R&D-Portfolio Management of German Industrial Enterprises - An empirical survey -

1. Introduction

It has increasingly been recognized that a strategy of rationalization aiming at reducing cost only, is as ineffective as a partial innovation offensive to bring products to market in shorter and shorter cycles. A well-balanced mix of cost optimization and improving one’s market performance is more important to successfully defend one’s competitive position and to occupy new growth fields (cf. Wildemann (1997), p. 3). At this point, already selecting innovation projects at an early stage of the innovation process plays a major role.

Due to the development described, the innovation project selection is becoming more and more important already in the early stages of the innovation process, from both a scientific and a business point of view (cf. Spielkamp; RAMmer (2006); Herzberg (2006); Sammerl (2006)). So it appears that executives of German industrial enterprises are increasingly estimating effectiveness and efficiency in the R&D-portfolio management as a strategic competitive advantage (Wildemann (2008b); S. 8). Thus methods and instruments for the portfolio management of R&D-projects are increasingly taken into account to be able to successfully realize the aspired aims customer benefit, optimum time, economic equilibrium, focusing resources and support in the ongoing process of self-modernization. (vgl. Seidemann (1999), S. 103ff.).

Therefore the research project, on which this article is based, aimed at empirically analyzing the general conditions and success factors in the R&D portfolio management of German industrial enterprises. The initial point for suggesting ideas were the existing gaps in scientific researches on innovation portfolio management (cf. chapter 2.1). Certain conceptually oriented activities have increasingly covered this subject over the last few years. Nevertheless, there are only few detailed empirical surveys which deal with the portfolio management of innovative solutions and the requirements for a practically oriented implementation.

In the research project, an EDP-based evaluation model for selecting and prioritizing innovation projects has been developed, which can sustainably contribute to increasing the effectiveness and efficiency of the Innovation Portfolio Management in German industrial enterprises by improving the transparency of the innovative performance. An empirical research on the early stages of the innovation process provided the basis for developing the evaluation model (cf. figure 1).

![Figure 1 The early stages of the innovation process](image-url)
innovation management and innovation portfolio management as well as on the existing deficits and restrictions the questioned companies are confronted with at the early process stages. Furthermore, current decision criteria in the innovation process were determined and classified, so that the relevance of selected factors influencing the innovation management in general and the evaluation of ideas in particular could be ranked. So the empirical analysis was oriented to the following questions:

- How does the innovation environment affect the effectiveness of the innovation project portfolio?
- How has an evaluation model for project selection and prioritization to be designed with special regard to company-specifically prevalent restrictions and conditions?
- How can the selection process be operationalized by a need-oriented and user-friendly IT tool to be able to derive the innovation portfolio ensuring maximum benefit?

After all, it can be stated that the analyzer “innovation portfolio management” entails various questions, which will be more closely scrutinized in the scope of the present article. As the depicted research questions show, are these primarily questions of evaluating and selecting an innovation portfolio with optimized utility, especially considering prevalent, firm-specific basic conditions and restrictions. The present article is thereby divided into a theoretical and an empirical part. In the theoretical part, based on the problems depicted in section 2, it is elaborated on the conceptual basic ideas and theoretic deficits of the innovations management in general and of the R&D portfolio management in particular. The empirical foundation of the present research topic starts in section 3 with basic insights into the innovation management of German industrial companies. Afterwards, the current trends, restrictions and factors of success of the innovation management of small and medium-sized enterprises (SME) and large enterprises (LE) are shown. Eventually, section 4 takes up the insight into the evaluation of ideas and the selection of innovation projects and analyzes them, considering their relevance for the design of F&E portfolio with an optimized utility. The insight into a design of a computerized evaluation model to select innovation portfolios leads in section 5 to a concrete demand to operationalize the R&D portfolio management. In section 6, the concluding summary and also a depiction of the implications of the results for research and practice ensue.

2. Literature review and theoretical background

Within the research, the term innovation did not comprise technical or product-specific innovation only, but also process improvements within the creation of value. Innovation management is considered as the sum of all activities promoting innovations by realizing appropriate conditions along the entire innovation process from the stage of generating ideas to adjusting ideas to the concept development and realization. The precise evaluation of specific projects is already required at the early stages of the innovation process to successfully bring new ideas from the state of invention to an innovative market performance. To achieve this, the innovation portfolio management can be used to reduce uncertainties and risks at an early stage and to identify sustained potentials for success (cf. Graning (2005), p. 135). In this process, the methodical analysis and evaluation of innovation projects has a crucial impact on an enterprises’ innovative ability (cf. Farrokhzad et al. (2005), p. 281).

For the matter in question, R&D-portfolio management is the disposition of available resources for the purpose of maximizing the company profit contribution. Innovation portfolio management describes the distribution of available corporate resources to current and planned R&D-projects. These projects determine the innovation portfolio. The objective is to achieve as an ideal combination of future R&D-projects as possible while maximizing (monetary) company benefit for sustainably securing company success. Managing innovative performance by a structured design of R&D-activities intensely supports a long-lasting corporate success, as innovations frequently are an essential condition for sustainably increasing and securing growth potential (cf. Grand et al. (2007), p. 60). However, innovative ability does not only mean to generate numerous new ideas, but to also select the most promising ideas (cf. Farrokhzad et al. (2005), p. 282).

Successful companies distinguish themselves by deliberate investments in facilities, technology and human capital. Innovative activities are part of the measures developing competencies, without which a company is
hardly able to survive in competition (cf. Spielkamp; Rammer (2008), p. 4). Other important competitive factors are the individualization of the performance range, customer orientation, the level of product and service quality, the “on-time” market launch of solutions as well as the linking of R&D-projects for realizing synergy effects (cf. Arvanitis; von Arx (2004), p. 8f.; Hirzel (2006), p. 11ff). Therefore, a lot of competitive factors are based on the successful portfolio management of R&D-projects (cf. Wildemann (2007), p. 6ff).

Innovation and performance profiles that are transparent to the customers enable the company to generate unique features, also in highly competitive markets and to be successful in the long run due to continuous innovation.

2.1 Deficits in innovation management

A literature research about innovation management of SME shows, that essential deficits exist in this area. Companies are frequently confronted with restricted technical opportunities, missing financial resources, restriction in the capacity of personnel and temporal shortages. In addition, formal structures in the innovation management are missing, such as the formation of an individual department for R&D tasks (cf. Spiegelkamp; Rammer (2004), p. 16 et seq.). The product development as such is certainly important, because it constitutes the competitive advantages in most companies (cf. Brown et al. (1995), p. 343) and therefore it constitutes an essential factor of success. Moreover, the literature shows the current need of research not only in product advantages and market attractiveness, but also puts the necessity of a realignment of the internal organization in the foreground (Brown et al. (1995), p. 351). From an operative point of view, it is evident that in the scope of the product development, the support of the portfolio management by selecting promising ideas through appropriate methods and tools is often impossible. The decision makers’ overview on actual project is often insufficient (cf. Spielkamp; Rammer (2004), p. 16 et seq.). Furthermore, the companies are not aware of the strengths of its own employees and deficits often exist in the culture of innovation of the companies. In addition to this an acceptable depiction of the standardization of the ideas management does rarely occur, so that lengthy, repetitive processes often proceed in a company (cf. Wildemann (2008b), p. 8 et seq.). The basis of information about the market situation and the know-how position, which is consulted for the selection and definition of projects, is in comparison less distinctive at SMEs than at large enterprises (cf. Wildemann (2008b), p. 8 et seq.) So far, portfolio-based methods of decision making at SMEs are hardly applied, as the herefore required methodological skills are often missing (cf. Spiegelkamp; Rammer (2004), p. 17). Next to missing, portfolio-based methods of decision making, Ernst identifies a central disadvantage of much research work in the insufficient analysis of single projects (cf. Ernst (2002), p. 33). Individual factors, which relate to various projects and an analysis of the multi-project management, have been hardly studied so far.

From these deficits derives a gap in research, related to the R&D portfolio management of industrial companies in Germany. In addition the analysis of 480 company data collected by the online tool “Innovationsaudit” offered for free on the internet by the researching institute (www.tcw.de) states clearly that German industrial enterprises have deficits in their innovation management despite the high relevance of innovations. The analysis has shown that actual problems can be solved by an accurately designed innovation portfolio management (cf. Wildemann (2008b), p. 9ff):

• One of the basic problems in innovation management is the insufficient orientation to the customer and to competitors. More than 80% of the companies state that customer demands are not exactly recorded. One third of the participating companies hardly consider customer demands in product development. In addition, less than half of the participating companies conduct competition benchmarks. The insufficient orientation to the customer and to competition leads to inefficiencies and waste of resources. Consequently, an implication for the portfolio mangament might be, that it has to be analyzed whether customer requirements of the potential innovation projects are sufficiently taken into account.

• One third of the companies does not have or use requirement or task profiles within the R&D-department. Especially in small and medium-sized enterprises, the employees’ skills are not evaluated by their superiors, whereby the selection of further training is unstructured and the employees’ potential cannot fully be exploited.

• In one third of the inquired companies are new ideas assessed sceptically by the superiors. The large workload additionally hinders in two third of all companies, that resources flow purposefully into generating future
technologies and ideas. The missing transparency of R&D project landscape as well as an enormous degree of skepticism lead to an atmosphere, hostile to innovations and therefore to a stagnation of the company's innovative ability. The necessity for a portfolio management can be derived from this, so that ideas are evaluated on the basis of standardized criteria. Only by doing so, subjective assessments of opinion leaders in the selection process can be eliminated to the greatest possible extent.

• Deficits in communication lead to so-called “U-Boot-Projekte” in about half of the companies. These projects are secretly conducted by employees without having official budget. This is a risk of wasting resources, as sometimes several employees might inofficially work on solving the same problem.

• Only one third of the companies explicitly and comprehensively protect their own knowledge. Remarkably, in none of the questioned companies delicate projects are exclusively accessible for the employees involved. This security gap results in the loss of knowledge and therefore in diminishing competitive advantages.

The deficits reveal essential starting points for improving company-specific innovation management; these have to be considered in the innovation portfolio management to create transparency and the reliability of decisions.

2.2 Empirical basis

The empirical study was conducted for evaluating decision-making processes and their success factors in the innovation management of German industrial enterprises. The contents of the study aimed at analyzing correlative interdependencies as well as the conditions in designing optimally profitable innovation portfolios. The survey focused on the identification of current deficits and needs for action in prioritizing and selecting R&D-projects at the early stages of the innovation process. The study tried to compare and validate the underlying questions and hypotheses in terms of the design of an EDP-based evaluation model for the innovation portfolio selection with the estimations of potential users. For this purpose, personal experience, assumptions and needs of potential users were recorded and evaluated. The structure of the survey participants according to trade and company size is shown in figure 2.

<table>
<thead>
<tr>
<th>Trade</th>
<th>Number of companies (n)</th>
<th>Share of answers (n/%)</th>
<th>Company size (in m. Euro)</th>
<th>Share of answers (n/%)</th>
<th>Company size (in Employees)</th>
<th>Share of answers (n/%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Mechanical Engineering</td>
<td>15</td>
<td>33</td>
<td>=1</td>
<td>0</td>
<td>=100</td>
<td>6</td>
</tr>
<tr>
<td>Plant Special Mechanical Engineering</td>
<td>8</td>
<td>13</td>
<td>1–3</td>
<td>3</td>
<td>100–250</td>
<td>13</td>
</tr>
<tr>
<td>Automotive Suppliers Industry</td>
<td>11</td>
<td>33</td>
<td>5–10</td>
<td>0</td>
<td>250–500</td>
<td>38</td>
</tr>
<tr>
<td>Electronics/Information Tech</td>
<td>7</td>
<td>15</td>
<td>50–100</td>
<td>17</td>
<td>500–1,000</td>
<td>17</td>
</tr>
<tr>
<td>Pharmaceuticals/Chemistry</td>
<td>3</td>
<td>8</td>
<td>500–5,000</td>
<td>17</td>
<td>5,000–10,000</td>
<td>13</td>
</tr>
<tr>
<td>Synthesis/Compounds</td>
<td>3</td>
<td>8</td>
<td>500–10,000</td>
<td>17</td>
<td>10,000–20,000</td>
<td>0</td>
</tr>
<tr>
<td>Paper/Pulp</td>
<td>2</td>
<td>4</td>
<td>=500</td>
<td>28</td>
<td>=10,000</td>
<td>0</td>
</tr>
<tr>
<td>TOTAL</td>
<td>47</td>
<td>100</td>
<td>TOTAL</td>
<td>100</td>
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</tbody>
</table>

Figure 2 Structure of surveyed participants by industry and size

For the analysis the questioned companies were divided into two groups: small and medium-sized enterprises (SME) and big enterprises (BE). Thereby, the different ways of management and problems of SMEs and BEs were meant to be identified and contrasted in the continuing analyses. As an EDP-based evaluation model for the innovation portfolio selection can only be used at a certain rate of innovation, the sales-related limit between
SMEs and BEs was shifted from the traditional level of 50 m. Euro to 100 m. Euro within the study. Thus the objects of investigation divided into N=26 SME and N=21 BE for the evaluation of the empirical findings.

3. Findings on innovation management

Besides human, time and financial resources further factors have an influence on the corporate innovation management, e.g. the corporate strategy, the customer demographics, the product and production technologies as well as the corporate culture. By the changing customer behavior, the growing saturation of the markets, accelerated technology cycles and an increasing globalization these factors have become more and more complex and demand the innovation management in a new way. In this respect, the decision makers in the companies have an increased demand of a flexibly and transparently designed innovation process as well as methods supporting them in the decision making process concerning the portfolio compilation (cf. Kuster, et. al. (2006), p. 26ff). To account for the effectiveness of innovation project portfolios, the following hypotheses were formed which had to be verified by the empirical survey:

- The available innovation budget determines the effectiveness of the innovation portfolio.
- The more complex the innovation environment, the more transparency and reliability of decisions in the innovation portfolio management is required.

3.1 General conditions for innovation management

On the basis of the analyzed results, the differing and common aspects of the innovation environment in SMEs and BEs are determined below. Another aspect was the identification of the complexity drivers in the innovation environment and the analysis of trends, success factors and restrictions companies face when designing their innovation management.

For characterizing the general conditions of innovation management, the criteria of employed time and financial resources in the innovation management of SMEs and BEs were empirically analyzed. The aim was to contrast the criteria value and to identify differing and common features. In the inquiry, the way of employing financial resources was found out by asking for the available innovation budget of a company. The following chart gives an overview of the innovation budget and the innovation employees in the queried companies.

![Figure 3 R&D-intensity of the queried SMEs and BEs](image-url)
SMEs spend with 5.6% on average a considerably larger innovation budget on their innovation management than the BEs do with 3.4%. One of the reasons for this innovation intensity being slightly above the German average is that all SMEs stating an innovation activity above average almost exclusively pursue the strategy of taking the innovative leadership. So taking into account the statement that the innovation intensity is characteristic for a company’s innovation activity, it can be concluded that in the larger part of the examined SMEs an effective innovation management is conducted.

Besides considering the innovation budget, the number of employees in the innovation management related to the total number of employees in the company was analyzed. The results from the empirical analysis have shown that in SMEs relatively more employees work in the innovation management than in BEs. In BEs 3% of the employees work in the innovation management on average, whereas the average of the SMEs is 9%. In an empirical survey on the development of small and medium-sized enterprises in Germany, the share of employees in the innovation management was precisely examined (cf. Bretz; Irsch; Lagemann (2008), p. 139ff). There it was differentiated between employees working in the innovation management full-time and merely part-time. This differentiation delivered the result that in SMEs the so-called innovation employees are not employed in the innovation management full-time in contrast to the BEs. Additionally, it has become obvious that not all SMEs have an institutionalized innovation management, what complicates a clear attribution of the human resource capacities to the innovation management.

The innovation type describes the new aspects contained in an innovation. Relying on the economics literature on innovation management, in this article it is differentiated between incremental and radical innovations (cf. Knack (2006), p. 66). Incremental innovations are innovations barely differing from current solutions, whereas radical innovations are completely new solutions. In the empirical analysis of the innovation types, it had to be clarified to which ratio the innovative performances of companies are divided into incremental and radical innovations. As it can be seen in figure 4, the analysis resulted in a ratio of 60 to 40 of incremental and radical innovations in SMEs. In BEs this ratio is 80 to 20. This result has indicated that SMEs attaching more importance to a high innovative performance create more radical innovations, which accounts for the relatively higher share of the sales volume by economically successful innovation projects.

![Figure 4](image_url)  
*Figure 4  Distribution of the innovation forms and types in SMEs and BEs*

Radical innovations are primarily generated in companies in which the corporate environment supports the employees’ creativity. Characteristics of an innovation friendly company are e.g. short decision making processes and simple hierarchical structures. In SMEs short decision making processes are more common than in BEs because of their smaller company size. This has a positive impact on the employees’ willingness to show initiative and be creative and therefore it supports their innovative activities (cf. Fueglistaller; Müller; Volery (2004), p. 104f).
Besides the differentiation of innovations regarding their types, the empirical analysis considered the forms of innovation appearing in the companies. The forms of innovations to be recorded are product, process and service innovations. The enterprises were asked to determine the distribution of innovation forms conducted in their company by percent. In the distribution of the innovation forms, no significant differences between SMEs and BEs can be detected (cf. figure 4). In both classes of enterprises, about two thirds of the generated innovations are product innovations and about one third is process innovations. This result accords with the distribution in product and process innovations described by Aschhoff, Doherr und Köhler (cf. Aschhoff; Doherr; Köhler (2008), p. 1ff). A further insight the result offers is that in SMEs service innovations form another considerable share of nearly 10%. It shows that SMEs see a future competitive advantage in the development of industrial services and the combination of these services with the immaterial performance programs to hybrid performance clusters respectively (cf. Wildemann (2008b), p. 1).

3.2 Contribution of innovation management to corporate success

Analyzing the companies’ innovative performance serves as an indicator in the survey, how the companies estimate their own innovative power compared to the one of their direct competitors. The analyses have shown that the most part of the queried companies have estimated themselves as “much better” or “slightly better” (cf. figure 5). In this, the SMEs act in a very self-confident way, as all asked SMEs declared that their innovative performance was better than the one of their direct competitors. By this statement of the SMEs as well, it becomes clear that the overall aim of the SMEs is achieving the innovative leadership in order to assert their market position. This corresponds with the declaration of those SMEs which frequently see themselves as innovative leaders in terms of their strategic orientation.

![Figure 5: Evaluation of one's own innovative performance](image-url)

To measure the effectiveness of innovation projects over the last business years of the companies, the number of successfully introduced innovations to the market compared to the number of initiated innovation projects was determined. It was examined in detail the number of conducted innovation projects, of registered patents, of technically and economically successful innovation projects as well as the share which the economically successful innovation projects have of the company or the department sales volume.

The data analysis has shown that BEs, by 86 conducted projects on average, initiate four times as many R&D-projects per year as SMEs (which initiate 21 projects).Remarkably, just 23 of the initiated projects of the BEs are economically successful, i.e. successful on the market, which equals a failure rate of 73%. In contrast to this, the failure rate of SMEs is only 19% (cf. figure 6). Thus four fifth of the R&D-projects, initiated by SMEs, result in successful market innovations.
The comparison between SMEs and BEs allows for the conclusion that there are basically different approaches in selecting and prioritizing R&D-projects. Whereas it can be assumed by the success rate of SMEs, that SMEs are already selecting the innovative ideas forcefully before initiating R&D-projects, the high failure rate of BEs indicates more flexibility in the innovation management, which offers the employees more room to realize new or varying methods. Thus in BEs, ideas with a lower market potential are admitted to the innovation portfolio and it is decided about their initiation not until a later stage of the process.

3.3 Trends, restrictions and success factors of the innovation management

The identification of the predominant trends which German enterprises encounter in the innovation management was another part of the empirical survey. Basically, eight fundamental influencing variables can be identified that were empirically analyzed in the inquiry according to their relevance to SMEs and BEs (cf. figure 7).
Both the executive managers of the SMEs and the BEs regarded the development from the traditional product supplier to a customized problem solving company as a challenge for the corporate-specific innovation management. SMEs primarily focus on meeting the growing customer demands, whereas BEs mainly endeavor to reduce total costs. Shortening product life cycles as well as the increasing competitive pressure are further trends having a strong impact on the innovation management of SMEs and BEs. These trends challenge the companies, regardless of their size, to design their innovation process in a lean and efficient way and therefore, to be able to quickly and economically generate new innovations. The increasing performance complexity, the utilization of external resources and the growing danger of plagiarism were estimated as important by both company types, but these factors play a minor role compared to the influences mentioned above. The insignificant differences between the evaluations of the trends in innovation management by BEs and SMEs have made the universality of the influencing factors clear. This finding can be supported by the economics literature, as well (cf. Arndt (2008), p. 17). However, the specific design of the innovation portfolio management with regard to the respective forms plays a decisive role in dealing with the influencing factors and thus, to be able to holistically optimize the success factors costs, time, quality and economic efficiency. Besides the trends, the restrictions determining the innovation process were identified in the empirical survey. The results in figure 8 show that the named restrictions are similarly relevant for SMEs and BEs.

Figure 8  Inhibiting factors influencing the innovation management in SMEs and BEs

The shortages of time and human resources are the determining restrictions in all queried companies. In BEs the lacking project prioritization follows, whereas in SMEs the shortage of financial resources was seen on the third rank of the influencing restrictions. SMEs estimate a lack of project prioritization as the fourth most important restriction. Furthermore, the “subjectivity of the project selection” was seen as an inhibiting factor by SMEs. Lacking evaluation competency, unclear responsibilities and insufficient qualification of employees are estimated as rather non-relevant restrictions by both SMEs and BEs. It can be assumed by these results that companies particularly need methods and concepts which allow for regulating the shortage of time, human and financial resources to avoid the waste of corporate resources and successfully design their innovation management. The empirical innovation studies that try to find out which factors influence the success of new solutions offer an overview of the success factors in the innovation management (cf. Papes (2006), p. 15ff). The corporate culture, the strategy and the operational and organizational structure of the innovation management were comprehensively named as success factors. On the contrary, it was assigned no or only few importance to the innovation portfolio management in general and to the evaluation of ideas in particular. In this respect the analysis of the empirical data especially focussed on the relevance of the named factors for German industrial enterprises.
The survey has shown that evaluating the innovation projects as well as adjusting the innovation strategy to the corporate strategy are important success factors for SMEs. This result corresponds with the finding gained from the analysis of the contribution to success that SMEs already try to select their innovative ideas at a very early stage of the innovation process (cf. figure 9). That the factor innovation as an element of the corporate strategy is much more relevant in SMEs than in BEs, may be explained by the smaller extent of the performance programs in SMEs by which changes in the performance portfolio directly affect the corporate strategy. In contrast to this, BEs prioritized lean and clear process structures and the complexity management in the innovation portfolio as success. This has clarified that especially the reduction and the reliable handling of complexity respectively are estimated as crucial factors for a successful innovation management by BEs. This fact can be explained by the main focus of BEs on costs, which has already been identified in the trend analysis. The slightly less importance of the complexity management in SMEs may be accounted for by the smaller number of R&D-projects in SMEs. By a growing number of projects the overall complexity of the project management increases as well, which bears challenges for BEs in particular. That the factor cross-functional team formation was evaluated as highly important, as well, has indicated the importance of this factor. So successful innovation projects have a cross-functional character, and the efficient cooperation of the different corporate departments is essential for the success of the innovation management. Being supported by the corporate management as well as clear responsibilities in the innovation process, were estimated as rather less relevant by both SMEs and BEs. This allows for the conclusion that both factors have already sufficiently been operationalized and have merely been a hygiene factor, regardless of the respective corporate size.

3.4 Context of justification of the hypotheses

Although BEs – absolutely seen – have a much higher innovation budget, it emerged that only one fourth of the launched innovation projects survive on the market. In contrast to this, SMEs manage that eight of ten conducted innovation projects become a market success, what is probably owed to the fact that SMEs primarily focus on their core competencies. Consequently, the hypothesis that “the available innovation budget determines the effectiveness of the innovation portfolio” has to be abandoned. The current and future challenges in the innovation management for both SMEs and BEs are significantly determined by increased customer demands, shortened product life cycles, the reorientation from products to problem solving services and last but not least by a growing competitive pressure. The increase in the complexity of the innovation environment connected with this fact has allowed justifying the hypothesis that “the more complex the innovation environment, the more transparency and reliability of decisions in the innovation portfolio management is required”. Considering that the shortages of time, financial and human resources were identified as the main deficits in the innovation management and that the creation of transparency was urgently demanded, this hypothesis can be considered as justified.
4. Findings on the evaluation of ideas and the innovation project selection

The economics literature names several criteria for evaluating innovation projects. There is broad consensus that numerous company-specific and external factors have to be considered in evaluating innovation projects. Criteria often mentioned in the literature are the competitive environment, market chances and legal conditions (cf. Aumayr (2006), p. 58). From a company-internal point of view efficiency aspects, technological, financial and personnel restrictions are named as important evaluation criteria (cf. Stern (2007), p. 181).

There are significant differences between radical and incremental innovations. Radical innovations create new procedures or product lines, whereby new markets emerge where companies have not been able to gain experience so far (cf. Krieger (2005), p 12). By the higher uncertainties typical of radical innovations, the need for comprehensively evaluating and reviewing this type of innovation within the innovation process increases (cf. Veryzer (1998), p. 317).

Considering the questions of company-specific conditions, it has to be analyzed which differences between SMEs and BEs there are. In the literature on innovation management it is often mentioned that especially SMEs are subject to temporal and financial restrictions. This influences their innovative ability within the resource-intensive innovation process. Thus it is necessary, especially for SMEs, to early identify the unpromising projects by continuous project evaluation. Only in doing this, “sunk-costs” for abandoned or unsuccessful projects can be avoided (cf. Schwarz (2004), p. 259). Thus, the following hypotheses could be specified for the questions formulated at the beginning of the article:

• Comprehensive company-internal and -external criteria catalogues have to be consulted in evaluating innovation projects.

• The higher the rate of radical innovations in a company, the more important is the application of methods for evaluating ideas.

• By a decreasing availability of resources, the necessity for regular and institutionalized prioritization and selection of R&D-projects rises.

To give reasons for the hypotheses, companies were questioned on their procedure, criteria and methods of evaluating ideas. The urgent need for action in this context becomes visible, as only half of the surveyed SMEs – in contrast to all questioned BEs – have gained experiences in evaluating innovation ideas by now.

4.1 Decision makers and the moment of evaluating ideas

By analyzing the survey, it was identified that the functional Research and Development division, due to its professional decision-making competency, as well as the management as the highest authority in the company are the essential decision makers in the process of evaluating ideas (cf. figure 10).

The integration of the functional Marketing/ Sales division in evaluating innovative ideas suggests that sales-specific aspects are very important for the evaluation. This assumption is taken up again in paragraph 4.2 “Criteria for evaluating ideas”, and is reviewed based on the answers of the surveyed companies.
The results of the evaluation concerning the relevance of the early stages of innovation for evaluating ideas show that especially the stage of “Generating ideas” is of major importance (cf. figure 11). All companies stated that the relevance of the stage “Generating ideas” is “high” or “very high” for evaluating ideas. Compared to generating ideas, the stages “Concept development” and “Concept adjustment” become less important. The high relevance of evaluating ideas at the beginning of the innovation process refers to the fact that costs for innovation projects are disproportionately growing during the process. Thus it is necessary to already avoid “sunk-costs” at the beginning of the innovation process, and to pursue promising ideas, only (cf. Zayer (2007), p. 58).

The fact that SMEs attach more importance especially to the phase of concept development than BEs indicates that these companies review their innovations more often than BEs do. This can be explained by the relatively high economic relevance of single innovations for the company success of SMEs in contrast to BEs. Only one third of the surveyed SMEs and BEs stated that the third phase “Concept development” is of importance for evaluating ideas. Despite the low intensity of evaluating ideas in the later stages of the innovation process, these results emphasize that the continuous evaluation of innovation concepts in the innovation process is considered necessary by the enterprises. In this context, the knowledge was gained as an implication for an EDP-based evaluation model for SMEs that an opportunity of evaluating the specific stages in the innovation process has to be allowed for.

![Figure 11 Importance of the stages of innovation for evaluating ideas](image)

### 4.2 Criteria for evaluating ideas

After having identified the decision makers in the innovation process and the importance of the respective steps of selection, the essential criteria for evaluating innovation projects have to be defined. At this, external and internal criteria are distinguished. The evaluation criteria are very important particularly with regard to developing an EDP-based evaluation model for innovation projects. They provide the basis for an effective innovation portfolio selection. The experts of the enterprises were asked to determine the importance of selected intra- and extra-corporate factors for evaluating ideas. Thereby, the internal factors were divided into “Strategy”, “Production”, “Procurement” and “Sales” (cf. figure 12). The extra-corporate factors could be classified as “Market”, “Competition”, “Legal aspects” and “Efficiency”.

It shows that sales figures are regarded as an important part of evaluating innovation projects. The evaluation criteria are even more important to SMEs than to BEs. It can be assumed that, due to the much broader sales networks of larger companies, reviewing sales competencies is a less relevant restriction for big enterprises. By contrast, SMEs have to develop sales cooperations, especially when applying new technologies, to be able to profit from a network of sufficient density and quality (cf. Sattles; Conrad (1997), p. 97).
The factors relevant to production are rated by SMEs as other important intra-corporate influences for evaluating innovative ideas. The average evaluation relevance of 4.3 for the influencing factors illustrates that reviewing the practicability of innovation projects by means of production-specific resource restrictions is an essential part of the project selection. BEs classify the importance of production factors merely a little less relevant. For both SMEs and BEs procurement-specific and strategy-specific factors are less relevant. SMEs regard the question about the necessity of procuring additional labor capacities only as important for project selection. It is also noticeable that strategic aspects are considered to be of little relevance. Just the contribution to achieving one's corporate objectives and the accordance with one's strategic orientation is important for SMEs.

**Figure 12  Relevance of intra-corporate criteria**

Considering the extra-corporate factors (cf. figure 13), it shows that both SMEs and BEs rate these as more important than the previously analyzed intra-corporate factors. The areas Market and Efficiency are the extra-corporate factors of highest importance. So the basic economic evaluation figures such as market volume, costs of realization and achievable price are included in evaluating innovation projects. Consequently, reviewing the competitive position is seen as relevant for the evaluation, as by realizing concrete competitive advantages distinguishing features can be developed and higher prices can be achieved on the market. Only legal aspects are seen as a little less important in evaluating innovation projects.

The data analysis illustrates that especially extra-corporate factors have to be considered in an evaluation model for project selection.

However, it has to be noted that assessing the criteria “Market” and “Efficiency” in a systematic evaluation is just possible by accepting some uncertainties (cf. Reinecke (2004), p. 311).
4.3 Methods for the innovation portfolio selection

After having discussed the criteria for evaluating ideas, in the next step the companies’ procedure of innovation project selection has to be outlined. In addition, it is analyzed afterwards which methods are applied in the process of selecting innovation projects. According to the results of the evaluation in figure 14, it can be said that, especially in SMEs, the selection of innovation projects is often a mere “gut decision” due to the scarcity of resources. This is particularly true for incremental innovations. In this context, BEs have already implemented standard procedures in functional divisions or company-widely defined methods respectively.

In both company classes, radical innovation projects are selected by company-widely defined methods, as in the event of failure serious economic consequences arise due to a high loss of capital and the waste of human resources.

For the concept of the EDP-based evaluation model, these findings imply that two different evaluation procedures for incremental and radical innovations have to be provided. The different features of the innovation types in terms of the technological and economic risks should be considered, too.
In the following, the methods are analyzed which the surveyed companies apply in selecting innovation projects. At this, it had to be discussed how important the questioned methods are for evaluating the innovation projects. In evaluating the methods application, the focus was on those companies that had already gained experience in evaluating ideas (50% of the questioned SMEs and all of the questioned BEs). In terms of the methods’ relevance, however, all surveyed companies were included in the evaluation. The objective was to gain knowledge concerning the integration of the relevant methods into the EDP-based evaluation model (cf. figure 15).

About half of the questioned SMEs and the BEs, that are already experienced in evaluating ideas, use mainly the cost-benefit-analysis and the Scoring-Model as instruments for the project selection. Irrespective of their application, both methods were ranked highly relevant by all questioned companies. Furthermore, the application of the portfolio analysis is especially significant in BEs, though both company categories classify it as an important method for the innovation project selection. The amortization calculation is used by about 40% of the SMEs and, accordingly, is of high relevance. The high level of application of these methods implies the necessity to integrate them into the EDP-based evaluation model.

The statements of the questioned companies on the relevance of the strengths-weaknesses-analysis (SWOT) are less clear. Though only used by one third of the companies, it is of highest relevance for SMEs. It can be derived from this that the analysis is not applied due to temporal restrictions and insufficient methodic knowledge. The integration of the SWOT-analysis into the EDP-based evaluation model supports to reduce these barriers and a more frequent use.

Furthermore, it is shown that the methods of the dynamic investment analysis, such as the real options analysis or the net present value analysis, are not or hardly considered both in application and in relevance in the analysed companies. This can be traced back to the difficulty of making valid statements about the return on investment in the distant future. Especially for radical innovations, both the market volume and the sales prices can scarcely be determined for sure (cf. Trossman et al. (2002), p. 23).

Figure 15  Methods of the innovation project selection

4.4 Problems in the innovation project selection

In the following, the problems in evaluating and selecting innovation projects are identified. They indicate in which areas of the selection process there is need for action.

The evaluations in figure 16 show that both SMEs and BEs see the main problems in the insufficient acquisition of information. At this, SMEs are dependent on universities and research institutes to get access to knowledge if they do not have extensive networks by collaboration with other companies (cf. Tintelnot et al. (1999), p. 38). Whereas big enterprises can use both external sources of information and substantial information from internal research departments which are often linked globally.
Further on, SMEs complain about the lack of proper evaluation instruments and about their decision makers’ lack of time. This suggests that a “gut decision” is preferred in SMEs to structured methods of project selection due to resource restrictions. The available methods in SMEs cause evaluation efforts which cannot be done with these companies’ capacities. Furthermore, especially BEs named the orientation of innovation projects towards short-term objectives as a problem in selecting innovation projects. SMEs and BE state that the premature evaluation of innovations by means of monetary criteria is an additional problem. This means for the EDP-based evaluation model that qualitative criteria have to be considered more intensely, especially at the beginning of the innovation process. Minor problems in the process of selecting projects result in an insufficient management of the responsibilities. For this, both BEs and SMEs seem to have clear definitions of the responsibilities. The specific estimation of risks appears to be secured in all companies according to the company data.

4.5 Context of justification of the hypotheses

Concerning the criteria of an EDP-based model for evaluating innovation projects, it is clear that not all criteria are of high importance. Of the extra-corporate criteria, especially the areas Market and Efficiency were ranked as important. From an intra-corporate perspective, the areas Sales and Production are highly important. Thus it has become clear that especially economic figures, such as achievable market prices, are of high relevance. Other soft features, as legal aspects and the area Strategy, were of little importance in comparison. Therefore the hypothesis that “comprehensive intra- and extra-corporate criteria catalogues have to be considered in evaluating innovation projects” can only partly be affirmed, namely in terms of the criteria evaluated as important.

The evaluations concerning the procedure in selecting innovation projects show the different approach of SMEs and BEs. The decision for or against incremental innovations in SMEs is mainly made based on “gut instinct”, whereas BEs have already implemented an idea evaluation procedure defined for functional divisions or company-wide. But it has been agreed on the fact that the innovation project selection of radical innovations has to be done using company-wide defined methods, as in the event of failure serious economic consequences arise due to high loss of capital and the waste of human resources. This finding strengthens the hypothesis “The higher the rate of radical innovations in a company, the more important is the application of methods for evaluating ideas.”
Though half of the surveyed SMEs have had no experience with systematically evaluating innovations yet, they agree on the importance in terms of the prioritization and selection of innovation projects.

Furthermore, it can be said that BEs, of which the total sample has already had experiences in evaluating innovations, name the simplification of the decision-making, the acceleration of the decision-making process and the objectification of the selection as a positive experience. Considering the scarce resources, the criteria do indicate a regular application and the implementation of an institutionalized application of an innovation portfolio selection. The hypothesis that “by the decreasing availability of resources, the necessity for regular and institutionalized prioritization and selection of R&D-projects rises” can be approved.

5 Findings on the design of an EDP-Based evaluation model for the innovation portfolio Selection

In the course of generating ideas, mostly, several solutions are proposed. The portfolio selection supports to decide which innovation projects are going to be realized in the end. In the context of project selection, basically three decision-making scenarios can be distinguished (cf. Rieck; Stark; Zimmermann (2006), p. 26). On the one hand, one has to decide about the accomplishment of single projects (single decision). On the other hand, only one of the different, mutually excluding projects has to be selected for realization (selective decision). The third decision concerns the problem to select several projects for realization out of a certain number of not mutually excluding projects (program decision).

Especially for the last of the points mentioned above, the question concerning the best of all solutions can only be answered sensibly if there are restrictions on the decision-making options. Such a case the economics literature defines as an optimization problem (cf. Nordmann (2002), p. 8) consisting of two main elements: the value to be optimized (target function) and restrictions. Usually, the Operations Research as a field of mathematics is used for solving optimization problems.

Electronic data processing plays a special role in solving optimization problems. Very complex problems can be solved in appropriate time by a continuous and still significant increase in efficiency regarding speed and the quantity of the processed data. The development of powerful and cost-effective computers as well as already today available software packages make solving optimization problems interesting even to those enterprises that abstained from selecting innovation portfolios by means of Operation Research so far. But it has to be considered that many users have a reserved attitude towards using formal-optimizing methods (cf. Beuermann; Ellinger; Leisten (2003), p. 6).

Regarding these developments and within the objectives and requirements on an EDP-based evaluation model for the innovation portfolio selection, two hypotheses could be derived that are eventually discussed after defining the objectives in selecting innovation portfolios as well as the requirements on and the features of the EDP-based evaluation model:

• The objective of the innovation portfolio selection is the design of a benefit-ideal and resource-protecting innovation portfolio.

• The structured collection of innovative ideas and the company-specific selection of evaluation criteria are basic conditions for an EDP-based evaluation model.

5.1 Objectives of the innovation portfolio selection

By an early identification of unrealizable ideas and of need for improvement, instruments for selecting innovation portfolios principally have to increase the amount of information within the selection process. The result of the innovation portfolio selection is, especially in SMEs, the combination of a multi-project portfolio aiming at increasing customer orientation and at an ideal benefit contribution to the enterprise. The latter agrees with findings of Leyendecker who, in this context, identified selecting and prioritizing innovation ideas for the purpose of the company’s success and value creation as an essential objective (cf. Leyendecker (2006), p. 80). Different from the objectives of SMEs, BEs aim at reducing complexity in the sense of the structured processing of information overload, besides the early identification of unrealizable ideas (cf. figure 17). The information overload results
from the large number of existing innovative ideas. Furthermore, BEs pursue an increased process stability in the selection process for the purpose of standardizing and simplifying cross-functional communication.

Figure 17 Objectives of the innovation portfolio selection

5.2 Requirements on an EDP-based evaluation model

Due to the findings that enterprises work often quite unsystematically when evaluating and selecting innovative ideas (as to that cf. Schmelzer (1992), p. 123), the analysis results were clustered in the three categories “Project initiation”, “Evaluating ideas” and “Portfolio optimization” for the purpose of structuring and later operationalizing the EDP-based evaluation model (cf. figure 18).

While in the project initiation the possibility of collecting and describing innovative ideas is focused on, the category “Evaluating ideas” comprises a comparative and factually accurate evaluation of these innovative ideas. The third category “Portfolio optimization” meets the requirements on an ideal combination of the multi-project portfolio.

The results of the category “Project initiation” agree with the previously accomplished analysis of the ratio of types and forms of innovation in the innovation management. As the majority of realized innovation projects in BEs consists of incremental innovations, their requirements on an EDP-based evaluation model has to focus on these types of innovation. SMEs have the same focus, but do not neglect demanding initiation possibilities for their considerable rate of radical innovations.

There is a wide consensus between SMEs and BEs on the need for initiation possibilities regarding the forms of innovation. In first line are product innovations, followed by process innovations and the opportunity to integrate service innovations into the evaluation model.
To consider the different levels of detail in evaluating ideas, it is useful to divide the evaluation criteria by the qualitative criteria “rough evaluation” and by the quantitative criteria “detailed evaluation”. The adjusting to the corporate strategy and the adjusting to budget and risk evaluation are part of the category of rough evaluation, whereas the detailed evaluation consists of the cost estimation and value contribution analysis.

The criteria of the rough evaluation attend to the objectives of an early identification of unrealizable ideas respectively of need for improvement. Risk evaluation of innovative ideas plays a major role for both company groups and, according to Amelingmeyer, serves as an indicator for the early recognition of promising innovations, too (cf. Amelingmeyer et al. (2002), p. 215). Congruent to the success factors of the innovation management, SMEs additionally demand for the possibility to be able to adjust innovative ideas to the corporate strategy, especially as, according to Huber et al. (cf. Huber et al. (2006), p. 29), more and more “strategic” innovation projects are initiated for implementing the corporate strategy.

The criteria of the detailed evaluation consider the evaluation of innovative ideas by temporal, personnel and financial aspects. An essential indicator for this is the adjusting of implementation efforts of innovative ideas to available resources that were previously identified as significant restrictions in innovation management for both SMEs and BEs. Cost estimation, as another important aspect, is closely followed by the value contribution analysis in SMEs. Though Glaschek found out in an empirical study that financial aspects are most important for selecting projects in both SMEs and BEs, according to the results of the evaluation, BEs consider the value contribution analysis to be highly important, but rate that feature lower than SMEs in the requirement ranking due to the different objectives in the innovation portfolio selection.

The subject of the category “Portfolio optimization” is the creation of transparency in both single projects and multi-project management as a basis for deciding on the approval of innovation projects and for selecting adequate innovation portfolios. At this, it is especially important to create an optimum between the conflicting priorities of available resources and maximum benefit contribution. The criteria of the previous category of “Evaluating ideas” serve as input data. These practical requirements are also affirmed by the theoretical side in the literature on innovation management where instruments are demanded again and again that allow transparency about different ideas and the selection of single projects as well as of multi-projects (as to that cf. Rüdrich (2006), p. 94).
5.3 Features of an EDP-based evaluation model

After having determined the essential requirements on an EDP-based evaluation model, the survey results are evaluated in terms of features implemented in the EDP-based evaluation model for the innovation portfolio selection.

The classification of the features in “No relevance”, “Basic feature”, “Performance feature” and Excitement feature” is based on the Kano model to explain the interrelations between features and satisfaction of potential users (cf. Bailom; Matzler (2004), p. 263 f.).

Features with no relevance are those features that are irrelevant to potential users both when existent or absent. Therefore, they cannot bring satisfaction and do not lead to dissatisfaction either. In the following, not one of the features was in this category.

Basic features in this context are considered as those performance components that are presupposed by the potential users of the EDP-based evaluation model. Performance features, however, play a more important role in bringing satisfaction, as these features allow a direct comparison with already existing solutions. Performance features are expected and explicitly demanded by potential users. Excitement features contribute to an essential additional benefit. Those features that have not been integrated in existing evaluation models so far, but do have a disproportionately strong influence on the satisfaction of potential users of an evaluation model for selecting innovation portfolios, are defined as excitement features.

As EDP-applications are often overengineered without considering concrete requirements of potential users, the intuitive user guidance for simply navigating in the EDP-based evaluation model is regarded as a basic feature by both SMEs and BEs (cf. figure 19). Therefore, an important success criterion for accepting the EDP-based evaluation model is the design of a simple and easy-to-handle user interface – even in consideration of the complexity of the applications as a negative feature in evaluating ideas, as mentioned before. The feature of the situation-specific selection of evaluation criteria is viewed as basic feature, too, due to the variety of innovative ideas.

The gradual evaluation respectively the single evaluation of innovative ideas was identified as an essential performance feature. Furthermore, the saving of ideas for currently unrealizable projects is expected. SMEs
consider the situation-specific selection of evaluation criteria as performance feature. Due to the difficulty of selecting the ideal innovation portfolio out of the numerous innovative ideas in consideration of the restrictive conditions, prioritizing innovative ideas by benefit contribution, considering restrictions and visualizing the innovation portfolio are regarded as excitement features. These are features contributing to benefit; the integration of those features into the evaluation model allows a distinction towards already existing models. Furthermore, they are prerequisites for operationalizing the previously determined requirements to an EDP-based evaluation model.

5.4 Context of justification of the hypotheses

The main objectives in selecting innovation portfolios differ between SMEs and BEs. Especially in SMEs, increasing customer satisfaction is of the highest priority and benefits in the enterprise are to be optimized by ideally compiling a multi-project portfolio, whereas BEs hope for complexity reduction, standardization and improved communication in the selection process. Compiling the ideal multi-project portfolio is of high importance to SMEs, but plays a minor role compared to the previously mentioned criteria. Therefore, the hypothesis that "the objective of the innovation portfolio selection is the design of a benefit-ideal and resource-protecting innovation portfolio" can be affirmed for SMEs only.

Prerequisites for accepting and applying an EDP-based evaluation model are the intuitive user guidance as well as the situation-specific selection of evaluation criteria, besides the structured collection of innovative ideas. In addition, the functionalities classified by the enterprises as excitement features are of high importance for developing an EDP-based evaluation model. Prioritizing ideas by benefit contribution, considering restrictions and visualizing innovation portfolios were explicitly named in this context. The findings named previously show that the hypothesis that "the structured collection of innovative ideas as well as the company-specific selection of evaluation criteria are basic conditions for an EDP-based evaluation model" can be affirmed.

6 Summary and possible solutions

The Implementation of ideas in products and processes which is personally conceived as new by the potential users or vendors, means progress to the companies and brings variation to the markets. Therefore, innovation as an enabler of economic growth is of special importance in our society. The relevance of innovations for the competitiveness of companies is uncontradicted. Innovations lead to renewing corporate structure, to new business fields, new forms of organization as well as processes, and advance growth extremely necessary for success.

The apparently high importance of innovations for the company success is confronted with a not negligible number of failures. Responsible persons as well face the challenge of deciding on which ideas from the variety of potential innovative ideas are to be pursued and what priority to give them. In that context it could be shown that often practical evaluation models are missing, allowing conclusions about the prospective success contribution of certain innovation projects and thus enabling to compare different innovative projects. Furthermore, it lacks options to select the innovation portfolio with the highest benefit contribution for the company in consideration of the company-specific restrictions. But those evaluation models are especially important at the early stages of the innovation process as corrections can be made here without considerable expenditures, and unpromising projects can be abandoned without phenomena as “sunk-costs” affecting continuation.

The findings identified in the study were used as implications for the development of an EDP-based evaluation model. It can be said that the amount of capital locked up due to the implementation of innovative ideas as well as the number of involved human resources increase the requirements on an evaluation model for the innovation portfolio selection. Therefore, it is important to prioritize the large number of innovative ideas to eventually select the “right” innovation portfolio in the sense of benefit optimization.

Following the previously clustered requirements, the implementation of the EDP-based evaluation model is based on a three-step model. Its structure is illustrated in the following figure 20.
Within the project initiation depicted in the evaluation model, the planned innovations are characterized explicitly by a transparent project structure with standard innovation profiles. The innovation profile allows the characterization of the planned innovation by means of qualitative input fields for illustrating descriptions on problems, benefits and solutions, and assigns every project a distinct project key. Furthermore, the innovation projects are classified specifically according to demand as well as existing implementation risks and expected objectives are determined. The EDP-based evaluation model enables the users to differentiate incremental and radical product, process and service innovations.

The module “Evaluating ideas” contains the strategic, technological and market-related pre-evaluation of future innovation projects by means of company-specifically configurable K.O.-criteria as well as a qualitative rough evaluation of influencing figures to estimate chances, benefits and risks. The strategic pre-evaluation is a so called “Quality Gate” by which, depending on the evaluation results, innovation projects are sorted out, delayed or brought to the next step of the “Concept development”. In the “Concept development”, ideas positively evaluated in the rough evaluation are quantified by means of performance-related and financial indicators. In doing so, the concept state is gradually recorded considering the factors costs, time, quality and efficiency. For determining the success potential, relevant data are questioned by standard input masks and evaluated on a compact information level using a decision-making cockpit. The decision-making cockpit contains graphical evaluations for single evaluation criteria of the R&D-projects and is the basis for the second Quality Gate. Ideas not meeting the previously defined minimum requirements of the concept development are sorted out in this step and cannot be brought automatically to the stage of “Benefit optimization” of the project portfolio.

The module of Portfolio optimization comprises the compilation of multi-project portfolios ideal for benefit. Considering company-specific restrictions, an ideal portfolio is identified by using linear optimization logic within the Operations Research. The portfolio determines the maximum benefit attainable from all processed innovative ideas by considering the given conditions. Beside the insights for the development of a computer based evaluation model described above, further insights for an innovation management can be extracted from the survey which could be scrutinized more deeply in future research activities. For example the comparison between the market success of innovations of SMEs and big businesses has revealed a market success rate of big business innovation projects of about one quarter. Despite having a significantly lower budget for innovation projects in absolute terms, SMEs achieve a market success rate of about eighty percent. Hence it seems that the available budget for innovation projects today is no significant determinant for the effectiveness of innovations. This finding raises the question how the budget for innovation projects can be used effectively in the future and where are the differences between SMEs and big businesses in this regard?

Furthermore it could be discovered that the frequently discussed Real Options Analysis (cf. Schwarz; Trigeorgis (2004) for the selection of innovation projects is scarcely used in companies. Wether this is due to the application’s complexity or possible other reasons should be subject of further research activities. In the context may be examined which measures are to be taken in order to implement the method of Real Options Analysis successfully in the companies.
References


