1 is two percent more and 2.5% more investing A - integrator. This result could be assumed, since the value added is usually the value-added chain integrator.

Many companies that are part of international corporations are implementing some of the value chain activities in the Czech Republic. Although it is not possible to flatter, companies at a position that generate lower added value are less likely to benefit from the use of research or development activities. However, development activities with higher added value are a key component of corporate innovation processes and it is important for companies to gradually expand their activities to other parts of the value chain from the perspective of the country's long-term innovation capacity.

Tab. 13 The Importance of Own R&D, option: A- A very significant B-significant

Expenditure on R&D				
Strategy	Mean		N	Std. Deviation
A	5.1700		30	4.07508
B	4.2706		17	5.10340
Total	4.8447		47	4.44061

Source: author´s own work

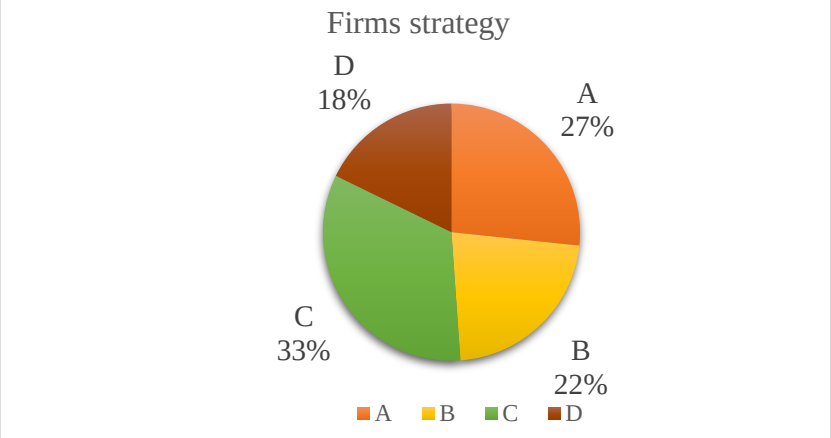

Fig. 7 Company strategy: A - Expansion, B - Stabilization after previous growth, C - Defensive D others

Source: author´s own work according to interview information by 50 companies

A large part of successful companies was founded in the 1990s and its owners now have to face the issue of succession. Due to the impossibility of private business before 1989, there is not enough experience in this area. However, the overwhelming majority of respondents agreed that successful handover is one of the most difficult steps for entrepreneurs. Many companies are in the process of generational exchange and this is also related to the form of strategy that is not expanding in these cases, but rather aims to maintain existing positions.

It was interesting to follow another phenomenon, which in a simplified form can be called a smart follower of innovation trends. It is an innovation strategy that uses the know-how of other companies in a sophisticated way. The research showed that this group is the largest share of R&D companies. This finding correlates with the outcomes of the measurement of the regular Innovation Union Scoreboard published by the European Commission. It was

thus verified that the research presented by the European Commission correlates fully with the situation in one of the most developed Czech regions. Innovation Union Scoreboard presents as an indicator, which adequately expresses the innovation performance of the economy, the so-called "innovation index". This index is based on a multi-criteria evaluation of the innovation ecosystem. Selected indicators capture important inputs, processes and outputs of the innovation ecosystem, capture the level of R&D expenditure of companies, the availability of university-qualified people, the number of patents related to the size of the economy, and venture capital investments. Several factors monitored by the European Commission have been monitored in this research (see methodology). Below is a graph showing a comparison of aspirations to innovations by country, processed in the framework of the Report Union scoreboard 2017. The chart shows that the Czech Republic is a so-called moderate innovation in terms of aspiration to innovation.

5.4.5 Open innovation as a tool for strategic management in Czech companies

The largest number of companies using the open innovation session model as a tool of strategic management was made up of machinery SMEs that implemented Industry 4.0. These companies are mostly focused on the machinery and ICT field and consider open innovation as a suitable tool for developing their strategic tools to meet the Industry 4.0 content. More than half of all applicants were firms with 51 to 250 employees. More than half of applicants had never worked on a project with a university before. Here we can see the main impact of the Open innovation session model. In 68% of cases, the main reason for cooperation on the part of the company was knowledge of the specific researcher´s team.

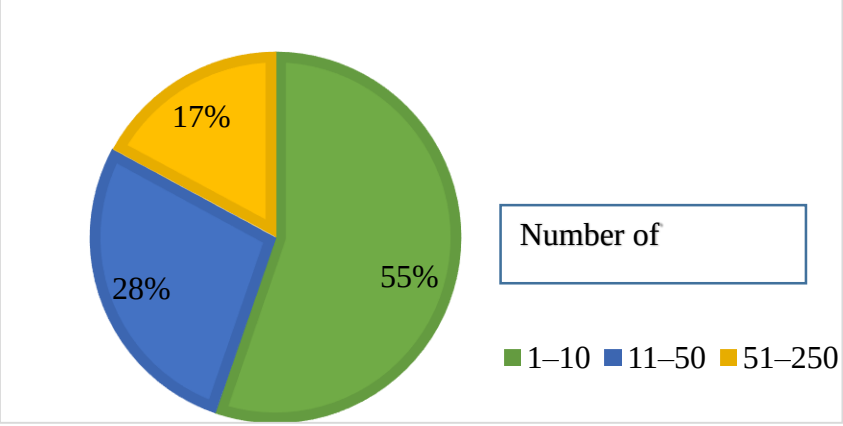

Fig. 8 Frequency of participation in the Open innovation session

Source: author´s own work

The research is focused on the association between the size of the company and the frequency of participation in the Open innovation session. Companies were divided into three groups according to the number of employees: 1-10, 11-50 and 50-250 employees. Companies with 1-10 employees most frequently used the open innovation model, in the role of presenters of solutions to larger companies. Companies with 50-250 employees were most often the beneficiaries. Fig. 8 shows how often companies used open innovation in correlation to the number of employees.

Tab. 14 Barriers, A-No major Barriers, B-significant barriers source: own

Expenditure on R&D			
Barriers	Mean	N	Std. Deviation
A	3,8875	32	2,92770
B	7,3889	9	6,97790
N	6,1333	6	5,55506
Total	4,8447	47	4,44061

Source: author´s own work

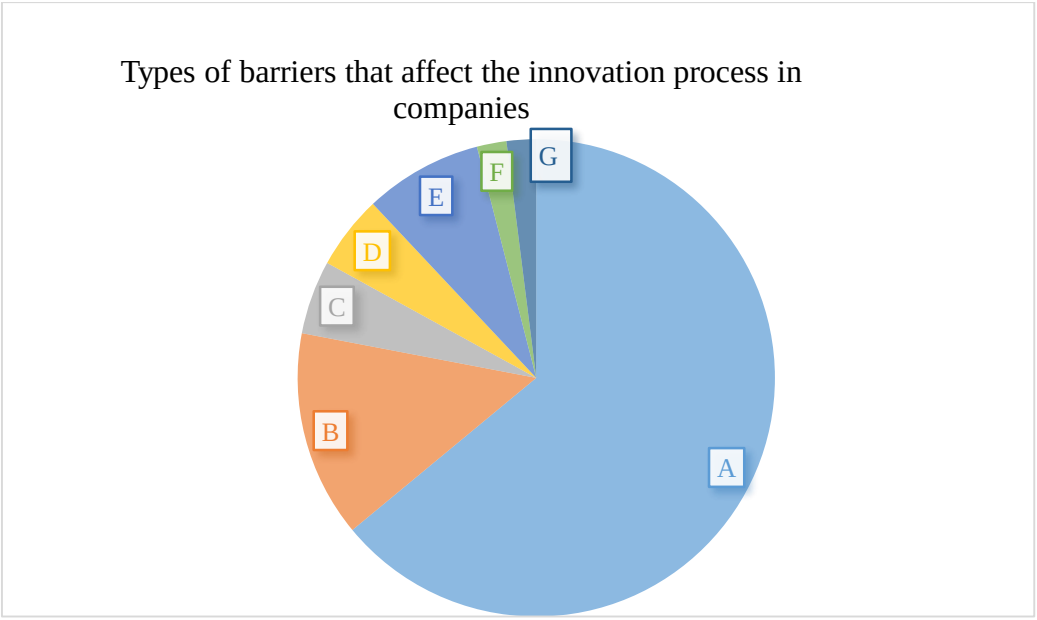

Fig. 9 Types of barriers that affect the innovation process in companies. Processing according to information from interviews of 50 companies

Source: author´s own work

Tab. 15 Barriers affecting the innovation process in companies

Lack of qualified staff	A
Lack of finance	B
Restriction coming from headquarter	C
Difficult to enter others markets – according territory	D
Education system insufficiently responding to social and technological changes	E
Difficult to enter others markets – by field	F
Unstable economic environment	G

Source: author´s own work

The lack of qualified staff, especially technical education, is so clear and the most significant factor in the innovation process follow-up when monitoring innovation barriers. Another factor is related to this barrier, namely that the education system does not respond sufficiently to long-term technological and social changes. The financial factor is not the most significant. To a small extent, innovations and their implementation are influenced by the restrictions of parent companies, the marginal part is formed by barriers such as unstable economic, political environment or market saturation. The barriers to the innovation process are detailed in fig. 9. In line with the evolutionary approach to the development of innovative systems, the emphasis is on long-term trends. Annual, let alone quarterly data on economic performance, are not very relevant as they are subject to a number of short-term effects. The central theme is productivity, which can be measured in more ways and at different levels of the economy (the whole economy, industry, industries, and companies). In relation to innovation, there is a need to highlight the dual way in which innovation affects productivity. Firstly, it is about increasing efficiency, which means that more production can be generated from the same resources through innovation. The second way is to discover new needs and thereby create new values.

The growing dynamics of global environment change (economy, society, technology, etc.) are particularly crucial to the long-term prosperity level, generating new sources of value. This duality of innovation in terms of impact on productivity is crucial to the sufficiency of quality jobs, which is one of the main objectives of economic policy. While resource efficiency innovations contribute significantly to the competitiveness of such innovative

companies, the release of labour is associated with these innovations from the point of view of the national economy. Innovation generating new sources of value is therefore crucial to creating enough new jobs. This duality of the impact of innovation on the labour market is so extensive that it falls outside the regular assessment of the innovation capacity of the economy. However, it should be noted that this is a crucial issue that deserves special attention. Indeed, for a number of reasons, the speed of job creation can lag behind the speed of job cuts due to accelerating technological developments.

One of the most interesting factors was the monitoring of aspirations for innovations, or the division of companies based on the strategy chosen by the company owner/executive in the area of innovation implementation. It was found that the entrepreneurial settings of the owners and thus the innovative aspirations differ significantly among the companies. At the outset, it was assumed that all companies followed the expansion strategy. Research has found that this is not the case in all cases.

There are several reasons why the situation is different. During my questionnaire survey, conducted by a qualitative form of research, I had the opportunity to learn more about these reasons and describe them. The main reason was the lack of interest in entering other export markets (product) in the event of market saturation with current production. Another factor is the fear of change and the associated risks. Owners often said that they preferred smaller steps to increase the company's profitability and relative certainty over significant expansion.

6 Model of innovation use in business practice with a focus on open innovation

Given the results described above, according both the multi-criteria analysis, the research and the questionnaire survey based on depth interview among fifty companies according methodology set in advance, the starting points of the proposed solution described SECI model.

The results of the questionnaire survey and the variables themselves lead to the determination of several specific segments and innovation vectors for further research work.

6.1 Description and segmentation of open innovation segments and vectors

Business innovation challenges have typical patterns in different life cycle transitions. Most entrepreneurs do not have experience in this kind of transitions, are not aware of the related challenges, and are not adequately prepared for handling them. The business innovation model offers them a comprehensive, holistic model for analysing implications and challenges along this dynamic. Along the transition from one life cycle stage to another the company business innovation system needs to be adapted with regard to its main vectors: offering, process, distribution, and customer. A creative change of one or more of these will lead to business innovation, defined as new value for the customer and the firm. A precondition for initiating and successfully changing these vectors is the availability of resources.

Segments:

- Aspiration of innovation leadership
- Firm Culture
- Partnerships
- Market

Vectors:

- Strategy
- Organisation
- Qualification
- Market
- Finances
- Firm Culture
- Leadership
- Distributors
- Customers
- Suppliers
- Education and research
- Partnerships
- Private investor
- Public support (regional, national level)

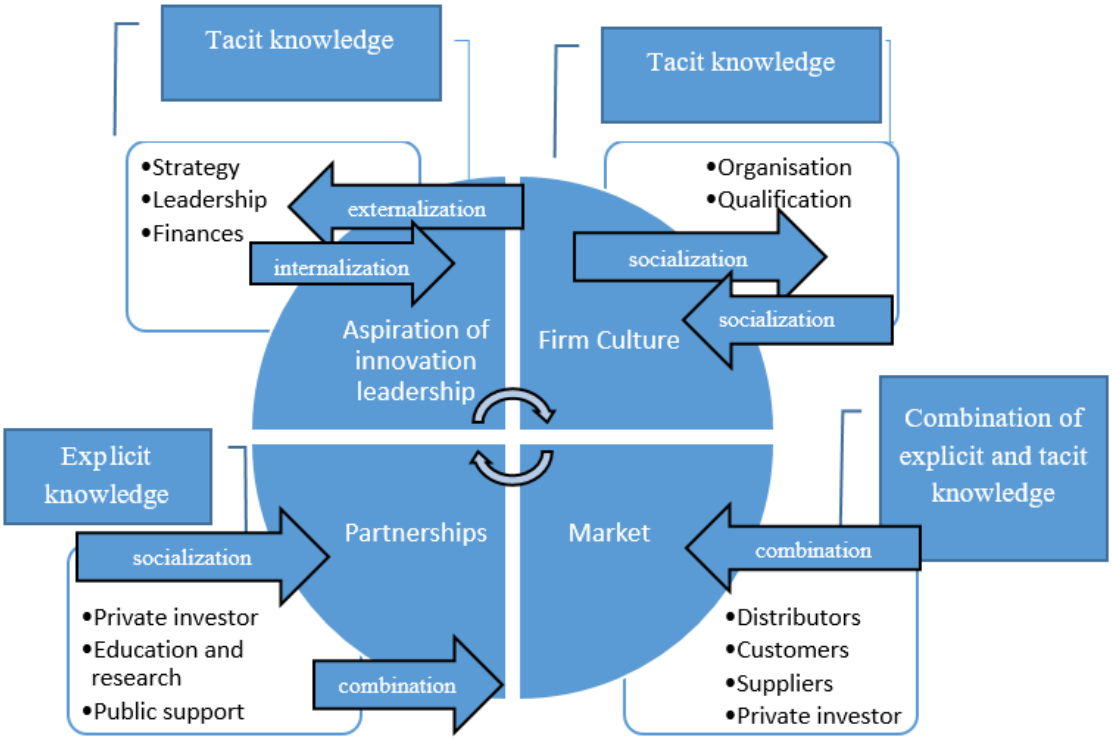

Fig. 10 Segments and vector of open innovation based on SECI model

Source: author´s own work

6.2 An evaluation model of innovation based on the SECI model

The aim of this work is to propose an evaluation model of innovation use in business practice with focus on open innovation. The model is based on management as a discipline specifying work with explicit and tacit knowledge as they are key to innovation and on analysis have been defined four main segment of open innovation. According multi-criteria analysis is the model based on SECI model. Figure 10 shows the four main sector and following vector. Individual segments and vectors of innovation can be seen as two forms of tacit and explicit knowledge and individual segments and vectors were defined on the base of research, which were subsequently classified into the knowledge. With this knowledge, it is possible to focused on and work with these segments at the level of knowledge management. In the fig. 10 is visible also the flow of knowledge. There are four main knowledge creation processes socialization, which is mainly observe at segment represent firm culture and generating attitudes and ideas of an organisation and the way in which they affect how it does business and how its employees behave. Externalization and internalization is mainly observed at segments represents aspiration of innovation and leadership, where is stablishing a clear

vision and sharing that vision with others and mobilizing them. Providing information, knowledge and methods to implement that vision, counter-balancing resistance and passivism and also coordinating and balancing the conflicting interests of all members and stakeholders.

An evaluation model of innovation use in business practice with focus on open innovation.

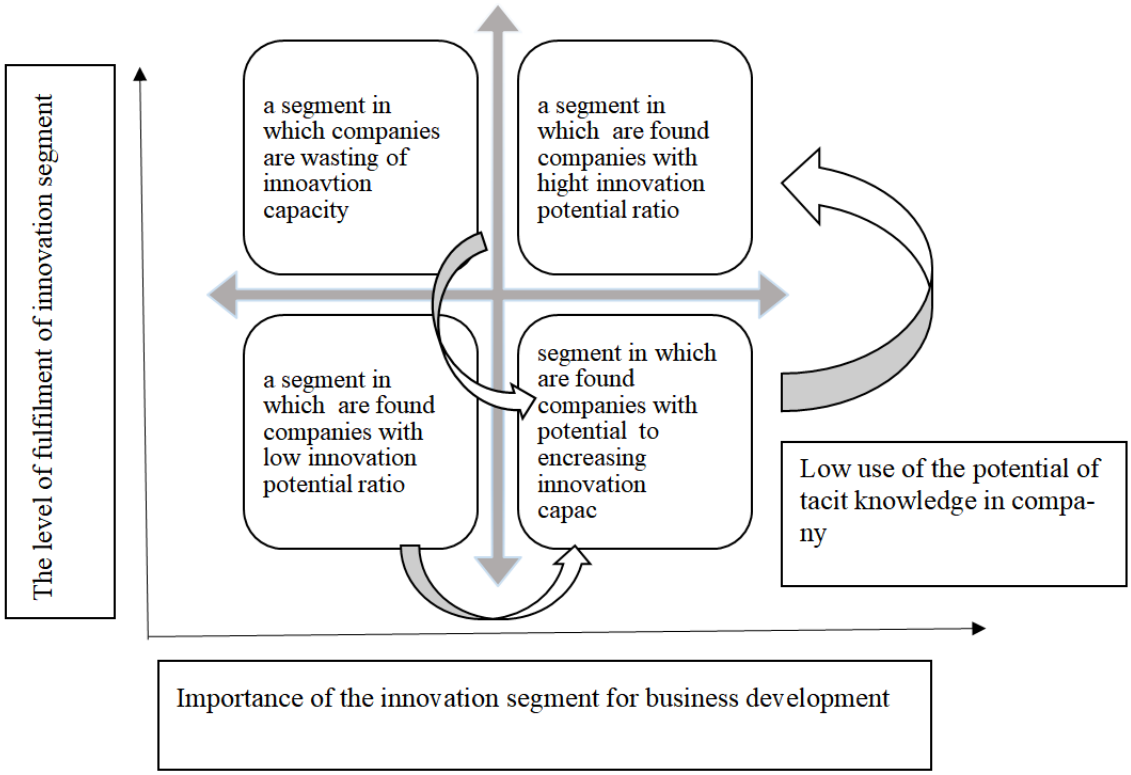

Fig. 11 An evaluation model of innovation use in business practice with focus on open innovation

Source: author´s own work

An evaluation model of innovation use in business practice with focus on open innovation is based on SECI model. Individual segments and vectors of innovation can be seen as two forms of tacit and explicit knowledge. The model describes the main open innovation segments based on innovative vectors. According to the importance of the segment for open innovation in the company, the appropriate quadrant is set on the X axis. Based on the evaluation of the vector of innovation, to what extent the given vector is being filled, the quadrant is set on the Y axis. Based on the intersection of the quadrant on the X-axis and Y, the innovation potential for open innovation is determined. Arrows in the graph show the

appropriate targeting of the movement between the individual quadrants. The combination is flow in segment focusing on market. Especially there are these processes: identification and valuation of customers and markets; need and opportunity analysis including analysis of competing technologies and approaches. Analysis of direct competitors; Analysis of regulator and other frame conditions. There are also flow of segmentation and identification of entry markets and planning of marketing mix implementation. Created model is in the form of mental map represented graphically diagrams of individual innovation vectors and segments with mutual relations and connections in connection with further research, verification and completion of the existing model. This part of work is leading to capture conceptual model including software processing and graphical notation to model business processes in the area of open innovation potential of companies.

7 Case study

In this chapter are described four case studies of pilot testing the evaluation model of innovation use in business practice with focus on open innovation based on SECI model. Individual segments and vectors of innovation can be seen as two forms of tacit and explicit knowledge.

7.1 Aim of case studies

The case studies describe and illustrate the steps of the method on real data in real firm´s environment. The first and the third case studies demonstrate the possibility of using the method on a Czech medium-sized manufacturing company. The second describes the applicability of the method in ICT company operating in industry 4.0. As it has been considered as an important industrial stage in which several emerging technologies are converging to provide digital solutions and the verification of this model is for usage of evaluation model very important, because there is a lack of understanding of how companies implement open innovation in these technologies. And one of case study was realised in civil engineering company where technology and services are combined. The result has shown that applying the method of evaluation model of innovation use in business practice with focus on open innovation based on SECI model is possible and that the methodology is usable for different field of business operation.

7.2 Methodology

In the social sciences, the term case study refers to both a method of analysis and a specific research design for examining a problem, both of which can be used to generalize findings across populations. A case study examines a person, place, event, phenomenon, or other type of subject of analysis in order to extrapolate key themes and results that help predict future trends, illuminate previously hidden issues that can be applied to practice, and provide a means for understanding an important research problem with greater clarity. A case study research method examines a single subject of analysis, but case study can also be designed as a comparative investigation that shows relationships between two or more subjects. The methods used to study a case can rest within a quantitative, qualitative, or mixed-method investigative paradigm. However, identifying a case to investigate involves more than choosing the research problem. A case study encompasses a problem contextualized around

the application of in-depth analysis, interpretation, and discussion, often resulting in specific recommendations for action or for improving existing conditions. Practical considerations such as time and access to information can influence case selection, but these issues should not be the sole factors used in describing the methodological justification for identifying a particular case to study. An evaluation model of innovation use in business practice with focus on open innovation was verified in 4 case studies as the main areas selected were companies focused on IT and machinery and civil engineering companies. These segments are deliberately chosen because they are sectors that have different needs for open innovation and cover a wide variety of innovative needs. Based on these case studies, the proposed evaluation model was finally modified and as a follow up was designed software modelling in the program Standard Business Process Model and Notation (BPMN), which will provide businesses with the capability of understanding their internal business procedures in a graphical notation and will give organisations the ability to communicate these procedures in a standard manner. Furthermore, the graphical notation facilitates the understanding of the performance collaborations and business transactions between the organisations. The aim of the case study was to verify the evaluation modus in practice, the intention was to test whether the choice of individual segments was correct and whether the company management can respond to the individual key vectors of innovation.

7.2.1 Selection for case study´s company

One of the most important part of the case study´s preparation was selection of company, where the model will be verified and the selection was based on a multi-criteria selection for company involved in the case studies. The first criterion was the knowledge intensity of the company; this criterion was given by the minimum amount of investment in own research or development activities depending on the performance of the company. The resulting interview sample was designed to include companies with relatively high R&D expenditures for the company's total turnover. The reason for the emphasis on the knowledge intensity of companies is the fact that the critical capacity of financial, technical and other R&D capacities largely determines the company's innovation capacity in the area of higher order innovation. However, this does not mean that insufficient attention is paid to innovations that do not require their own R&D. Another criterion was active involvement in R&D projects in the last 3 years (national subsidies, innovative vouchers, creative vouchers, ministry of industry projects, etc.) Another criterion was classification according to the Classification of Economic Activities (CZ-NACE). This criterion was based on core

industries for the CR economy according to NACE classification. The following selection criteria were applied: the company’s knowledge intensity, measured by the minimum volume of investments in its own research or development activities, the company's performance, emphasis was placed on rapidly growing technological SMEs, active involvement in R&D projects over the last 3 years, category according to the Classification of Economic Activities (NACE); the key sectors for the Czech economy according to the NACE classification were selected

7.3 I. Case study Alumistr

7.3.1 Description of the firm's context

The company was incorporated in the Commercial Register in 2000 and entered the Czech market as a construction company in the area of manufacturing and installation of frame glazing systems. It uses a network of approximately 30 dealers to distribute its systems, and facilitates its own installation. Production range includes structures for gazebos, winter gardens and porches for single-family houses, interior glazed walls and partitions, and atypical structures made of aluminium profiles adapted to the customer’s specific ideas. The products are distributed via a network of trained business partners across the Czech Republic, Slovakia, Sweden and Norway. Constant activity in the area of development and innovation of its own products have led to a gradual expansion of the company’s portfolio.

Tab. 16 Description on company´s context

Turnover (last year)	130 mil CZK
R&D expenditures (last year)	2 mil CZK
Number of employee	50
Year of company establishment	2000
Country	Czech
NACE CLASSIFICATION	
F41 - Construction of buildings C25.1 - Manufacture of structural metal products C25.1.1 - Manufacture of metal structures and parts of structures C25.1.2 - Manufacture of doors and windows of metal	

Source: author´s own work

7.3.2 I. Case study: assessing the business innovation system

According the questioner there were evaluated business innovation segments and its vector. The concept of business innovation is used as a proven basis for analysing the state of innovation. A business innovation is defined by creating substantial new value for the customer and the firm. This can be achieved through modification of any of the four business vectors: Offering (product/service), Process (organisation & resources), Distribution (business model, sales, branding), Customer (segments, relationship). The assessment was based on the set of questions (attachment n. 1) how high is the strategic importance for targeted context – it means how is the strategic importance of each segment to the target position of the market and how the owner of company /general manager asses the preparation level for the target context. Strategic importance for targeted context is scaled from 0 to 10 points. 10 points illustrated very high strategic importance and zero points describe very low strategic importance for targeted context and in parallel evaluation is evaluated preparation level for targeted context on the scale from 0 to 10 points. 10 points illustrated very high preparation level for targeted context and zero points describe very low.

Tab. 17 Assessment of innovation vector, own work

Key vectors of business innovation	Assessment of criteria	Assessment of criteria
	Strategic importance (for targeted context)	**Preparation Level (for targeted context)**
	10 = very high, 0 = very low	10 = very high, 0 = very low
Aspiration of innovation leadership		
strategy	8	2
leadership	7	5
finance	8	10
Firm Culture		
organisation	7	3
qualification	5	7
Market		
distributors	7	3
customers	7	7
suppliers	3	4
investors	not relevant	not relevant
product	5	5
Partnership		
R&D	4	6
public support	3	1
universities	4	6
investors	not relevant	not relevant

Source: author´s own work

The assessment was based on the set of questions (attachment n. 1) how high is the strategic importance for targeted context – it means how is the strategic importance of each segment to the target position of the market and how the owner of company /general manager asses the preparation level for the target context. The crucial vector for the company is the strategy because for the company for target context is very important to make innovation (8 point) in this field but the preparatory for this innovation is low (2 points). This is typical for company after the transformation of owner's management to professional management.

A red circled segment (upper left segment), is the most important for increasing innovation capacity and with the potential to increasing innovation capacity for target context.

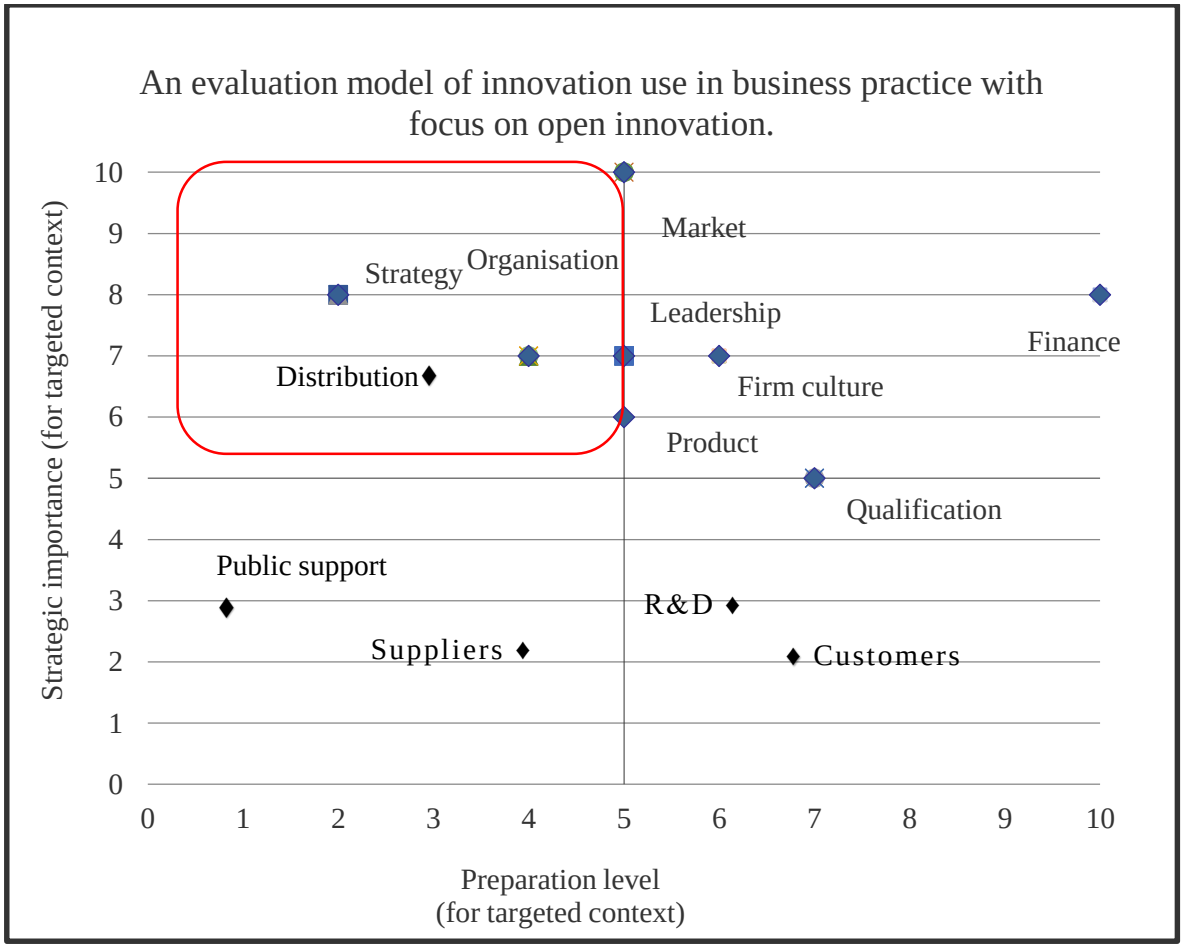

Fig. 12 An evaluation model of innovation use in business practice with focus on open innovation

Source: author´s own work

The company has now undergone a fundamental change in top management, which is related to setting a strategy that is not quite clear at the moment. In general, the main point of the company's strategy is to increase its turnover 3 to 5 years and expansion to foreign markets. Nowadays, the entry into the Polish market is becoming a strategic goal (block of flats construction has not yet undergone extensive revitalization as in the Czech Republic). An estimate of the potential for non-revitalized houses in Poland is the potential growth potential. The expansion has not yet been thought through, analysed, designed or anchored. The company is constantly growing and shows signs of expansion (construction of a new hall, recruitment of new employees), but the main market, i.e. revitalization of prefabricated

houses in the Czech Republic is largely saturated and it is necessary to look for new areas of application, expand into new markets. Action plan to increase innovation ration is following: to systematize the collection of innovative materials from employees. Focus more on the use of internal sources of innovative ideas. And qualification of key employees. Setting the company strategy in relation to the set goals. Setting up a sales department and selecting a sales director. To evaluate the possibilities of cooperation with foreign distributors. It is closely related to defining the strategy of expansion to foreign markets. To find out possibilities of cooperation with R&D in the field of new simulation of static construction.

7.4 II. Case study Kentigen s.r.o.

The second case study describes the applicability of the method in ICT company operating in industry 4.0. As it has been considered as an important industrial stage in which several emerging technologies are converging to provide digital solutions and the verification of this model is for usage of evaluation model very important, because there is a lack of understanding of how companies implement these technologies.

7.4.1 Description of the firm's context

Company is involved in measurement test systems for example functional testing and TestCell for production lines and for single purpose machines. Advanced technical solutions and their interdisciplinary overlap is the main field of company´s work. Firm is focused on modern measurement applications with product portfolio of National Instruments. Data acquisition and storage of data are integral part of production and test systems. Company uses standard database systems (Microsoft SQL Server) as well as higher level systems for traceability and process control B&R APROL DCS. Expansion packs (for APROL system) for energy monitoring (EnMon) and conditional monitoring (ConMon) allow multipurpose utilisation of the single system. The selected company is progressive company which is focused on modern high-tech solutions in industrial automation and biomedical industry bringing technological progress to industries, which use obsolete or old technologies. Point of difference: solving speed of complex algorithmic problems, high emphasis on project solution and its successful finalization, using the latest technologies.

Tab. 18 Description on company´s context, own work

Turnover (last year)	50 mil CZK
R&D expenditures (last year)	3 mil CZK
Number of employee	25
Year of company establishment	2013
Country	Czech
NACE CLASSIFICATION	
62 - Computer programming, consultancy and related activities J.62.0 - Computer programming, consultancy and related activities J.62.01 - Computer programming activities J.62.02 - Computer consultancy activities	

Source: author´s own work

7.4.2 II. Case study: assessing the business innovation system

The concept of business innovation is used as a proven basis for analysing the state of innovation. A business innovation is defined by creating substantial new value for the customer and the firm. This can be achieved through modification of any of the four business vectors: Offering (product/service), Process (organisation & resources), Distribution (business model, sales, branding), Customer (segments, relationship).

The assessment was based on the set of questions (attachment n. 1) how high is the strategic importance for targeted context – it means how is the strategic importance of each segment to the target position of the market and how the owner of company /general manager asses the preparation level for the target context. Strategic importance for targeted context is scaled from 0 to 10 points. 10 points illustrated very high strategic importance and zero points describe very low strategic importance for targeted context and in parallel evaluation is evaluated preparation level for targeted context on the scale from 0 to 10 points. 10 points illustrated very high preparation level for targeted context and zero points describe very low.

Tab. 19 Assessment of innovation vector, own work

Key vectors of business innovation	Assessment of criteria	Assessment of criteria
	Strategic importance (for targeted context)	**Preparation level (for targeted context)**
	10 = very high, 0 = very low	10 = very high, 0 = very low
Aspiration of innovation leadership		
strategy	9	3
leadership	9	6
finance	2	6
Firm Culture		
organisation	9	2
qualification	8	7
Market		
distributors	2	1
customers	8	4
suppliers	9	8
investors	2	0
Product	10	7
Partnership		
R&D	2	9
public support	3	1
universities	5	9
investors	2	0

Source: author´s own work

Company is leading by young team which has no so much experience and from start-up company grow fast and there are no internal processes prepared for expansion, we can see this in the evaluation focused on the preparation of strategy, processes, organisation and leadership for targeted context. A red circled segment (upper left segment), is the most important for increasing innovation capacity and with the potential to increasing innovation capacity for target context.

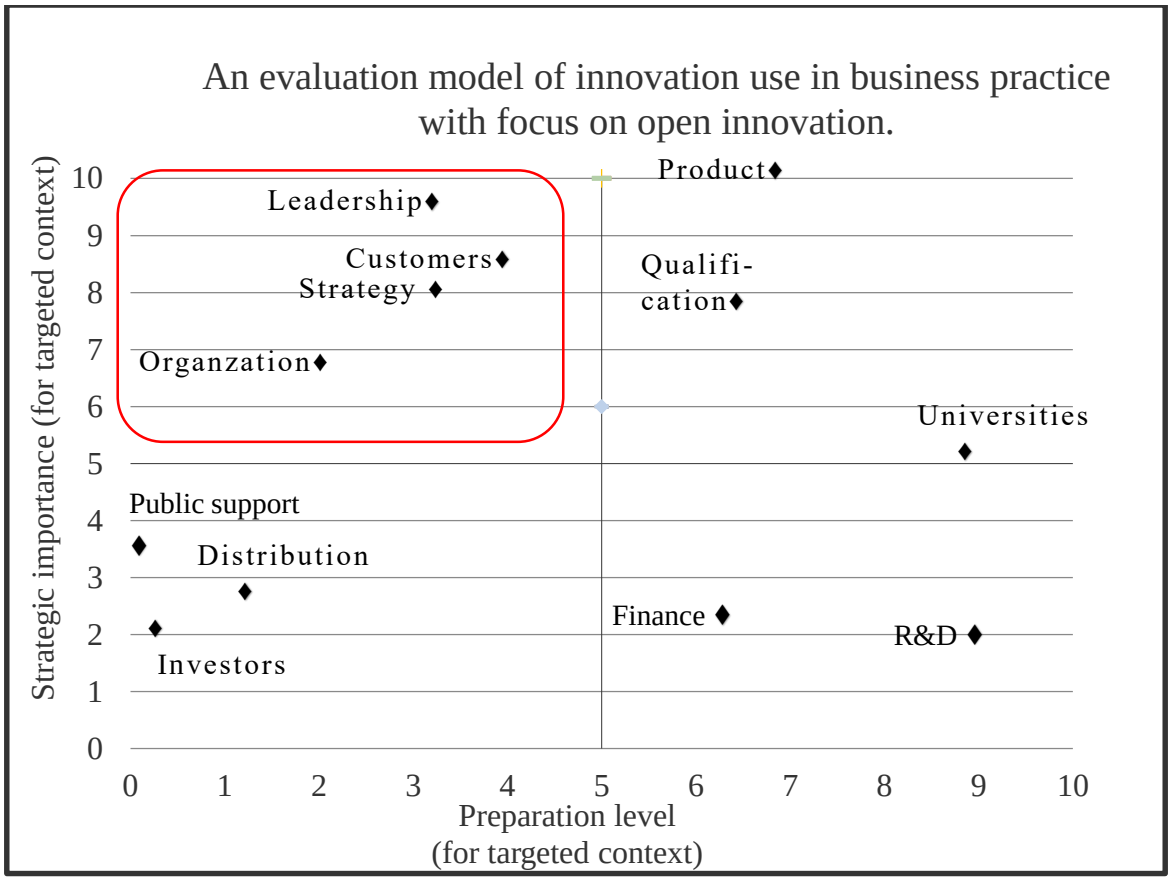

Fig. 13 An evaluation model of innovation use in business practice with focus on open innovation

Source: author´s own work

Product innovation is key to the functioning of the company, software development is growing very fast ahead, the company communicates with customers directly, is in close contact with them. Management do not see space to distribute or resell their products. Products are always tailored to a specific customer and customer relationships are based on long-term cooperation. The company does not actively work with customers and do not systematically acquire new customers. The processes in the company are set up very freely. There is very strong segment of in which company is wasting of innovation capacity. The development strategy is given rather as a framework, it is not clear exactly how the company will try to increase its export share and in what direction the branch in Brno will develop. The main source of innovative ideas are wealthy companies, the organisational structure is freely built, there are no fixed internal processes.

The most important vectors for open innovation for the company are customers, internal processes, internal sources of innovative ideas. Clear setting of the strategy, including the base of this strategy with regard to the organisation of internal processes.

7.5 III. Case study ALFE

7.5.1 Description of the firm's context

ALFE Ltd., is a foundry of many years' tradition in manufacture of castings. It was founded in 1912 as the first Czech foundry in the Brno region. After nationalization in 1950 it was affiliated subsequently to the textile factory and castings for textile machines were manufactured here. Since 1992 the foundry is again a private one with Czech owners with no foreign co-ownership. It continues in traditions of foundry manufacture and it employs 30 employees for manufacture of lamellar graphite and spheroidal graphite iron castings and aluminium alloys castings cast in sand moulds. Since 1995 the manufacture of precision zinc and tin casting cast by centrifugal casting technology in rubber moulds has been introduced in the foundry.

Tab. 20 Description on company´s context, own work

Turnover (last year)	30 mil CZK
R&D expenditures (last year)	3 mil CZK
Number of employee	30
Year of company establishment	1992
Country	Czech
NACE CLASSIFICATION	
C.28 - Manufacture of machinery and equipment n.e.c 28.30 - Manufacture of agricultural and forestry machinery C.28.4 - Manufacture of metal forming machinery and machine tools C.28.41 - Manufacture of metal forming machinery C.28.49 - Manufacture of other machine tools C.28.9 - Manufacture of other special-purpose machinery C.28.91 - Manufacture of machinery for metallurgy	

Source: author´s own work

7.5.2 III. Case study: assessing the business innovation system

The concept of business innovation is used as a proven basis for analysing the state of innovation. A business innovation is defined by creating substantial new value for the customer and the firm. This can be achieved through modification of any of the four business vectors: Offering (product/service), Process (organisation & resources), Distribution (business model, sales, branding), Customer (segments, relationship). The assessment was based on the set of questions (attachment n. 1) how high is the strategic importance for targeted context – it means how is the strategic importance of each segment to the target position of the market and how the owner of company /general manager asses the preparation level for the target context. The strategy of the company is divided into several key points and is actually formed organically, which is related to the generational transformation in the company management. A red circled segment (upper left segment), is the most important for increasing innovation capacity and with the potential to increasing innovation capacity for target context.

Tab. 21 Assessment of innovation vector, own work

Key vectors of business innovation	Assessment of criteria	Assessment of criteria
	Strategic importance (for targeted context)	Preparation level (for targeted context)
	10 = very high, 0 = very low	10 = very high, 0 = very low
Aspiration of innovation leadership		
strategy	10	3
leadership	9	3
finance	10	6
Firm Culture		
organisation	8	2
qualification	9	9
Market		
distributors	1	6
customers	8	4
suppliers	4	8
investors	0	0
product	6	6
Partnership		
R&D	2	0
public support	3	1
universities	5	3
investors	0	0

Source: author´s own work

Strategic importance for targeted context is scaled from 0 to 10 points. 10 points illustrated very high strategic importance and zero points describe very low strategic importance for targeted context and in parallel evaluation is evaluated preparation level for targeted context on the scale from 0 to 10 points. 10 points illustrated very high preparation level for targeted context and zero points describe very low. The concept of business innovation is used as a proven basis for analysing the state of internal processes need to be improved and management is working on it. The challenge is to increase employee motivation and further develop the corporate culture. leadership for targeted context. A red circled segment is the most important for increasing innovation capacity and with the potential to increasing innovation capacity for target context.

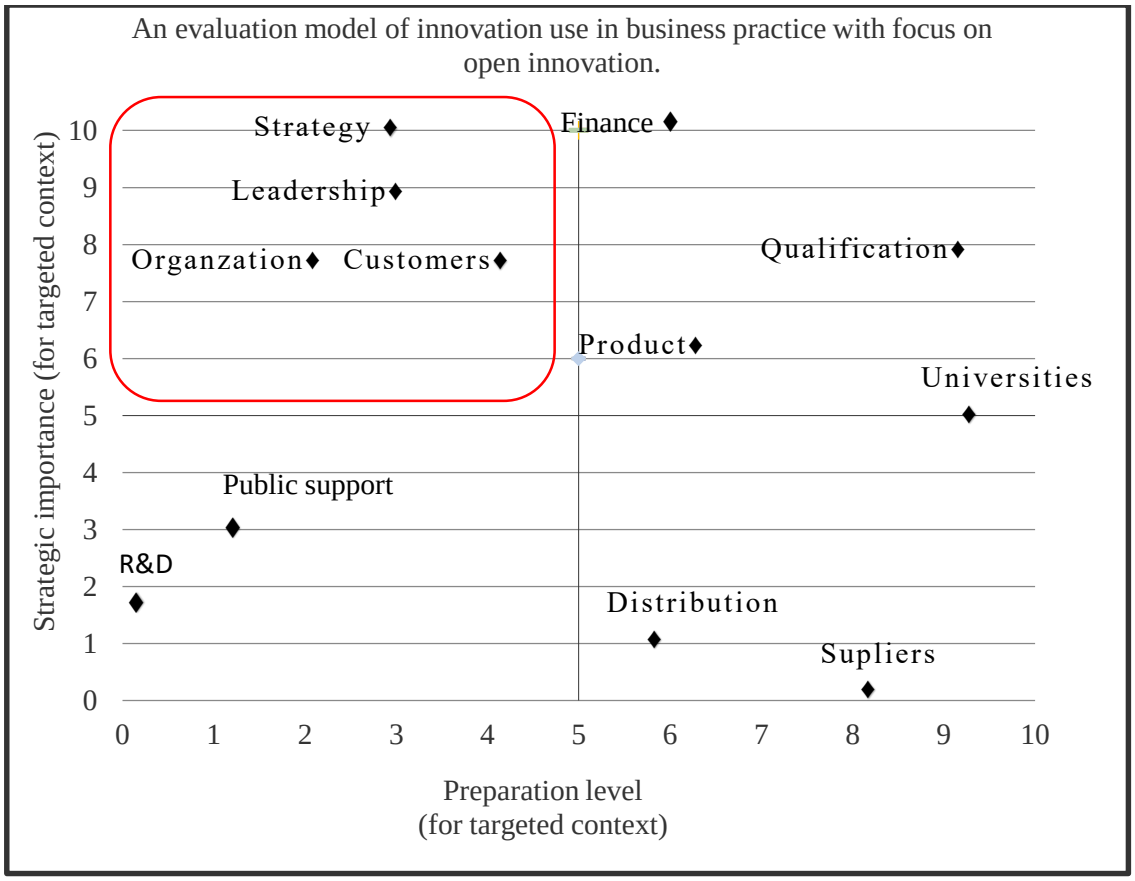

Fig. 14 An evaluation model of innovation use in business practice with focus on open innovation

Source: author´s own work

The company is mainly based on invention of employees who have a lot of experience in the field of foundry and moulding, now it is very difficult for firm to find an expert because there is no vocational training and know-how is not intergeneration shared. At present, the management of the company should organisation transferred with the support of the owners, as a result may be a decrease in sales and production of the company. There is a lack of clear commutation inter in company. Middle management is almost absent. Currently, leadership is the bearer of innovation in the company. It is currently being considered whether the time is right to set up a development department. This is closely linked to the idea of finding own new product and the overall shift in the supply chain. At present there is no interaction with R&D (preparation for target context is 0), but due to the search for new technologies it would be appropriate to establish cooperation with relevant institutions and there is potential for increasing innovation potential.

7.6 IV. Case study IN-EKO TEAM

7.6.1 Description of the firm's context

In-Eko Team s.r.o. was founded in 1995. Based in central Europe with H.Q. and production site, since its establishment, the company's focus has been on stainless steel products for wastewater treatment. Business is driven by an emphasis on high quality work, innovative processes, and comprehensive after-sale services. Firm operates in the Water and Wastewater Systems Sector worldwide and is a key player for microfiltration in the European markets. All devices have been designed and developed by own engineers, and we dedicate all our knowledge and experience in water filtration to develop efficiency and innovative technologies. Company is available on the market technologies for wastewater treatment plants, the equipment used is of its own design. Steady exports to many countries. In the future, it wants to focus on the markets of Africa or Latin America. Climate change, on the one hand, and pollution caused by sewage and industrial enterprises, on the other, make water an increasingly valuable the company know how. The main production program of the company consists of so-called micro-mesh filters. All company products are the result of internal development and the work of internal designers and engineers.

Tab. 22 Description on company´s context, own work

Turnover (last year)	130 mil CZK
R&D expenditures (last year)	6 mil CZK
Number of employee	80
Year of company establishment	1992
Country	Czech
NACE CLASSIFICATION	
C.28 - Manufacture of machinery and equipment 28.30 - Manufacture of agricultural and forestry machinery C.28.4 - Manufacture of metal forming machinery and machine tools C.28.41 - Manufacture of metal forming machinery C.28.49 - Manufacture of other machine tools C.28.9 - Manufacture of other special-purpose machinery C.28.91 - Manufacture of machinery for metallurgy	

Source: author´s own work

7.6.2 IV. Case study: assessing the business innovation system

The concept of business innovation is used as a proven basis for analysing the state of innovation. A business innovation is defined by creating substantial new value for the customer and the firm. This can be achieved through modification of any of the four business vectors: Offering (product/service), Process (organisation & resources), Distribution (business model, sales, branding), Customer (segments, relationship). The assessment was based on the set of questions (attachment n. 1.) how high is the strategic importance for targeted context – it means how is the strategic importance of each segment to the target position of the market and how the owner of company /general manager asses the preparation level for the target context. Strategic importance for targeted context is scaled from 0 to 10 points. 10 points illustrated very high strategic importance and zero points describe very low strategic importance for targeted context and in parallel evaluation is evaluated preparation level for targeted context on the scale from 0 to 10 points. 10 points illustrated very high preparation level for targeted context and zero points describe very low. A red circled segment is the most important for increasing innovation capacity and with the potential to increasing innovation capacity for target context.

Tab. 23 Assessment of innovation vector, own work

Key vectors of business innovation	Assessment of criteria	Assessment of criteria
	Strategic importance (for targeted context)	Preparation level (for targeted context)
	10 = very high, 0 = very low	10 = very high, 0 = very low
Aspiration of innovation leadership		
strategy	10	5
leadership	10	8
finance	10	8
Firm Culture		
organisation	8	6
qualification	9	9
Market		
distributors	1	6
customers	10	6
suppliers	4	8
investors	0	0
product	10	6
Partnership		
R&D	2	0
public support	3	1
universities	5	3
investors	0	0

Source: author´s own work

The company has undergone rapid growth and a new organisational structure is implemented. The need is clearly described in processes, powers, responsibilities, distributors are used partially, sometimes trough partners abroad company operate on the local market. The potential for finding new partners and possibly abroad need more planning of strategies in individual markets and business strategy needs to be set. Strategy is based on new products; cooperation with public support is ongoing, but the cooperation with universities is not being used optimally.

The priority for open innovation is in the market and strategy. Company is very well prepared for the changes in innovation. The company has a properly designed product, it is necessary to focus on business strategy (especially foreign markets - Russia, South America, the recovery of Western Europe (Italy) and internal processes, especially automatization in administrative.

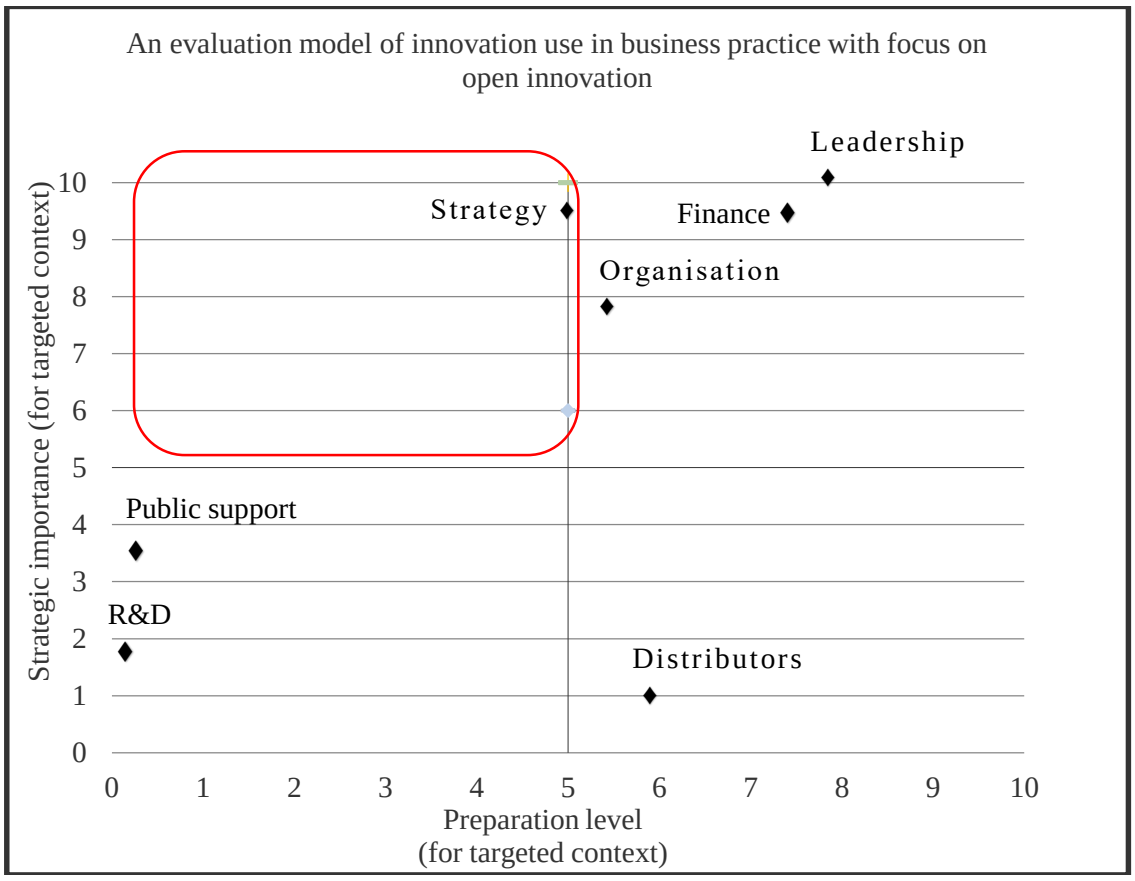

Fig. 15 An evaluation model of innovation use in business practice with focus on open innovation, source case study 4, own work

Source: author´s own work

8 OPENSEC-IN process evaluation model

8.1 Research base

It is commonly accepted that innovation is vital to economic growth, to the formation of new industries and to the tackling of societal challenges. The paradigm of open innovation is based on the idea that it is not always necessary for an enterprise to work on innovation single-handedly. In practice, this approach has led to an acceleration of the innovation process and its higher efficiency, as has already been proven abroad mainly by examples of large corporations. However, in the Czech Republic, this is a relatively new topic, which has not yet been given as much space as abroad. Open innovation works with knowledge and with effective knowledge management, so it is clear that mapping this phenomenon must be linked to knowledge management. Knowledge management has recently emerged as a discipline in its own right and, given its newness, is probably still developing its theoretical base. Furthermore, knowledge management plays an important supporting function by providing a coordinating mechanism to enhance open innovation segments.

The aim of this work is to propose an evaluation model of innovation use in business practice with a focus on open innovation. The model is based on knowledge management as a discipline specifying work with explicit and tacit knowledge as a key factor to innovation.

Methodological approaches to modelling include retrospective analysis, qualitative and quantitative surveys in the private sector, multi-criteria decision-making and interviews with business innovation managers. The proposed model allows the evaluation of quality benefits and contribute to the expansion of the possible methods used in knowledge management.

8.1.1 The design of the model

The proposed model finds answers to the following research questions:

- What are the factors which influence the knowledge management model for application to open innovation?
- What vectors and segments are decisive for modification of basic theoretical models?
- What key flows, segments and vectors of innovation through an appropriate knowledge model influence open innovation?
- How can we create an evaluation model of innovation use in business practice focusing on open innovation and taking into account critical points and segments?

The design of the model is based on partial data focused on the following areas:

- Research of knowledge management methodologies, both their original forms and modified versions applied in a certain area. Attention was focused especially on working with tacit and explicit knowledge, which is also crucial for open innovation.
- Literature research in relation to models and methodologies of knowledge management and possible methods of innovation evaluation as a basis for determining the framework of the proposed model.
- Selection of methods with a potential measurement of innovation.
- Multi-criteria analysis of variants for the selection of a specific methodological approach to knowledge management based on the identification of alternatives, choice of criteria, assessing the impact of individual alternatives in relation to the individual criteria, determining the weight of the criteria and assessing alternatives.

Selection of criteria:

- C1: Ability of the model to reflect the specifics of the innovation potential of the company – the most important criterion.
- C2: Simplicity and clarity of the model.
- C3: Interconnection of the model with literature.
- C4: Quantitative result of model segments.
- A questionnaire survey focused on an analysis of innovation activity, innovation barriers and motivation of stakeholders for the implementation of an innovation strategy among Czech companies.
- Selecting relevant representative sample companies.
- Defining criteria for in-depth interviews.
- Conducting in-depth interviews among fifty companies according to the criteria which were set in advance and in correlation with the open innovation focus.
- Selecting segments of open innovation.
- Defining the vectors of open innovation.
- Synthesizing knowledge and proposing an evaluation model of innovation use in business practice with a focus on open innovation.
- Correlating the new model with the SECI model and describing the main vector.
- Describing the first version of an evaluation model of innovation use in business practice with a focus on open innovation.
- Case study verification.
- Conceptual model design.

Based on the theoretical background, a questionnaire for an in-depth analysis in companies was designed. Segments and vectors of innovation were verified, appropriate models of knowledge management were selected and the most appropriate model was chosen on the basis of multi-criteria analysis to create an innovation potential assessment model with a focus on open innovation. Following the creation of the model, the model was verified on

case studies, refined and completed, a methodology was created for an evaluation of the innovation potential and open innovation was incorporated as a suitable tool of knowledge management. Following the verification of the newly revised SECI model, a wider concept of knowledge conversion will be designed, including the space where knowledge is present.

The model was verified by its implementation directly in companies focusing on the evaluation of individual vectors. Based on the evaluation of vectors from the point of view of importance as a source of innovative ideas for the company, the curve of the importance of the open innovation segment was determined and subsequently the degree of preparedness and knowledge of the given segment was measured. The difference between these two curves determined the potential that the company could develop in the field of open innovation. This model was verified in four companies. The main areas selected were companies focused on IT and machinery engineering companies. These segments were deliberately chosen because they are sectors that have different needs for open innovation and cover a wide variety of innovation needs.

The focus was on an analysis of innovation segments and vectors, which were defined on the basis of in-depth interviews in fifty companies that represented the innovation segment of commercial entities. These segments were defined more closely and the open innovation evaluation model was validated. Based on multi-criteria analysis, suitable approaches to modelling were chosen, the most appropriate SECI model was selected and subsequently, vectors of open innovation were modelled according to this basic model. A multi-criteria analysis of variants for the selection of a specific methodological approach to knowledge management was conducted. A questionnaire survey focused on an analysis of innovation activity, innovation barriers and motivation of stakeholders for the implementation of innovation strategy among Czech companies. Relevant representative sample companies were selected.

Criteria for in-depth interviews were defined. In-depth interviews were conducted among fifty companies according to the criteria which were set in advance and in correlation with the focus on open innovation.

Segments of open innovation and vectors of open innovation were selected. A synthesis of knowledge was performed and an evaluation model of innovation use in business practice with a focus on open innovation was proposed. The correlation of the new model with the theoretical SECI model and the main vector were described.

8.1.2 Software modelling of the OPENSEC-IN process evaluation model

The standard Program Business Process Model and Notation (BPMN) is a graphical notation (a set of graphical objects and rules by which they are linked) to model business processes using process diagrams. BPMN is also a ratified standard of the International Organisation for Standardization as ISO / IEC 19510: 2013. BPMN has been developing in the field of process modelling since 2004. After several versions, the BPMN 2.0.2 version has been introduced since 2014. Currently, BPMN documentation is so well elaborated that patterns are being developed to address standard situations that may arise during process management. The standard Business Process Model and Notation program was used to design the OPENSEC-IN process evaluation model. This part of the work captures the conceptual model, including software processing and a graphical notation of model business processes in the area of the open innovation potential of companies.

The flow of innovation vectors

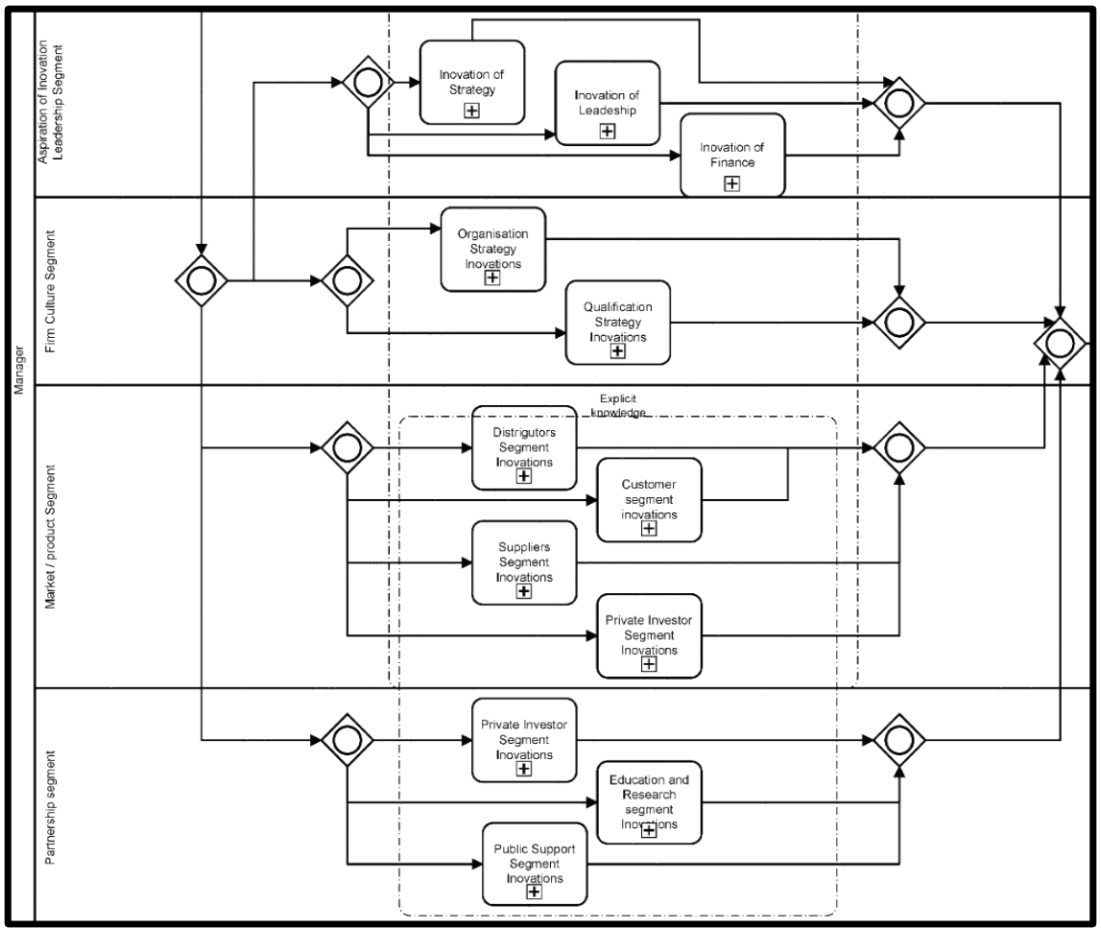

Fig. 16 An evaluation model of innovation use in business practice with a focus on open innovation, source: own work

Source: author´s own work

Figure 16 shows the individual segments and vectors of innovation, which can be seen as two forms of tacit and explicit knowledge. The individual segments and vectors were defined on the basis of research and were subsequently classified into knowledge. With this knowledge, it is possible to focus on and work with these segments at the level of knowledge management. There are four main knowledge creation processes, which are most evident in the segment representing firm culture. This involves generating attitudes and ideas of an organisation and the way in which they affect how the organisation does business and how its employees behave. Externalization and internalization are mainly observed in the segments representing aspiration of innovation and leadership, which involves establishing a clear vision, sharing that vision with others and mobilizing them. This means providing information, knowledge and methods to implement that vision, counter-balancing resistance

and passivism and also coordinating and balancing the conflicting interests of all members and stakeholders. A combination of these gives rise to the flow in the segment focusing on market. There are particularly the following processes: identification and valuation of customers and markets, need and opportunity analysis, including an analysis of competing technologies and approaches, analysis of direct competitors and analysis of regulations and other framework conditions. There are also a flow of segmentation, an identification of entry markets and the planning of marketing mix implementation. The created model is in the form of a mind map represented graphically by diagrams of individual innovation vectors and segments with mutual relations and connections in connection with further research, verification and completion of the existing model. Each segment is under the decision flow of the general director. The flow is to go through these segments: offering (product/service), process (organisation & resources), distribution (business model, sales, branding), customer (segments, relationship). The assessment flow is based on the measurement of how high the strategic importance for the targeted context is – it means how the strategic importance of each segment relates to the target position of the market and how the owner of the company or general manager assess the preparation level for the target context. The strategic importance for the innovation context is scaled to the illustrated strategic importance for the targeted context.

8.1.3 OPENSEC-IN process evaluation model

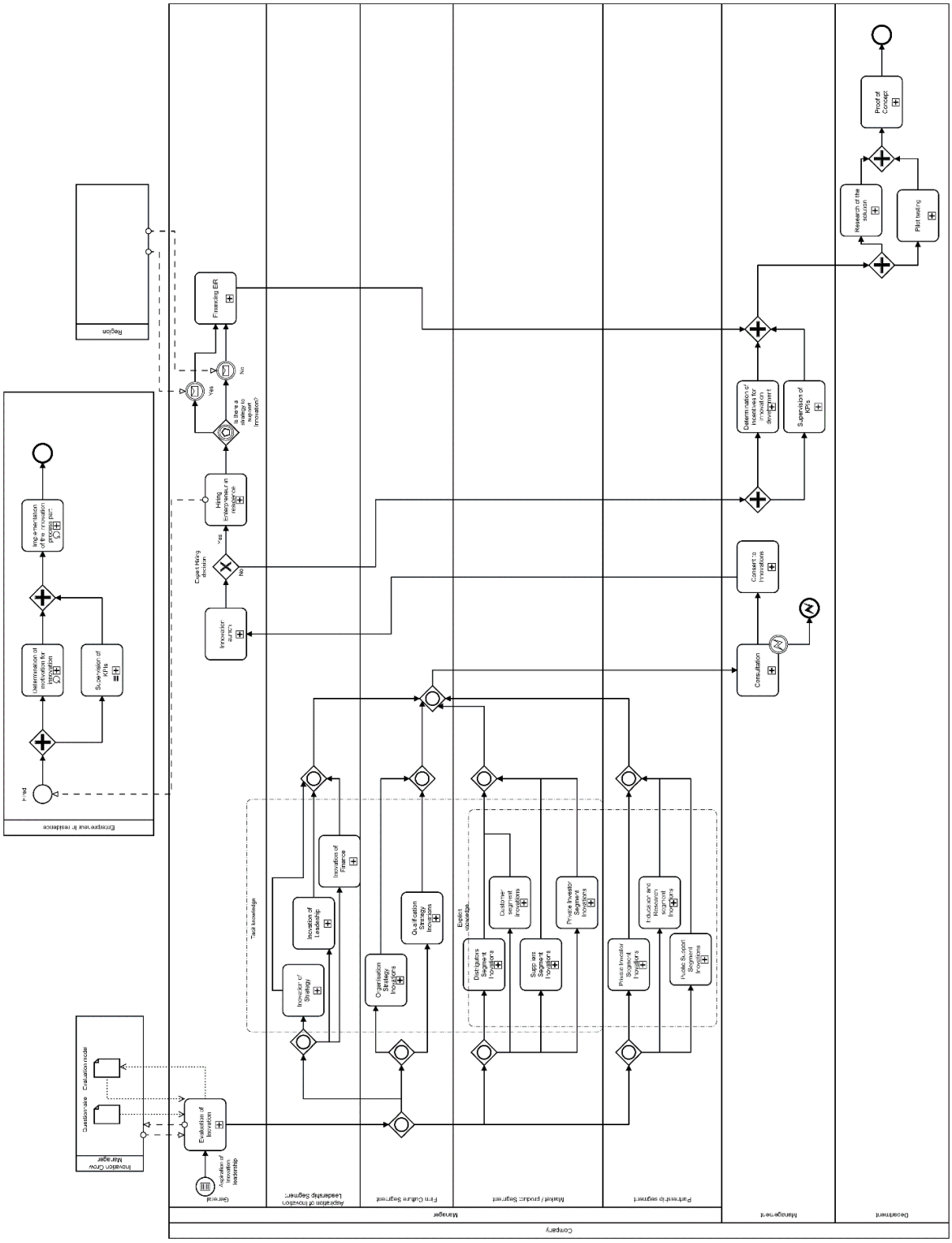

Fig. 17 OPENSEC-IN process evaluation model, an evaluation model of innovation use in business practice with a focus on open innovation, source: own work

Source: author´s own work

The holder of innovations in the company is the owner of the company, in the case of a foreign company it is the director of an autonomous branch or general manager. It is necessary that the management of the subsidiary abroad fully approves an independent innovation strategy. Based on the identification of the individual key segments for innovation, the individual tasks are further distributed to lower levels. However, it is necessary to take into account the special area of tacit knowledge, which is crucial for the successful implementation of open innovation. From a procedural point of view, it is necessary for the business owner to go through the individual segments and evaluate each key segment separately.

The process starts by approaching the business innovation manager of the company and carrying out together with the owner of the company an evaluation of all the segments according to the evaluation model (see figure 17). An assessment of the importance of innovation with respect to the target context is performed and preparations for innovation are made. There are two most important segments: a segment where companies waste innovation capacity – the importance is very low and the preparation for innovation is very high – and a segment which includes companies with a potential to increasing innovation capacity. The business growth manager is objective and competent to make an evaluation of these two segments. The next step is a discussion with wider but still top management level concerning the operation of the company in the determined segment. Then there are two possible flows: either the owner of the company or general director is the holder of the changes which lead to innovation in the company or the company hires an entrepreneur in residence (EIR) to implement part of the innovation process. The CEOs should include the EIRs in meetings that concern venture capital, influencers and agencies. Their experience as entrepreneurs and their ability to capitalize on connections provide counsel and knowledge that benefit the deal. The EIRs must be given all the resources they need to succeed with portfolio companies. An EIR may be asked to help out due diligence and provide operational assistance to existing portfolio companies. The goal, however, remains to develop a fundable concept that the venture capital firm can seed and that the EIR can run or at least be co-founder of. Another way in which EIRs might help a firm is when they are fundable executives but also have deep domain expertise in an area of thematic interest to the company. The company must hire an EIR with the right skills for market research, innovation and developing an investment thesis.

The EIR cooperates with middle management, sets incentives for internal innovation development and oversees the KPIs. At the same time, there is a search for the solution either internally in the company or externally in a patent office or industrial property office. As part of follow-up processes, a team is set up to carry out a pilot test and provide a proof of concept. Then the quality control team runs a quality control, eventually completing the certification. In a process innovation involving communication and customer access, the marketing and sales department is involved - the team leader is responsible for managing these innovative flows. The last phase, measuring innovation in the short term, is conducted by the leaders of the teams in which the innovation takes place and is based on an evaluation with the above-described evaluation model. The finance department is responsible for the control of measurement and impact of the innovation in the long term. Important inputs coming from the outside are supporting mechanisms involving regional strategy, support of municipalities, R&D facilities, universities, functioning transfer technology offices and effective means of public support. Knowledge of the innovation environment in the context of its progressive development is crucial for the effective implementation of the region's innovation strategy.

9 Summary of fulfilment of the dissertation´s goals

The aim of this work was to propose an evaluation model of innovation use in business practice with a focus on open innovation. The model was based on management as a discipline specifying work with explicit and tacit knowledge, as these are the key to innovation. **All objectives of the dissertation were fulfilled.** In the chapter 3.1. were set the goals and methods, all objectives and research questions were presented and numbered, see table 2. Each research question was addressed through relevant research methods. This chapter summarizes the fulfilment of the dissertation´s goals the achieved objectives.

Methods overview

- Literature research in relation to models and methodologies of knowledge management and possible methods of innovation evaluation as a basis for determining the framework of the proposed model.
- Multi-criteria analysis of variants for the selection of a specific methodological approach to knowledge management.
- A questionnaire survey focused on an analysis of innovation activity, innovation barriers and motivation of stakeholders for the implementation of innovation strategy among Czech companies.
- Statistic evaluation: advanced statistical methods and Excel and SPSS.
- A synthesis of knowledge and a proposal of an evaluation model of innovation use in business practice with a focus on open innovation.
- Case studies.

Research questions and the fulfilment of the dissertation´s goals

Each research question was numbered I.- IV. and addressed through relevant research methods. This chapter summarizes the fulfilment of the dissertation´s goals the achieved objectives. There were following research questions set and consequently answered: What key knowledge or knowledge management approaches can be used for open innovation in business? What key flows, segments and vectors of innovation through an appropriate knowledge model influence open innovation? What is the current state of open innovation in enterprises? And how can we create an evaluation model of innovation use in business

practice focusing on open innovation and taking into account critical points and segments? Is it possible to design a model and methodology of effective evaluation of open innovations which would reflect the character of the business environment? All these questions were answered and the findings were described in detail in chapters 4 to 8. All research questions were set in the chapter 3.1.

I.

What key knowledge or knowledge management approaches can be used for open innovation in business?

Methods: literature research, multi-criteria analysis

Findings: In literature, there are several different knowledge management approaches which have a potential for the implementation of the open innovation model in business.

Identifying alternatives, based on the research activities and the focus of the work on the possibility of interconnecting the open innovation model with the knowledge management model, the following alternatives were considered.

- SECI model Nonaka–Takeuchi.
- Knowledge spiral.
- "Choo" model.
- Boisot model.

As the selection of criteria and determination of their impact is a rather subjective issue, the criteria were consulted with an expert board. The pool of experts included entrepreneurs of important industry fields focusing on innovative entrepreneurship (7 experts), experts and consultants from the South Moravian Innovation Centre (4 experts) and academics (4 experts). For the overall evaluation of all the used methods of the multi-criteria evaluation of variants, an overview table is used, in which the results of the individual methods are captured. The order of advantage of the given decision options, determined by one of the methods of the multi-criteria evaluation of variants, depends mainly on the weights of the individual criteria and on the method used.

II.

What key flows, segments and vectors of innovation through an appropriate knowledge model influence open innovation?

Methods: literature research, correlation to models and methodologies of knowledge management, multi-criteria analysis, questionnaires, in-depth interviews, statistic evaluation: advanced statistical methods and Excel and SPSS, case study

Findings: One of the most interesting factors was the monitoring of aspirations to innovations, in other words, the division of companies based on the strategy chosen by the company owner or executive in the area of innovation implementation. It was found that the entrepreneurial settings of the owners and thus the innovative aspirations differ significantly among companies. At the outset, it was assumed that all companies followed the expansion strategy. Research has found that this is not always the case. There are several reasons why the situation is different. During my questionnaire survey, conducted by the qualitative method of research, I had the opportunity to learn more about these reasons and describe them. The main reason was the lack of interest in entering other export markets (product) in the event of market saturation with current production. Another factor was the fear of change and the associated risks. The owners preferred smaller steps to increase the company's profitability and relative certainty over significant expansion. Business innovation challenges have typical patterns in different life cycle transitions. Most entrepreneurs do not have experience in this kind of transitions, are not aware of the related challenges and are not adequately prepared for handling them. The business innovation model offers them a comprehensive, holistic model for analysing the implications and challenges entailed in this dynamic. With the transition from one life cycle stage to another, the company business innovation system needs to be adapted with regard to its main vectors: offering, process, distribution and customer. A creative change of one or more of these will lead to business innovation, defined as a new value for the customer and the firm. A precondition for initiating and successfully changing these vectors is the availability of resources.

The key flows and segments of innovation through an appropriate knowledge model that influence open innovation are, based on research, the following: aspiration to innovation leadership, firm culture, partnerships and market.

The key vectors of innovation through an appropriate knowledge model that influence open innovation are: strategy, organisation, qualification, market, finances, firm culture,

leadership, distributors, customers, suppliers, education and research, partnerships, private investor, public support (regional, national level).

III.

What is the current state of open innovation in enterprises?

Methods: literature research, questionnaires, in-depth interviews

The author of the present work personally conducted a survey and visited 50 companies. The two-hour interview was only possible with the owner of the company; in the case of foreign companies, it was possible to conduct the interview with the CEO or general manager. In both cases, the key criterion was that the director or owner is the person responsible for the company's innovation strategy. The verification of the model is based on four case studies.

Findings: In practice, this approach has led to an acceleration of the innovation process and its higher efficiency, as has already been proven abroad mainly by examples of large corporations. However, in the Czech Republic, this is a relatively new topic, which has not yet been given as much space as abroad. Open innovation works with knowledge and with effective knowledge management, so it is clear that mapping this phenomenon must be linked to this topic. Knowledge management has recently emerged as a discipline in its own right and, given its newness, is probably still developing its theoretical base. Furthermore, knowledge management plays an important supporting function by providing a coordinating mechanism to enhance open innovation segments. The first basic driver for knowledge management role in innovation in today's business environment is to create, build and maintain competitive advantage through utilisation of knowledge and through collaboration practices. A typical feature of knowledge management is its multidisciplinary which is a key issue in open innovation as well. When we combine several companies of the same focus together, we get to meet competitors who will be very cautious about communicating their ideas. But we will connect companies from different disciplines, in some cases even very distantly related, to get very interesting results leading to product or process innovation.

It has been found that open innovation is not just about technological innovation but it can be a connotation of objects in the transfer system: production innovation, innovation process, marketing innovation, material innovation, organisation and knowledge innovation, social and technological innovation are often transferred as tangible technology, such as equipment or product, or even as intangible technologies, such as software, documents, know-how, etc.

The results of the interconnection of individual systems reflect the potential of the business community to absorb or adopt innovative technology. The integration of innovative technology is categorized as the initial phase of the process of open innovation itself. An evaluation of the given innovation potential and the subsequent decision on the handling of the given technology fundamentally influence the speed and quality of the whole process. The support system provides a guarantee of knowledge transfer to the commercialization facilitation itself within the so-called open innovation session. It is a complex process with the result of being marketed. A number of economic, managerial and technical issues need to be addressed throughout this process. It follows from the above that it is not only an investment at the outset but also includes many other factors, such as human, material, resource and financial.

Incentive mechanisms are a fundamental factor in improving the effectiveness of the mechanism system to accelerate the process itself and increase its efficiency. In the process of improving communication and deepening the relations between academic institutions and companies, investors and start-ups, technologies based on the very needs of the market are being developed, based on the mutual feedback between the two worlds.

SMEs and start-ups are the innovation engine of the European economy. Open innovation undoubtedly contributes to the commercial exploitation of research results and to the introduction of innovations in practice with the aim of increasing the industry competitiveness while applying the principles of sustainable development. A model that will be able to measure innovation potential and describe innovative technologies and their direction will be a very useful tool for knowledge management, as innovation and creativity will be a key future driving force that will ensure the success of the new economic model and also stimulate the economy. Innovation is the key to creating wealth and long-term prosperity. Organisations and other stakeholders raise the question of complementing the current innovation systems by a need- and demand-driven component.

There are several factors of a different nature that influence the degree of innovation in companies and thus their added value in the market. The research suggests that there are different links and correlations between the factors. It is precisely their keying and mapping that can be one of the clues to effectively setting the innovation policy and choosing the appropriate tools to support innovation policy at regional and national levels. It is important to significantly strengthen the segment of companies that decide autonomously on their

overall strategy and strategic innovation. It is advisable to support companies implementing high added value and target their export to demanding foreign markets. The degree of innovation is significantly influenced by the overall business vision. It predetermines the path the company tries to follow for a long time. It identifies specific short- and medium-term objectives, including the resources needed to achieve them. Corporate aspirations and objectives of the owners in terms of assessing the innovation capacity of the economy are of great importance. They form the focus and boundaries of the company's innovative efforts. Given the effective set-up of regional policy instruments, it is interesting to note that financial barriers are not among the most significant innovation barriers for companies with a high innovation potential but they are reflected in human resources, strategy setting and succession issues. New economic support instruments should be devised in this respect. Of course, for the final proposal of long-term effective mechanisms, it is necessary to build on this research and to map out the specifications of individual areas in more detail so that every crown invested in supporting the Czech Republic's innovation capacity will bring significant benefits to the Czech economy in general.

In order to continue to be able to effectively design programs supporting the introduction of innovations in companies, it is necessary to constantly monitor the corporate environment, analyse and then choose effective means of public support.

IV.

Is it possible to design a model and methodology of effective evaluation of open innovations which would reflect the character of the business environment and take into account critical points and vector segments?

Methods: literature research, correlation to models and methodologies of knowledge management, multi-criteria analysis, questionnaires, in-depth interviews, statistic evaluation: advanced statistical methods and Excel and SPSS, case study, software modelling in standard Business Process Model and Notation

Findings: Based on a synthesis of all results, the OPENSEC-IN process evaluation model was designed in The model is described in chapter 9. The OPENSEC-IN process evaluation model of innovation use in business practice with a focus on open innovation is based on the SECI model.

10 Practical and theoretical benefits

The proposed OPENSEC-IN process evaluation model of innovation use in business practice with a focus on open innovation based on the SECI model contributes to the development of a theoretical framework in the field of the knowledge management science discipline. Specifically, it is based on a modification of the SECI model and in the planned connection with the *Ba* model in the context of open innovation. The author's solution clearly demonstrates the possibilities of using the theoretical foundations of the knowledge management science discipline in the areas related to the mapping of innovation potential and determines the extension of the knowledge management area to the aspects of processes in the field of evaluation of the use of innovation. Evaluating the use of innovations and describing the interrelated individual processes as well as organisations is a very complex area of research. This work discusses in detail one of the possible approaches, which is based on the dynamics of knowledge processes in relation to the SECI model and subsequently on the premises of Ba and on setting up the key segments and innovation vectors.

The main benefits of the open innovation model are: simplifying work and saving time for the company, as it only explains its challenge once, and the facilitators take over the tedious job of pre-selection and routine communication with potential partners and get the company's offer through to the relevant partners across the region/country. The individual segments and vectors of innovation can be seen as two forms of tacit and explicit knowledge. Based on the evaluation of the vector of innovation, the potential of a company for open innovation can be measured. So far, the model of tacit and explicit knowledge and its flow have been described on the theoretical level by the SECI model, and this work applies the empirical knowledge on the theoretical model and modifies the model for the field of open innovation and its measurement. The prerequisite is that the target users of this model are primarily firms in the secondary public sector.

The proposed model will both allow the evaluation of quality benefits and the expansion of the possible methods used in knowledge management. Working in a cohesive manner that leads to strategic innovation management can result in a number of new skilled jobs in several new high-tech firms. Supporting open innovation helps foster a system where there is collaboration and reduced costs when it comes to transaction, augmenting the entrepreneurs' and researchers' comprehension of what innovation is. This helps augment the demand for greater functionality when it comes to research institutes and their internal

processes and regulations in terms of collaboration for companies and researchers. It also helps create trust for local public administrative bodies and offers better value to foreign investors and has helped local governments create opportunities where knowledge-oriented operations can be developed for transnational firms.

11 Conclusions

The aim of this work was to propose an evaluation model of innovation use in business practice with a focus on open innovation and describe the key knowledge or knowledge management approaches its segments and vectors which can be used for open innovation in business and answered the question of current state of open innovation in enterprises. All objectives of the dissertation were fulfilled and the model based on management as a discipline specifying work with explicit and tacit knowledge, as they are the key to innovation was succesfully created and verified. Identifying new collaboration opportunities, a knowledge of the regional as well as the Czech national ecosystems will allow companies to tap into the pool of expertise and talent of start-ups, SMEs as well as academic institutions. One of the targets is to achieve a successful cooperation between industry and universities. One of the very important tools which was implemented is the model of open innovation as a tool of strategic knowledge management.

The work has eleven main chapters and was divided into two main parts: theoretical and practical.

The following research methods were used: literature research in relation to models and methodologies of knowledge management and possible methods of innovation evaluation as a basis for determining the framework of the proposed model; scooring methods, multi-criteria analysis of variants for the selection of a specific methodological approach to knowledge management; a questionnaire survey focused on an analysis of innovation activity, innovation barriers and motivation of stakeholders for the implementation of innovation strategy among fifty Czech companies; statistic evaluation: advanced statistical methods and Excel and SPSS; a synthesis of knowledge and a proposal of an evaluation model of innovation use in business practice with a focus on open innovation; questionnaires, in-depth interviews, case studies and software modelling in the standard Business Process Model and Notation and the model was finally proved by implementation in four case studies.

The most important research question was whether it was possible to design a model and methodology of effective evaluation of open innovations which would reflect the character of the business environment and take into account critical points and vector segments. Based on a synthesis of all results, the OPENSEC-IN process evaluation model was designed in the standard Business Process Model and Notation (BPMN) program. The model is described

in detail in chapter 8. The OPENSEC-IN process evaluation model of innovation use in business practice with a focus on open innovation is based on the SECI model.

The given model has been successfully tested in four high-tech companies as a case study and according the results (see chapter 4) there is a great presumption of the applicability of the evaluation model in practice. The prerequisite is that the target users of this model are primarily firms in the secondary public sector. The proposed model will both allow the evaluation of quality benefits of open innovation and the expansion of the possible methods used in knowledge management.

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Participation in research grants related to the topic of the dissertation

1. Within the grant scheme ÉTA of the Technology agency of Czech rep. (TAČR) author of work participates in a project called: Effective Management of Knowledge Transfer, 2018 - present.

Main activities in the project: member of the research team on the position of researcher, responsible for processing analyses in the area of industrial property protection and intellectual property management, coordination of cooperation activities with the application sphere, data collection, open innovation model description and implementation innovation opportunities for advanced technology firms in collaboration with the academic sector, social innovation, eco-innovation, application of public services, stimulation of demand, networking, professional cooperation in the preparation of workshops and conferences.

2. Within the grant scheme of the Technology agency of Czech rep. (TAČR) participates in the project entitled: Effective knowledge transfer management within the call GAMA2, 2020 - present.

Main activities in the project: active support of technology transfer at University Hradec Kralove processing of innovation opportunities analyses according to individual Proof of Concept projects (PoC), administration of partial projects of PoC, evaluation of research projects in relation to the degree of applicability in technology transfer, negotiations with the application sphere on the possibilities of using the results of science and research of the UHK, analysis of the results of technology transfer activities.

3. Internal research project SPEV - Evaluation of investments in the concept of Industry 4.0, Faculty of Informatics and Management University of Hradec Kralove, 2018.

Member of the research team as a junior researcher.

4. Internal research project SPEV - Economic and Managerial Aspects of Processes in Biomedicine, Faculty of Informatics and Management University of Hradec Kralove, 2015.

Member of the research team as a junior researcher.

5. The project CZ.1.07 / 2.2.00 / 28.0327 Innovation and support of doctoral study program (INDOP), financed from EU and Czech Republic funds, 2019.

Member of the research team as a junior researcher.

6. Peer-BIT project of the European Commission Horizon 2020, Business Upper Austria (Biz-Up), South Moravia Innovation Centre, Platinn innovation platform, Switzerland.

Member of the research team in the position of researcher, Responsibility for implementation of SMEmPOWER methodology, 2015 – 2018.

7. Chairman of The Council for Commercialization of the University of Hradec Králové, 2019 - present

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Attachment I.

Questionnaire - An evaluation model of innovation in business practice with focus on pen innovation

Questions:

I. Aspiration of innovation leadership
Note: where is the table with scale please mark 1 as the lowest and 10 as the highest value.

1. How important it is for you to innovate in strategy to increase your turnover or for to stay on the market (expansion versus stabilisation strategy)?

1	2	3	4	5	6	7	8	9	10

2. How are you prepared for strategy innovation?

1	2	3	4	5	6	7	8	9	10

3. How important is for you to innovate in the area of management to increase your turnover or for to stay on the market?

1	2	3	4	5	6	7	8	9	10

4. How prepared are you for the innovation of the management area?

1	2	3	4	5	6	7	8	9	10

5. How is the innovation process set up in the company?

1	2	3	4	5	6	7	8	9	10

6. What is the organisation structure of the company? *Open question.*
7. What are the funds that the company can spend on R&D (% of the company turnover)?

II. Firm Culture

8. How the corporate culture is set?

1	2	3	4	5	6	7	8	9	10

9. How important it is for you to increase employee qualifications to increase your turnover or for to stay on the market?

1	2	3	4	5	6	7	8	9	10

10. How important it is for you to innovate in the organisation as a whole,
to increase your turnover / stay on the market?

1	2	3	4	5	6	7	8	9	10

11. How are you prepared for organisational innovation?

1	2	3	4	5	6	7	8	9	10

III. Partnerships

12. How strategically important it is for you to innovate in setting up relationships with your partners?

1	2	3	4	5	6	7	8	9	10

13. How prepared you are for innovation in this area?

1	2	3	4	5	6	7	8	9	10

14. How strategically important is for you to innovate in the field of setting up a relationship with R&D institutions, universities, for example to obtain quality graduates contract research, etc.?

1	2	3	4	5	6	7	8	9	10

15. How prepared you are for innovation in this area?

1	2	3	4	5	6	7	8	9	10

16. How strategically important for to innovate is relationship with public support?

1	2	3	4	5	6	7	8	9	10

17. How are you prepared for innovation in this area?

1	2	3	4	5	6	7	8	9	10

18. How strategically important it is to be part of the region's innovation strategy?

1	2	3	4	5	6	7	8	9	10

19. How are you prepared for innovation in this area?

1	2	3	4	5	6	7	8	9	10

20. What is the relationship with private investors, venture funds, etc.?

1	2	3	4	5	6	7	8	9	10

21. How prepared are you for innovation in this area?

1	2	3	4	5	6	7	8	9	10

IV. Market

22. How important is for the target context to innovate the company's products / production technologies?

1	2	3	4	5	6	7	8	9	10

23. How are you prepared for innovation in this area?

1	2	3	4	5	6	7	8	9	10

24. How important is to innovate in the area of communication processes and customer relations?

1	2	3	4	5	6	7	8	9	10

25. How strategically important is to innovate in setting up relationships with your distributors?

1	2	3	4	5	6	7	8	9	10

26. How are you prepared for innovation in this area?

1	2	3	4	5	6	7	8	9	10

27. How strategically important you is to innovate in setting up a relationship with your manufacturers?

1	2	3	4	5	6	7	8	9	10

28. How prepared are you for innovation in this area?

1	2	3	4	5	6	7	8	9	10

29. How strategically important is for you to innovate in setting up a relationship with your suppliers?

1	2	3	4	5	6	7	8	9	10

30. How are you prepared for innovation in this area?

1	2	3	4	5	6	7	8	9	10

31. How do you innovate a business processes for the target context?

1	2	3	4	5	6	7	8	9	10

32. How are you prepared for innovation in this area?

1	2	3	4	5	6	7	8	9	10

Attachment II.

The questionnaire for statistical correlation
Fixed data:

Tab.: 1 Export

Export (mil. CZK)		Sales - territorial structure (%)	
2006		CZ	
2011		German	
2013		West Europe	
2018		East Europe	
		Word except EU	
Main market			

If the sales territorial structure varies considerably, please provide an estimate of the average over the last 3 years

Tab.: 2 Target state of export

Target state of export	
	%

If the sales territorial structure varies considerably, please provide an estimate of the average over the last 3 years

Tab.: 3 Structure of employee and salary

	Number of employee (FTE)	Share of university educated (%)	Average month salary
2006			
2011			
2013			
2016			

Tab.: 4 Structure of employee and salary

The Number of employee in R&D.	
R & D expenditure (mil. CZK)	
- own sources (mil. CZK)	
- subsidies, public support (mil. CZK)	
-outsourcing (mil. CZK)	
How much have you increased R&D expenditure in the last 3 years? o *0-9 %* o *10-24 %* o *25-49 %* o *50+ %*	

Tab.: 5 Company structure and milestones

Year of establishment of company	
Own structure	• Czech • Mixed (share of foreign owners below 50%)
Company´s structure	• A company without branches • Part of a group of companies o Parent company with branches abroad o Regional headquarters (controlling subordinate branches) o Subsidiary / affiliate
Products	
Outputs	
Milestones	o Up-grade o Down-grade o New business model o Entrance in new field of products o Leaving the field of products o No strategical changes o New market in Europe o New market in global scope

Segment: product

The idea is to find out what company sell to customers, what products they use for, and what they do to bring them to customers and to the end-users.

1. ***What are your company's products? The most important products (products, services) in terms of turnover. For companies with a broad product portfolio, specify a maximum of 5 major products or product lines, or product categories.***
2. ***Which activities to secure the mentioned production in the Czech Republic?***
3. ***Activities carried out under the production of the company. Own production / production and commercial activity (resale of own production).***

Open answer + classification

- production
- sales and distribution
- customer service / technical support
- strategic marketing
- development of own products or parts thereof
- independent decision-making on production organization, incl. purchase of components
- Other - explain.

4. ***Where and what are your products used for?***

End products / services What is the end market that affects the demand for your product and the company's production? Where (in what market) should we monitor trends that affect the demand for your products? If there are more, is one crucial? Who?

5. ***What are the processes between you and the end market?***

What is the process before the products reach the end user market? How (through what activities and by whom) will the product reach the end market? Does the company have the ambition to influence it? E.g. manufacturer of diagnostic kits and the role of turnkey laboratories.

6. ***Do you consider some of these activities to be crucial for your business?***
   - Yes
   - No
7. ***Do you plan to integrate or co-operate these activities between you and end customers?***

Yes, means that the company has the ambition to replace intermediaries or enter the upper floors of the value chain and have direct / more direct contacts to target users to influence or be closer to the market. to offer tailor-made solutions for customers to apply your insulation materials, another example: replacing an intermediary company).

- Yes - if so, list and explain which and why
- No - if not, then explain why not, why it is not possible or not interested
- There is no relevant question

8. What is the main subject of competition with competitors?

Which part of the product or what characteristic is decisive for gaining a competitive / strategic advantage? By improving what features or parts of a product will best improve your competitive position? E.g. for machine tool manufacturers (i) machine tool head design, (ii) machine placement in concrete to achieve maximum accuracy.

9. How far is the company away from the end markets? (position in GPN).

The position in the whole value chain

- Integrator (finished product - car manufacturer, turnkey factory delivery, production line)
- Tier 1 (the whole module - headlight, integral part of the production line - e.g. its control unit, single-purpose robot, even if it is a machine, chemical product entering directly into the production of the final product, etc.)
- Tier 2+ (component part - plastic part for headlight, gears for production line, chemical raw material)

Segment: Innovation, research and development

The key area we are interested in is the innovation process of the company and therefore not to start with questions aimed at R&D.

We have to clarify the definition of innovations.

Logical line / question system for this section:

10. What innovations do you make? What technical innovations do you perform?

11. What technical solutions do you need to make to these innovations?

12. What development or design do you need and do to make these innovations and engineering solutions? Who and where does the development or construction work?

13. What research do you need for technological innovation? Do you have any other research? What kind.

14. The aim of innovation is to gain some strategic advantage. What are the strategic benefits of the innovation process in your company? (max. 2 choices according to their importance for the fulfilment of the corporate strategy; for each option a box to describe / explain the innovation) Identify key innovations in relation to the competitive advantage of companies.

15. What competitive advantage do you want to gain?

- Offering something no one else can do (product uniqueness) - radical innovation - changing parameters
- Offer in a way that no one else can do (uniqueness of delivery)
- Manage something difficult to manage (technical complexity / uniqueness)
- Market first advantage (right timing)
- Ride with the new wave (smart follower)

- Distinguish (new competition factor) - find a new quality, a new area in which to start competing
- Use existing know-how in another market (diversification)
- other

16. What types of innovation have you implemented in the last 2 years? (For each option and sub-option, a box to describe / explain the upgrade)

- Product (goods and services)
  If we innovate a product, we look at the measure of novelty:
  - new for the world
  - new for the company's market (geographically)
  - new for the company, not on the market of the company
- Production process
  - If this is what we are investigating:
  - Buying foreign technology
  - By developing our own new technology
  - By changing the organization of the production process
- The method of sale or distribution
  - How to communicate with customers
  - Use of the product in a different context / market
  - Company management

17. What problems / barriers limit the innovation process in your company?

If you have any problems or needs in terms of managing innovation, please indicate what this is about:

• How do you address these needs?

• How can the public sector help you (who, how)?

18. Do you have research and / or development activities?

• Research - Yes / No (systematic activities undertaken to acquire new knowledge leading to a specific practical objective)

• Technical development - Yes / No (I can touch the result of technical development (proto-type)

19. Which of the innovation goals you have listed? Is the main focus of your company's R&D activities?

20. How many people work on R&D activities in your company?

21. How much have you increased R&D expenditure in the last 3 years?

22. What is the significance of R&D outputs for the company innovation process?

23. What problems / barriers limit the realization of R&D activity in your company?

First question 3 and possibly supplement with R&D?

Segment: customers and competition

24. Who are the main customers?

25. Between the end customer and the manufacturer there are also companies - e.g. retailers supplying consumer goods to the customer - particularly important if there are few buyers / traders for the manufacturer. What is your position towards them? (direction and nature of market x technological dependence, cooperation, etc.) Is the company substitutable or is the customers fighting for it and its position on the market is exceptional?

- Dependency of the surveyed company on the customer - strong / weak
- Dependence of the customer on the surveyed company - strong / weak
- Cooperation in R&D and / or innovation with the customer (Y / N)
- Number of leads vs. quantity actual (market size) - small / large
- Technology dependence (customer defines procedure, procedures, materials, etc.) - strong / weak
- Our company is moving to the level of the customer's competitor

26. Who are the main competitors? What is the position of competitors in the market?

27. Classify the market position as follows:

- One of the market leaders (global)
- A strong international company
- Local producer

Segment: Suppliers

The idea of survey is to understand who the key suppliers are, how and why the company depends on them. What would happen if the supplier had a downtime? - No / substitutability of supplier.

28. What are the key subcontractors of your company? List up to 5 major sub-supply types.

29. To classify supplier uniqueness as follows:

- Cannot be replaced
- Hard to replace
- Easy to replace

30. Why are these key subcontracts?

31. Why aren't they in-house?

32. How are these subcontracts substitutable?

33. What is your position towards suppliers?

34. Direction and nature of business and / or technological dependency or cooperation.

- Business dependence of the supplier on the surveyed company - strong / weak
- Business dependence of the surveyed company on the supplier - strong / weak
- Technological dependence of the surveyed company on the supplier - strong / weak
- Cooperation in R&D and / or innovation with the supplier / s - Yes / No

Segment: Strategy and competitive advantage

35. What is your advantage to the competition?

36. Why do customers buy your products?

37. How does your market evolve and what is happening in it?

38. How do you react to market developments and how do you respond?

39. At the branches of foreign companies - is it your strategy or your concern on an autonomy?

40. What is your current strategy?

- Expansive (business growth, market share)
    - Create completely new markets with new products
    - Maximize market share in operating markets
    - To penetrate existing products into markets where we are not established yet
    - Enter existing markets in other fields, ie. growth in other fields
- Stabilization after previous
- Defensive (maintaining position against competition, changing production portfolio in response to market downturn, etc.)

41. What is the overall aspiration (vision) of the condition of your company in 5 - 10 years?

42. What is your business strategy based on?

43. What is the competitive advantage of your company?

44. Why do your customers prefer your products to the competition?