Decision Making in Innovation Processes – a Concept to Support Small and Medium Sized Enterprises

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Abstract:

Innovation is a vital factor in today's markets and can dramatically change a company's competitive position. Despite its importance, innovation can also be a high risk adventure for companies due to the high level of uncertainty it entails. This article describes how well structured procedures can help companies guide through the whole innovation process, from idea generation to market launch. Furthermore, it illustrates how the decision making process regarding innovation management can be supported by appropriate software. First, currently existing innovation process models are investigated. How they support small and medium sized enterprises (SMEs) in their innovation activities is analysed and a modification Thom's well known process model is presented. Furthermore, a description of useful methods and instruments and their use within the innovation process is provided in the form of the innovation tool box. The innovation tool box helps companies both select and implement appropriate methods for the context at hand. A discussion of core factors and basic conditions for successful innovation management in SMEs rounds out the paper. A software tool for innovation management is then presented. Such software systematically supports innovation management and decision making throughout the whole innovation process. Furthermore, by demanding specific description and guidance of innovation methods it can additionally help companies in executing their innovation projects. How the database within the software can also be used to help companies distribute relevant information effectively is also described.

Keywords: *innovation, process model, decision making, innovation toolbox, innovation software system, small and medium sized enterprises*

1. Introduction

The management of innovation in companies is a complex, insecure process fraught with risk, and often entails dramatic changes within the company (Preissl, Solimene 2003). These may involve increased levels of competition, rapidly changing market environments, higher rates of technical obsolescence and shorter product life cycles (Griffin, 1997). Companies face with a multitude of challenges. On the one hand, dynamic markets are seen as the pulling force in the innovation process, demanding new and improved products. On the other hand, fast technological developments and rival inventions act as driving forces (Perl 2003).

To deal with this complexity, a thorough, well thought out structure encompassing the whole innovation process from idea generation up to final dissemination of the product or service is vital for success. Proper structure leads to a reduction of time to market, a reduction of R&D and production cost, and an improvement of product quality (Eversheim 1997; Sanchez, Perez 2003). However, a detailed look at companies, especially at small and medium sized enterprises (SMEs) is highly revealing. In contrast to large organizations, structured and well planned processes for innovation are often lacking in SMEs (Karapidis 2005, p. 437; Gelbmann *et al.* 2003). This is especially true with respect to evaluation and decision making during different stages of the innovation processes, and its considerable drawback. As already Cooper & Kleinschmidt (1986) noted, "what the literature prescribes and what most firms do are miles apart". SMEs in particular, are not used to supporting planning and decision making methods in innovation management, and they also suffer from a general lack of awareness with respect to the whole process. Furthermore, in contrast to big enterprises there is often no strict division of responsibilities, duties and work packages. Sometimes the head of the company is responsible for the whole innovation process on his own. As a consequence, very little time may be available for innovation, thorough structures and clear responsibilities are often missing. Successful realization of new ideas obviously requires specific forms of organization.

1.1. Objectives

The overall goal of the paper is to develop and illustrate an integrated concept which can be used to aid innovation management, as well as provide methodical support and software assistance.

We first present a structured process model which serves as a guide through the whole innovation process. This process model has been developed with the help of practitioners and is highly suited to the needs and demands of SMEs, especially concerning the limited financial and human resources available. Moreover, to add specific support for decision making in all phases of the product innovation process, we pay particular attention to the integration of methods and tools. This is illustrated with respect to the selection of proper methods and tools in the innovation process. Thus, the process model itself, together with the methods provided within the model and the software tool, act as guidelines through the whole innovation process and may help SMEs successfully execute innovation management. Finally, an important objective of this paper is to support innovation management by developing and evaluating specific software. The software used serves to integrate three key areas: the innovation process, support methods and the communication process between all the relevant actors.

1.2. Methods and means

This paper is based on three research projects, 'Innovital', 'Innovators' and 'Innoware', which altogether took up more than 7500 hours, and involved four research institutes and 15 companies from different branches, mostly of small or medium size. Additionally, in order to validate the usability and practicability of the project results, a further 15 companies were linked to the project research in the form of workshops.

Initial research focused on describing the status quo with respect to innovation processes. The field appears to be well developed. Approximately 40 theoretical process models, e.g. stage-gate-models, were analysed. However, the practical implementation of these models is still in its infancy, and requires adaptation for SMEs. We thus developed an ideal process model which employs a bottom up approach in order to better take the needs and demands of the companies into account.

Secondly, an intensive review of literature revealed that lots of innovation methods exist, but that clear and systematic description, as well as assistance with implementation are often totally lacking. Hence, the utilization of such methods remains rather rudimental. An important focus research was thus to further adapt the methods such as to meet the needs and demands of SMEs. This meant finding means for aiding the transfer of theoretical knowledge of innovation processes and methods into practical usage in order to secure broader acceptance. The development of practical parameters designed to make method implementation self-explanatory was a main source of research success. Our attempt to connect process structures with innovation methods is important and for the field of innovation management and remains highly neglected topic in the German speaking world.

Another important area of research described here focuses on the need to develop appropriate software. After a thorough investigation of existing software no suitable software for the execution of innovation management was found. We thus combined the results of process analysis and the development of guidelines and developed a totally new innovation software tool. A case study of 8 companies from different size and branches was used to assess the practicability of the new software tool.

2. Innovation Processes

Thomas A. Edison recognized innovation as the process of producing ideas into practical use. Thus, innovation covers not only the invention itself, but also its market implementation (Tidd *et. al.* 2001, p. 37). Is it possible to manage this innovation process? New product development is not just a series of predictable steps that can be identified and planned in advance. For many development projects neither the exact nature of the product nor the necessary means o production are known with certainty at the start of the development project. This uncertainty, along with the required amalgamation of project resources, calls on project managers to engage in project planning (Tatikonda, Rosenthal 2000, p. 402). Despite the great uncertainty surrounding innovation and its apparently random nature, several methods are available which help identify underlying patterns of success. We need to find to find out the extent to which innovation is based on routine and whether such routine can be learned and subsequently used to form patterns and clear structures. This does not necessarily mean that the innovation process will always be the same, but it may mean that with the help of suitable structures and process models, execution may require less detailed, conscious thought (Tidd *et al.* 2001, pp. 46). Research has demonstrated that not skipping steps increases the probability of success for any project (Cooper 1990a). Firms therefore have to find a balance between firmness and flexibility in product development (Tatikonda, Rosenthal 2000, p. 417).

Addtionally, innovation not only comprises the creation of new products to satisfy customers but also deals with the development of new services, processes and organizational structures within a company (Perl 2003, p. 35). However, many of the key success factors for new service product development are identical to those identified for manufacturing firms (de Brentani 1989; for differences between service and goods see Griffin 1997, pp. 452). Nevertheless, differences between products and services in the execution of innovation management make it apparent that an innovation process model should fit all types of innovation.

2.1. Existing process models

During the last few decades innovation management has become an essential scientific discipline. A large number of scientists now concentrates on the key issue of how to manage innovation. An overview of these endeavours can be found in the literature (Tidd *et al.* 2001, p. 51).

Common to almost all the literature on innovation management is the understanding that innovation must be viewed as a holistic process (Tidd *et al.* 2001, pp. 38, 44). This has obvious implication for the management of innovation processes.

In recent years, four, or perhaps five, generations of innovation models have been produced (Huizenga 2004, pp. 52; Tidd *et al.* 2001, p. 43). Initially innovation was seen as simple and linear, and models reflected this point of view by focusing on linear processes, with either a technology push or a demand pull fostering the innovation process (for example see Schwery, Raurich 2004). Later, interactions between different phases of the innovation process were recognized and feedback loops were employed (Huizenga 2004, p. 55). In the next phase there was an emphasis on linkages and alliances, including an upstream with key suppliers, and a downstream with demanding and active customers. The latest generation of process models focuses on systems integration and extensive networking, flexible and customized response, and continuous innovation.

More than 40 innovation process models were analyzed for the present projects. These included process models such as those from Utterback and Abernathy (Utterback, Abernathy 1975), Thom (Thom 1980), Cooper (Cooper 1990b), Utterback (Utterback 1994), Pleschak and Sabisch (Pleschak, Sabisch 1996, pp. 24), Brockhoff (Brockhoff 1999), Van de Ven *et al.* (Van de Ven *et al.* 1999, pp. 23) Tidd *et al.* (Tidd *et al.* 2001, pp. 19) and Vahs and Burmester (Vahs, Burmester 2002) (for an additional overview of process models see also Zotter 2003, pp. 49 and Afuah 2003, pp. 13). However, although there is such a huge number of process models, their practical dissemination is still in its infancy. They are often not appropriate for the needs and demands of SMEs, since they are very often too complex. Furthermore, they are not flexible enough to fit all specific kinds of innovation. As many of the process models described in the literature were found to be inadequate, the innovation process model described below was developed.

2.2. Development of a new innovation process model appropriate for SMEs

As already explained above, the following innovation process model is based on a study of more than 40 process models for innovation management.

The starting point of the innovation process model is the innovation process of Thom (1980). According to Thom (1980), the innovation process as a whole is divided into three overall phases; idea generation, idea acceptance and idea realization. However, especially with respect to idea generation and idea realization, we introduce several modifications to make the model suitable for SMEs. Moreover, in contrast to previous process models the results of each phase are here clearly defined.

The innovation process begins with some form of initial impulse (see Figure 1). This may take the form of demands, requirements or complaints from customers, hints from the marketing and distribution department, ideas from employees, new technologies, ideas from the research and development department to name but a few (following Yates/ Stone 1992, Forlani/Mullins 2000, see also Hilzenbecher 2005, pp. 67, Disselkamp 2005, pp. 40).

In contrast to many process models, emphasis here is placed on problem analysis and strategy definition, i.e. the first phase of the innovation process. This phase focuses on defining innovation strategy an dhow the company intends to reach its goals. In the second phase it is important to generate as many ideas as possible. This also entails the collection of existing ideas and solutions. As a consequence of this rather creative and very vaguely structured process, a pool of new ideas should result. As only some of these ideas can be investigated in detail, a rough selection of ideas has to be made in phase III. Out of this selection, a couple of concrete problem solutions and ideas should then remain.

Within the overall phase of idea acceptance it is necessary to investigate and analyze the ideas in detail before a basic decision about the project can be reached. So it is important to evaluate all technical and economic aspects of the innovation that may have an influence on the success of the product. A feasibility study with detailed realization plans should form the basis for the subsequent decision for an innovation project in phase V. In comparison to other process models, we focus on those decision making phases which particularly affect company competitiveness.

Once a decision for an innovation project has been made, implementation may begin. First of all it is important to generate a detailed realization plan for the product or the service, covering aspects such as size, materials, resources needed, costs etc. This is a very important phase for subsequent realization since essential aspects and criteria of the product are defined and fixed (for integrating user needs see Franke, von Hippel 2003 or Jeppesen 2005). A strong focus is placed on this phase, since it is here that SMEs often appear to neglect key items.

The product/service plan is followed by development and prototyping, resulting in a complete prototype by the end of this phase. Once all aspects and features of the prototype have been appraised, production starts (this phase is absent in service innovation). Product launch is the final phase of this process.

When looking at these individual phases it is very important to realize that this innovation process model

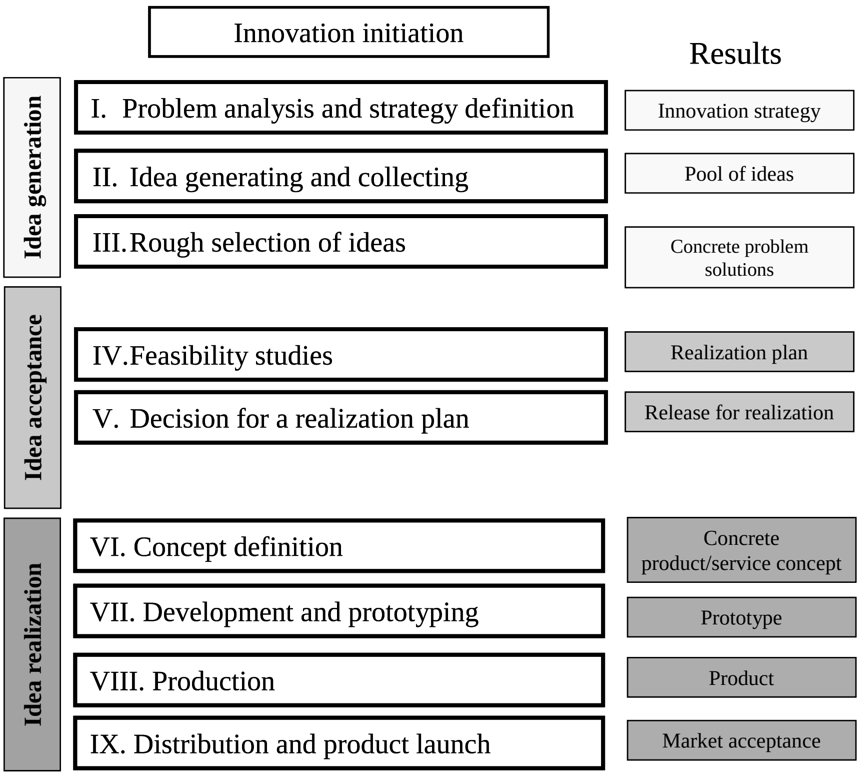

Figure 1. An innovation process model specific for SMEs.

should not be seen as linear. We have merely presented an ideal workflow illustration of the innovation process. Loops and steps backwards to former phases may be both necessary and desirable, especially when earlier phases of the innovation process have to be revised.

The innovation process model described above can be seen as very suitable for SMEs as it is not too complex and covers all the important factors for the management of the innovation. The usefulness of the process model has already been tested in several companies and branches, e.g. in primary industry, steel manufacturing companies, logistics software enterprises and in machine manufactures. It is suitable to both service and manufacturing companies.

2.3. Barriers for a structured innovation process model

Although the necessity and the possibilities for innovation process models are obvious, it cannot be denied that face several restrictions in practice.

First of all, a process model cannot replace organizational management and control of the innovation process. It serves merely as a guide, and offers an ideal-typical path for optimal innovation. It is essential that it not be seen fixed and unalterable. Companies often have to adapt as they innovate and follow process loops. They have to be conscious of the nonlinearity of the innovation process and must be prepared to retreat one or two steps in order to revise the plans.

Another limitation of process models for innovation management concerns the different organizational styles that are often needed. Within the idea generating phase, a rather unconstrained management style is needed in order to boost creativity. Further on, when the idea is being implemented, it is vital that the process is fairly rigorously organized. This is often called the 'organizational dilemma' (see Wilson 1966, pp. 195). However, Souder recommends that the most appropriate structure depends upon the level of innovation desired, and on the stability of the market and technical environment (Souder 1987). The complex interdependencies between the organizational context, business processes, and individual performers have also to be considered (Massey *et al.* 2002).

Last but not least there is often personal resistance to fixed or structured advancement. Employees feel imprisoned within the process and fear losing their personal area of responsibility and scope for development. It is the responsibility of top management to reduce such barriers and minimize such areas of potential conflict. In particular, flexibility and openness is required to overcome conflict arising as a result of employee resistance (Wengel, Wallmeier 1999, p. 77).

3. The support of methods in the innovation tool box

To successfully execute an innovation, it is not only of great importance to know each step of the process, it is also vital to know how to perform each phase of the innovation process in an ideal way. A study of 120 product development projects found a strong positive correlation between project methods and the project success achieved. Those companies that successfully employed specific methods to support their development process were more likely to succeed in the overall product innovation process [Tatikonda, 2000, p. 402]. Nevertheless, as other studies show, the use of specific tools and methods remains marginal (Farris 2003, p. 31; Gelbmann *et al.* 2003). Companies, especially SMEs, are largely unaware of innovation methods, nor do they dare to use them.

The following innovation tool box describes and illustrates how specific innovation methods can be used to support the innovation process.

3.1. The innovation tool box

The development of the innovation tool box was preceded by a study of existing guidelines on innovation management appropriate for SMEs carried out in 2003 (see Gelbmann *et al.* 2003, p. 86).

This research revealed that no complete guide for the management of innovation processes was available, and even fewer tools were found that might be suitable for sustaining innovation processes in SMEs. We thus decided to take up the challenge and develop a scheme suitable for the SMEs that could cover the whole innovation process, from initial idea generation, on to product/service development and distribution (see Figure 2).

The innovation tool box is based on the process model explained above. The phases from idea generation, idea acceptance and on to idea realization are represented on the left hand side. Specific methods are selected for each phase of the process. These can be seen on the right hand side of the tool box. However, circumstances and core conditions in companies always differ considerably. As a consequence, the methods offered within the innovation tool box are subdivided into several groups and depending on respective phase within the innovation process and on specific company characteristics. A more detailed description of the division of the methods will be provided in the next section.

3.2. Presentation of methods in the innovation tool box

Acceptance of the innovation tool box by SMEs depends on it being as comprehensible as possible. Furthermore, time is a very scarce resource for these companies; hence explanation of the methods involved needs to be simple and compact. It is also important to explain the methods and in such a way that the companies can use them without further assistance from consultants. The following structure for method description was thus chosen (see Table 1).

First of all general facts of the methods are presented. Secondly, the complexity of the method is explained using specific criteria (see Table 1). Criteria such as time, participants needed, degree of difficulty, to name but a few, were chosen and validated according to their operability with the companies included in the projects.

A further description of the procedure depicts how the method has to be used. Additionally, an example illustrates this in practice and helps participants understand the method. Last but not least, references for further information are provided.

The exact allocation of methods in terms of phase and specific company characteristics is undertaken as follows.

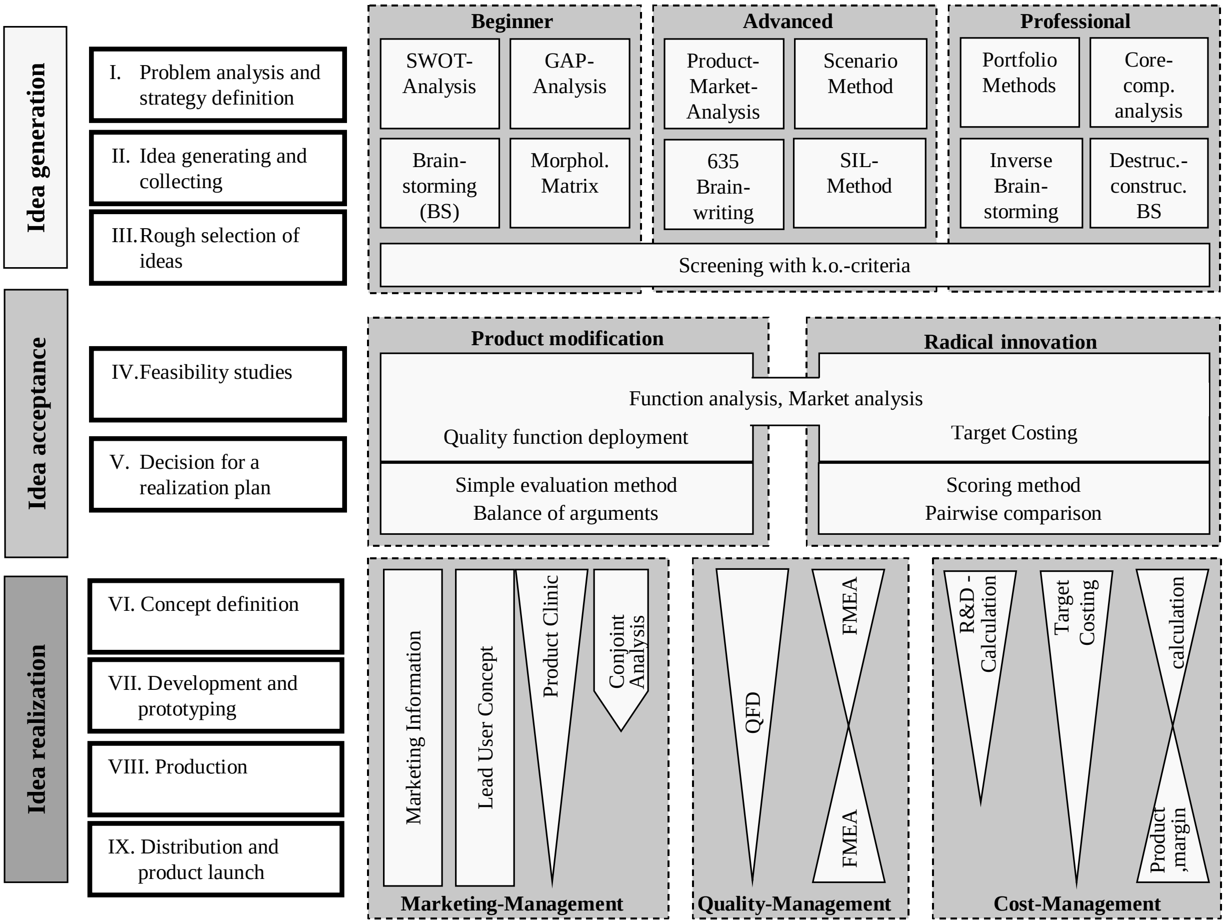

Figure 2. The innovation tool box.

Criteria	Evaluation of the criteria	Comments
Time		*Depends on the object itself and on the experience of the project leader with this method*
Participants needed	*3-7*	*Team work recommended*
Spatial requirements	*1 Room*	*No further requirements*
Extras needed	*Writing material, flip chart, pin board, additional presentation material*	
Moderator	*needed*	*Moderator is responsible for: Coordination of the method Tracing of the method through its whole cycle Documentation of the results participants' experiences during sessions*
Degree of difficulty	*high*	*External assistance and consultancies can be recommended if no experience with this method is available*

Table 1. The complexity of the method "Target Costing.

Division according to overall company experience with innovation methods

For the first three phases of the innovation process (problem analysis, idea generation and idea selection), the methods proposed are classified in terms of participants' previous experience with innovation techniques, and reflect the needs of beginner, advanced and professional innovator. A checklist with 12 short questions helps the companies allocate themselves to one of these groups.

For the phase covering rough selection of ideas with knock out criteria, only one general method is suggested as this process phase has to be done very thoroughly, no matter which innovation type the company represents.

Division according to the degree of the innovation

After rough selection of the idea, a further classification according to the innovation type is no longer appropriate. As the innovation is now more clear and specified, methods can be chosen corresponding to the type and novelty of innovation. Therefore, within the overall phase of idea acceptance, the innovation tool box distinguishes between incremental and radical innovation and allocates the methods accordingly.

In the literature many definitions concerning classification into degree of novelty exist (see for example Veryzer 1998; pp. 306, Tidd *et al.* 2001; Afuah, 2003, p. 14 Bourque 2005, p. 72; Hauschildt, Salomo 2007). If the degree of innovation is defined in terms of the extent to which it impacts a firm's capability, then the term radical innovation means that the technological knowledge required to exploit it is very different from existing knowledge. In contrast, incremental innovation is based on existing knowledge and on a current organizational pattern (Afuah 2003, p. 14). The emphasis in incremental innovation is cost and feature improvement in already existing products whereas radical innovation concerns the development of new businesses and products (Bourque 2005, p. 72).

However, the dimension of novelty is not only important for predicting an innovation's rate of adoption and diffusion. It also influences an innovation's developmental pattern (Veryzer 1998, Van de Ven 1999, p. 63). In this way the novelty of an innovation also has an impact on the selection of appropriate methods to support the innovation process. The innovation tool box thus provides scope in idea acceptance, by allowing for a division into radical innovation or modification and improvement of existing products and services. This applies to both the phase of feasibility studies and to that involving decisions on the start of the innovation project.

Division into marketing, quality and cost management

For the final phase of innovation realization, in order to reduce complexity, methods are only divided according to the key area they affect. Furthermore, the methods cannot be allocated to only one phase in the innovation process. Of course they do focus on particular phases, but as they can also affect other phases within the realization, the innovation tool box indicates both the focal point of the method and illustrates the other phases affected.

To ensure that method selection remains relatively straightforward for the companies concerned, methods are divided into the areas marketing management, quality management and cost management. If a company only needs help and information in one of these sectors it can easily find an appropriate method. However, it must be noted that a company still has to cope with all three areas to successfully manage their innovation process.

Although project management methods are also of importance, they have here been excluded from the general tool box and placed in a somewhat outer layer of the innovation process. Hence, in the realization phase, only methods suitable for marketing management such as the lead user concept, or Failure Mode and Effect Analysis in quality management, or for example target costing for cost management, are presented within the toolbox.

To sum up, the innovation tool box provides a systematic overview of both the innovation process as a whole and of the respective methods that can be used to support each specific phase of the process. Furthermore, by allowing for various subdivisions, it enables companies to identify the right methods for their specific problems.

4. A software program to support Decision making in innovation management

The use of software programs can be helpful in supporting innovation management and related decision making processes.

In recent years, the market for innovation management software has spread rapidly. However, an analysis of existing software solutions revealed that no complete solution for innovation management is available that covers all phases from problem analysis up to market launch (Vorbach, Perl 2005). Moreover, existing commercial software systems often cannot be used directly within companies, and they especially fail toe meet the specific needs and demands of SMEs. Consequently, customization with respect to SME requirements is clearly necessary. As part of the Innoware research project, the needs and demands of companies were analyzed and discussed, and then used as the basis for further software development.

Additionally, such software application has to target several goals in order to successfully meet the needs and demands of small and medium sized companies. First, it is essential that the software encourages a team focus, as innovation is mostly undertaken in teams from different departments. Second, the software should induce the maximum participation of all employees, regardless of their level in the company hierarchy. This is achieved by making the software s self-explanatory as possible. Finally, the software needs to be capable of adapting a process perspective.

4.1. The innovation workflow as a basic feature of the software program and knowledge management perspectives

Workflow conception preceded the above mentioned intensive analysis of innovation processes using the process model presented in Figure 1 and formed the basis for further development of the software. Workflow, as a basis for future software solutions, consists of the following general phases (see also Staltner *et al.* 2006):

- Problem identification and innovation initiation,
- Idea generation,
- Idea assessment and selection,
- Idea realization.

Finding the most appropriate structure depends upon the given level of innovation and on the prevailing stability of the market and technology environment (Griffin, 1997, p. 442). Therefore, with respect to innovation software, the various steps of the innovation process are not all obligatory for companies. Each company can decide for itself whether to execute all steps of the process. While complete execution is recommended, users may skip various steps. The system informs them of their omissions. This guarantees as much freedom as possible for the users of the software; but, some kind of guidelines should still be implemented by the company.

4.2. The support of knowledge management through specific databases

The innovation software includes a database to facilitate the storage of knowledge about the specific innovation project. In this database, data about the innovation project currently being undertaken is stored. All information about the innovation project, such as market data, technical features, the results of tests and assessment, need to be saved. It is also important that knowledge of all past ideas is stored. This enables employees to check whether specific ideas and solutions have already been attempted, and, if they were rejected, the reasons for rejection can be reviewed. The database should thus help tacit knowledge on innovation ideas and projects become common knowledge and make it easily accessible (see Karapidis, 2005 on integrating ideas into company knowledge management).

In the subsequent warrant of apprehension, the 'new idea sheet', the data management within the software is illustrated. At the top of the sheet, there is a clear identification of the project with an identification number, an abbreviated designation, and a few key words and the date of receipt. The names of the idea generators and their organisational units are also situated at the beginning. Afterwards, a short description of the project follows, as well as links and attachments for further information. These are the most important data for submitting and presenting ideas. However, the new idea sheet also includes information on the innovation advancement and the progress of the project. Data about classification of the idea, evaluation results, development concepts to name but a few are illustrated. Thus, the new idea sheet provides all essential information that is linked to the innovation. Additionally, it is possible for all employees to comment the idea, and, what is even more important, to add solutions within the new idea sheet.

4.3. Software support in the use of methods for innovation management

As mentioned above in chapter 3, the systematic and structured use of methods and tools to support the execution of innovation can contribute greatly to the probability of innovation success.

The methods presented in the toolbox in chapter 3 are thus fully integrated into the software. To facilitate acceptance, it is very important that method description and illustration be a comprehensible as possible. The software thus uses the scheme and selection criteria as described in section 3.2 above.

First of all, general facts relating to the methods are presented. Second, the complexity of the method is explained using specific criteria (see Figure 3 above). This

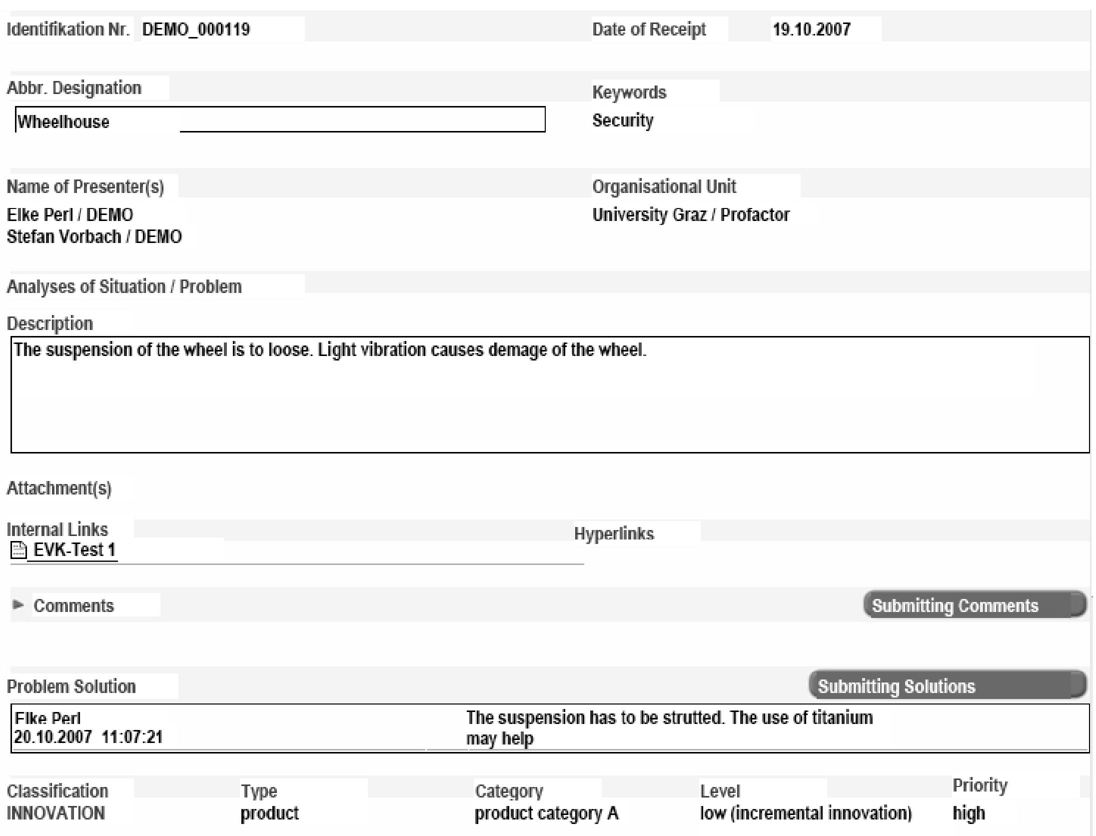

Figure 3. New Idea Sheet.

short overview of the complexity of the method is a very important part of the description because it gives the companies a very brief overview concerning core factors and requirements. A further description of the procedure depicts how the method should be used. This is illustrated by further practical example in order to promote greater understanding. Finally, references for further information are provided. Companies can also input their personal experience to complement method description. The methods database thus provides company specific knowledge concerning method usage and evaluation.

4.4. Limitations of software support for innovation management

Despite all the positive effects generated by the usage of software systems, knowledge driven innovation software lacks support in several key areas. First of all, sharing tacit knowledge through a virtual medium is particularly suitable for a stable, incrementally changing environment. Thus, storage of knowledge is only as good as the willingness of the employees to document their knowledge (Voelpel 2005, p. 19).

Furthermore, in transferring product and development knowledge, supplementary communication, such as face-to-face communication, is required. While direct interaction among personnel is of great importance for successful communication, this is only aided by the software, but not guaranteed. In addition, such interaction is vital for the transfer and identification of tacit knowledge throughout the company, and is one of the most important drivers of innovation (Voelpel 2005, p.19).

Product development is thus often characterized as an exercise in information processing (Clark, Fujimoto 2001; Tatikonda, Rosenthal 2000). Therefore, in many cases lack of information and communication is reported as a key factor in failure. Department-focussed thinking and non-interdisciplinary project teams often lead to project failure and inhibit innovation. Communication with customers also has to be planned and structured in a careful manner. Only appropriate communication within and between companies and the market can ensure that future products meet customer requirements. The innovation software presented her can provide assistance in all such problem areas. However, it has to be admitted that many of these barriers are of a socio-psychologically nature and thus cannot be easily solved by software systems.

Last, but not least, it needs to be noted that, when taking the implementation of innovation software into consideration, the success of software in supporting company innovation processes is highly dependent on the prevailing company culture and organizational structure. These are relatively rigid organizational boundaries and related problems cannot be solved by technical means alone, such as the installation of new software.

5. Implementation process of the innovation software

An intensive testing phase involving all 8 project companies was undertaken in an attempt to verify software results. The companies represented a diverse industrial background, mining, engineering, electronics, plastics etc. Furthermore, the companies were of different sizes. Testing verified that the software worked well in all branches and that it was well suited to the large organizations as well as to SMEs.

During the test phase, one outstanding characteristic became apparent. Companies need almost constant help and monitoring during the whole implementation process. Where this is not the case, many functions and features of the software remain unclear and unutilized.

This is particularly true with respect to the innovation process. In practice, several of the 8 companies, especially the SMEs, did not have a structured process model in place to aid innovation processes. Providing adequate support to companies restructuring their company processes towards a more systematic approach for innovation was of great importance here. In fact, it was a vital prerequisite for further implementation of the innovation software.

Moreover, assistance was also needed with the implementation of the methods provided in the software. Although a thorough and self-explanatory description of the methods is provided in the software, the companies still needed guidance and to engage in learning by doing. Companies frequently stated that it was hard for them to convince their employees of the usefulness of the methods. Higher acceptance was achieved when scientific consultants became more involved. Companies did, however, admit that the description of the methods and the data sheets provided to aid method execution were vital, especially for future method application.

This reveals the important fact that changes in innovation culture, in information management and in attitudes towards idea generation and idea handling are needed in order to ensure successful implementation of innovation software. Cultural aspects together with leadership styles are among the most important key aspects in innovation management since they often reflect and characterize the importance of new product development. Lack of support and acknowledgement by top management is especially damaging to the acceptance of innovation among employees since it quickly undermines the generation of employee commitment.

Finally, in the testing phase, it became obvious that the companies needed to establish appropriate infrastructure in advance in order to implement such a software tool. Without such preparation, implementation becomes so expensive that the companies are not willing to pay for the software system. Furthermore, companies are often highly reluctant to restructure their whole IT-infrastructure owing to the perceived risks that this entails.

In our case, following the testing and validation phase the software system was revised in accordance with company feedback and companies are now highly satisfied with the results. The producer of the software is now planning to translate the software into other languages. The innovation software described here won the international IBM Lotus award 2007 for the best industry solution.

6. Conclusion

Innovation drives corporate success and is a strategic endeavour contributing to the creation of differential advantage. It is precisely for this reason that a well structured and transparent procedure is needed to guide the whole innovation process and to ensure effective and efficient management of the innovation project.

The innovation process described above is just such a well structured process and can thus be of great support. However, as shown in several studies, SMEs still often lack such a clearly defined process.

Furthermore, there is a clear knowledge gap in many companies with respect to the methods and tools needed in the innovation management process. The innovation tool box helps close this gap between the advanced knowledge available in the literature and the relatively primitive methods applied in practice. Within this toolbox, the methods are described in a very short and understandable way and are furthermore linked to the various phases of the innovation process. The innovation tool box and its methods were tested within 30 different small and medium sized companies and were found to work well and improve innovation success.

The support of software systems in innovation management can have considerable positive effects on the execution of company programs in innovation management. The innovation software can help companies deal with the enormous amount of information within their innovation processes, assist them in making knowledge-based, structured decisions which are supported by appropriate tools and methods.

However, not all barriers and obstacles can be overcome with tools, methods and software systems. Innovation also depends on other core factors and basic conditions. Hence, a company has to ensure that these core factors are also taken into consideration and that basic conditions relating to the provision of appropriate information and communication within the company are successfully dealt with. Until this is done, no amount of technical adjustment will ever lead to innovation success.

Acknowledgments

The Institute of Innovation and Environmental Management at the Karl Franzens University Graz has been involved in the research of innovation management since 1990. In recent years investigation into the innovation process and the development of guidelines to support this process has continued to be one of the key research fields of the institute.

The basis of this paper derives three projects called 'Innovital', 'Innovator' and 'Innoware', comprising more than 7500 hours of work. The project partner of the first two projects were the Institute of Innovation and Environmental Management at the University of Graz, the Institute of Industrial Management and Innovation Research at the Technical University of Graz and the ARC Systems Research, located at the University of Mining, Metallurgy and Materials in Leoben. Furthermore, the project Innovital and the project Innovators entailed the cooperation of 2 and 3 companies respectively, thus ensuring practical relevance. Additionally, in order to verify the practicability of project results, a further 15 companies were integrated.

The software system is based on the research project 'Innoware', a project funded by the Austrian Federal Ministry of Economics and Labour. Research partners for the 22 month project are the Profactor Research Institute in Upper Austria, the Institute of Innovation and Environmental Management at the Karl Franzens University in Styria and the ARC Systems Research, University of Mining, Metallurgy and Materials in Styria. A further ten industrial partners complement the project team to ensure practicability.

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