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AN APPROACH TO SUPPORT THE SELECTION OF CUSTOMER INTEGRATION METHODS IN NEW PRODUCT DEVELOPMENT

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1. Introduction

1.1 Background

Since the late 1980s, a lot of research was done that proves the effectiveness of customer integration (CI) in new product development [Reichwald 2007]. Nevertheless, our research work indicates that most innovation projects (at least in Germany's producing industry) are conducted in the absence of customers for different reasons. This gap between the proven effectiveness and the negligence of customer integration in product developers' daily business encouraged the German Ministry for Education and Research to initiate the research project AKINET (Active Customer Integration in Innovation Networks). The project goal of AKINET is a guideline that supports small and medium sized enterprises in integrating customers, or stakeholders in general, in new product development (NPD) processes. Basically, the project's research questions can be clustered in three groups: (1) Who should be integrated, (2) when, i.e. in which NPD process phase should this integration take place and (3) how, i.e. by which means can this integration be supported? The first two clusters of questions have already been subject of research in the project years 2008 and 2009; some of the results have already been published by the authors (e.g. [Kirschner 2009]). The third cluster of questions with the subject of supporting means was worked on in the second half of 2009. In this paper, we want to give insights into the first results on this topic, after having clarified some important concepts of our project in the following section.

1.2 The project view of innovation networks

In the following, we will use the term Customer Integration (CI) Methods, as most of our data focuses on customers. Nevertheless, an expansion to the broader focus of Stakeholder Integration ([Abras 2004] and [Preece 2002]) methods is already part of our research project but not subject of this contribution. As depicted in Figure 1, the innovation network consists of two distinct “process roadmaps”, merely connected by the pivotal product. The left roadmap represents the branched NPD process with all its dependent supplier processes and with the product as its result. The right roadmap models one, or in the most cases more than one so called application processes, where the product is applied in the intended or an unexpected way. Both of the process charts include their own stakeholders that influence these processes. Additionally, the figure represents some specific interlinking stakeholders that influence both processes at the same time.
These interlinking stakeholders do not necessarily have to be customers of the final product retailing company but they have strong direct or indirect influence on both process roadmaps. As an example,

this role could be illustrated with legislative authorities that on the one hand give restrictions in the development of car seat belts, and on the other hand regulate the use of these items in the application process.

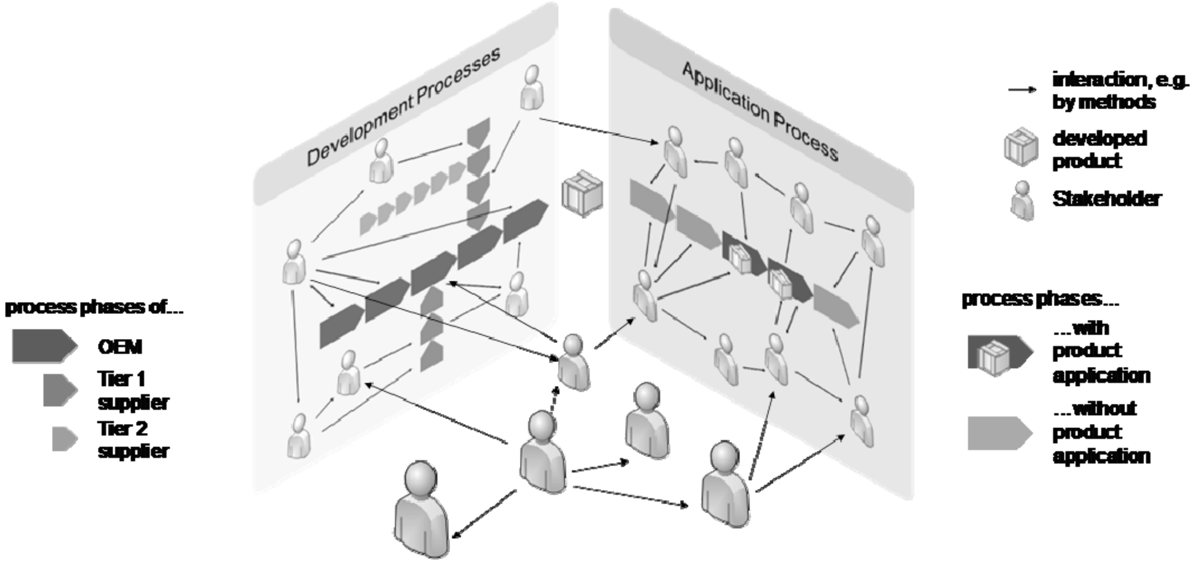

Figure 1. Stakeholders in an innovation network, partially interacting through CI methods

The results of our studies in different innovation networks indicate that the interactions (e.g. influencing other stakeholder's actions) between the stakeholders often base on hierarchical relations and/or on informal networks without a real need for knowledge transfer. As mentioned in chapter 1.1, one important part of the project is the identification of means that allow for the active integration of the identified stakeholders (or “knowledge carriers”) into NPD processes. In this context, “active” means that the knowledge transfer is initiated by the process owner of the root development process, in the example of Figure 1 this would be the OEM (Original Equipment Manufacturer).

Now, this process owner needs a set of means that support the integration of external knowledge, and, even more important, he or she needs a selection guideline that supports the identification of the best fitting means or method. CI research of the past two decades produced a multitude of methods that differ in various criteria, such as the number of integrated customers (or users in most cases), the necessary resources in money and time, the current phase in the NPD process etc. Nevertheless, very little attention has been paid on the development of an approach to identify the best fitting method for specific cases. In the following chapter, we will present the state of the art in this context.

2. State of the art and challenges of method selection

2.1 Taxonomy of CI methods

To be able to select the best fitting method for a specific situation, the criteria to be optimized of both the method itself and the situation have to be specified before. This requires a well defined taxonomy of methods. The main purpose of CI methods is the support of product development processes in order to increase the innovativeness of the results. Thus, taxonomy of CI methods can be transferred from established models such as the Process-oriented Method Model for product development proposed by [Birkhofer 2002]. This model differentiates methods by a set of criteria: general conditions, user characteristics, working aids and hints, as depicted in Figure 2.

Based on this model, [Reinicke 2004] developed a taxonomy model with the focus on integration methods. She detailed the *general conditions* with nine aspects: (1) Instrument class, e.g. philosophy, method, approach, tool, (2) data process level: data acquisition, data analysis etc., (3) detailed description, (4) field of application, (5) development status of the product (similar to [Bretschneider 2009]), (6) duration of the method, (7) place of application, e.g. field or laboratory, (8) preparation efforts and finally (9) the produced costs.

Further on, she detailed Birkhofer's *user* class with six aspects: (1) integration possibility/demand, (2) type of integration (active or passive), (3) necessary user attributes, (4) necessary product experience, (5) number of participants, and (6) necessary method experience of participant.
The other classes such as *input*, *output*, *working aids* and *hints* (Figure 2) do not have to be detailed for CI method classification purposes according to [Reinicke 2004].
This comprehensive taxonomy allows a very detailed classification of CI methods; however it lacks of a model that supports the selection of the "right", i.e. optimal method for a specific case regarding the stakeholder characteristics.

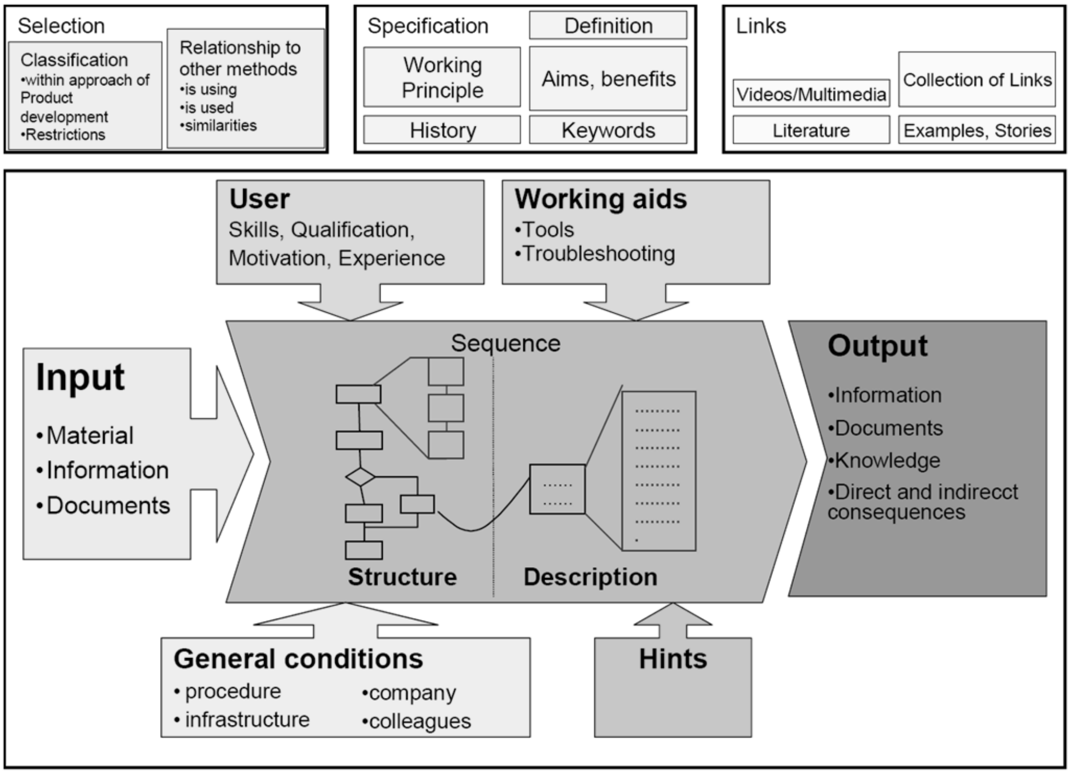

Figure 2. Process-oriented Method Model for product development [Birkhofer 2002]

2.2 Typical CI methods

During our data collection (see chapter 3.1), the following CI methods were mentioned frequently. This specific set of methods will also illustrate our results. Thus, we present the main characteristics of these methods in the following to allow a critical reflection on the results. For a more detailed insight and for a complete method list see e.g. [Bretschneider 2009].

QFD – Quality Function Deployment

According to [Akao 1994], QFD is a method to transform user demands into design quality, to deploy the functions forming quality, and to deploy methods for achieving the design quality into subsystems and component parts, and ultimately to specific elements of the manufacturing process.

Participant Observation

Following the sociological definition of Participant Observation, its aim is to gain a close familiarity with a group of individuals and their practices in their natural environment, i.e. interacting with their familiar products. Thus, from the product developer's view, this CI method allows deep insights into the actual product use. One of the main problems in this context is the selection of the appropriate users to observe. In order to increase the product's innovativeness, the "leading users" have to be observed, which finally leads to the Lead User Method (see below).

Toolkit Approach

With the help of web-based tools, this approach builds the interface between manufacturers and customers [Franke 2004]. The core idea is to outsource the task of designing new products to users by equipping them with a toolkit which enables them to convert their ideas into individual products. These toolkits allow trial-and-error experimentation and deliver immediate (simulated) feedback on the potential outcome of design ideas.

Ideas Competition

According to [Walcher 2007], an ideas competition is the invitation of a private or public organizer to a general public or a targeted group to submit contributions to a certain topic within a given timeframe. An idea reviewers committee evaluates these contributions and selects the rewarded winner(s).

Lead User Approach

Lead Users as defined by [Von Hippel 1988] characterize themselves by (1) perceiving needs before the mass market, and (2) expecting a high benefit by fulfilling their needs. Additionally Lead Users are (3) able to transform their needs into solutions by their own skills. By their anticipation of needs and their ability to prototype, Lead Users enrich NPD processes significantly. A systematic approach supports the identification of Lead Users taking into account requirements and resources of the specific situation. Nevertheless a lot of research focuses on detailing the method in order to ease the use.

Crowdsourcing methods

Crowdsourcing is a distributed problem-solving model. Problems are broadcast to an unknown group of solvers in the form of an open or partially open call for solutions. Users typically form online communities, and the crowd submits solutions. A typical example is the so called Pico Job method. This method uses very small tasks that are derived from the product and service development process and are processed by a large crowd of stakeholders (consumers, customers, users etc.) via the internet. The single stakeholder typically responds to 1-5 qualitative questions. This method can be applied throughout the whole product development process.

2.3 Approaches to select methods for specific situations

Various models exist that cluster CI methods along the NPD process in order to ease the selection of appropriate methods. An overview is given by [Bretschneider 2009], who matches popular CI methods with three stages of process phases, as represented in Figure 3.

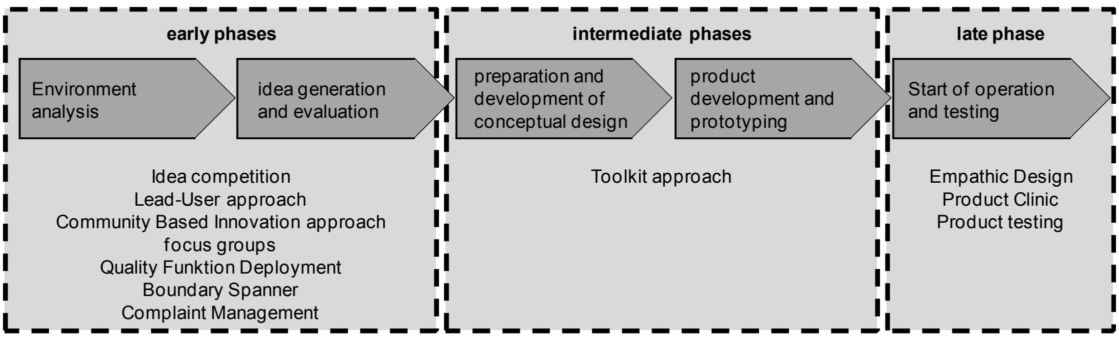

Figure 3. Matching CI methods with process phases [Bretschneider 2009]

Apart from these well established process phase based approaches, our study results revealed a lack of other formalized selection approaches that are applied in industrial business. As most of the CI method projects are accompanied by external consultancies, the selection of the method to apply is their task. In these cases, the consultancies select the best fitting method from their portfolio, which in some cases might not be the optimal method from a comprehensive view. Of course, the selection bases on

and is influenced by specific project characteristics such as technical or strategic project goals, available resources in time and money, available pool of possible stakeholders to integrate, degree of confidentiality of the project etc. Nevertheless, this selection relies on the experience and the implicit knowledge of the involved method consultants, who might be influenced by economic interests. In other cases, and especially in larger companies that have own method departments, a restricted set of integration methods is known and therefore applied on most NPD projects that could benefit from external knowledge input. As a result, some of the stakeholder integration efforts do not generate the aspired positive effects and in consequence, the involved project managers underestimate the potentials of CI methods in future projects.
We could not identify a satisfying approach which uses stakeholder related characteristics for the selection of CI methods and thus considers the appropriateness of methods in this regard.

3. Research Design

The described challenges led to the following research question:

> *What set of stakeholder related characteristics (and not of company, product, process etc) is necessary to select the appropriate integration methods?*

As the research field of CI method characterization is very new, we chose a theory-building approach grounded in the context of rich data. In this sense, our approach is an inductive method that draws theory from a set of case studies, well described in management studies such as [Eisenhardt 1989]. Our procedure to derive theory from qualitative data relied on established grounded theory principles [Glaser and Strauss 1998], where the first step is the data collection.

3.1 Data collection

The data in our study results from primary sources. The characteristics of the different sources will be detailed in the following.

Interviews

In 2008 and 2009, the authors conducted 34 interviews in different industries: service (10), products (21) and buildings (3). The companies selected for this study are commonly known as innovative and in some cases even experienced in customer integration. The sample consists of 25 interviewees in their function as project leaders of recently finished innovation projects. They were in different hierarchical positions: project managers, top managers and executives. Interviews ranged from 60-120 minutes and were tape recorded for analysis and documentation purposes. 44% of the analyzed projects dealt with customer-specific product development orders, the remaining 56% aimed at mass products or at least products for several customers.
To gather information about who was involved at which time in the innovation process by means of which integration method, we used an interview technique allowing for a considerable amount of temporal und relational complexity. A quantitative method would not be appropriate as it cannot display this temporal and relational complexity. Thus, we used the Timeline Technique (see [Wastian 2008] and [Wastian & Schneider 2005]). This method allows for getting started in a structured way but also for the interviewee to narrate the story of one specific project in a non-constrained, open manner. This helps to get a deep understanding of how the project proceeded, which were the critical events, who was involved in the process at which time and in the case of applied customer integration methods, the selection criteria of one specific method.

Innovation process observations

In order to obtain an even more detailed information basis about customer integration in innovation processes as it is possible by conducting retrospective interviews, the authors observed two ongoing projects for at least a 6-months period.
The first product development project took place at a tool manufacturer in Southern Germany from 4/2009 to 10/2009. Three of the authors were present at important milestone meetings, such as the project kickoff, the requirement definition meeting or the final presentation. The involved team

members, both from the company and the university, filled out a weekly online questionnaire that asked qualitative questions concerning e.g. newly involved stakeholders of the past week and quantitative questions such as personal satisfaction with the project progress marked on a scale. Thus, a rich data basis was collected to model the 6-months innovation project and, among others, the stakeholder involvement in the course of the project.

The second observed product development project was initiated by a Munich based start-up. After having won an important business plan contest, they had to redesign their core product within one year to fit the market needs. During this process, they allowed the authors to conduct an observation as described above, i.e. with online questionnaires, invitations to important milestone meetings and insights into their business decisions that were based on stakeholder needs and input.

Workshop

The authors analyzed the data obtained from the interviews and the two 6-months-observations so that in June 2009, first insights and hypotheses could be validated in an workshop with 12 participants from Germany and Austria. Participants represented both academia and consultancies with the focus on experts in customer integration methods research and application. During the workshop, the experts worked in three groups on a problem that emerged from one of the company observations. The three groups represented (1) a five-person start up with limited budget, (2) an international airport trying to improve the comfort of their own waiting area but without ambitions of exploring new business fields and finally (3) an airline. In a first session, the groups were asked to outline a NPD process that leads to an “innovative product that allows reposing when waiting at airports”. In a second session, the group members were rearranged and then were asked to sabotage the NPD process of the predecessor group by subversively changing parameters of CI methods.

They were explicitly assigned to use customer integration methods where possible and viable. Additionally, they were asked to explore and document the method selection criteria and, in the second session, the critical influences that lead to method failure.

The small group phases were tape recorded, the final result presentation and discussion phases were videotaped.

3.2 Data Analysis

We transferred the audio taped interviews to transcripts; together with the timeline graphs this was the basis for further data analysis. In a first step, we identified 233 critical incidents (i.e. project related incidents that affect the innovation success) according to the timeline graph. These critical incidents were then categorized in order to decrease data complexity. Beside this, we collected all applied CI methods and all mentioned innovation network stakeholders, and, in the case of the stakeholders, categorized them.

The data from the two innovation process observations was consolidated into two reports that included all relevant comments from the weekly online questionnaire together with “temperature charts” reflecting the 6-months-development of personal satisfaction and project progress.

Concerning the workshop data, we applied a six-step analysis pattern to match (1) the phase of the development process with (2) its direct results, (3) the applied CI methods within, (4) the involved stakeholders, (5) hints for method application and finally, (6) disadvantageous conditions that would lead to failed method applications in the described situation.

4. Results

4.1 Singular results

Interviews

Concerning the research question, the data obtained from the interviews had limited value. This is because the number of described CI methods was very low with only 2 cases. Additionally, the interviewees in these cases could not name explicit stakeholder related characteristics that led to the method applications. Nevertheless, some interviewees mentioned stakeholder related reasons that inhibited their integration. The following original statement indicates that there might be the fear of influencing the customer's view of the company in a negative way: "(...) our customers should not know that we try to improve this (...), as it is seen as one of our core competencies (...)". In another case, the interviewee mentioned the gap between the necessary and the available expertise of possible stakeholders as integration barrier: "(...) our specialists work hard on (...) for several years. I don't think that our customers could help us on a technical level in this (...)". Another interviewee mentioned confidentiality aspects as obstacles: "This was a secret project. Every integrated external stakeholder could provide our competitors with this information". Accordingly, (1) the need for CI methods in secret projects and (2) the need to estimate the necessary and the available expertise of possible stakeholders appear to be important criteria for integrating customers in NPD.

Innovation process observations

The above mentioned integration obstacles concerning confidential aspects could also be observed in the ongoing project of the tool manufacturer. Additionally, the project manager raised concerns that the integration of a large number of stakeholders could increase the project complexity and as a result increase the project costs.

In the case of the start-up, however, the confidential aspects did not play a major role, nor did the number of stakeholders involved. On the contrary, they recognized the potential of integrating a large number of customers and tried to combine integration methods with marketing methods.

Combining the results of the two observation cases, the identified stakeholder related characteristics were (1) different levels of information confidentiality that can be communicated and (2) the number of stakeholders to be integrated.

Workshop

The analysis of the workshop results revealed the expected rich insights. As all of the participants were deeply involved in the topic of stakeholder integration, and as they were explicitly asked to document their decisions for or against the use of certain methods, the obtained data could serve as sound validation data for the combined results.

4.2 Combined results concerning the research question

The different data sources delivered some consistent information concerning the research question. As important stakeholder characteristics we could identify: (1) the total number of stakeholders to be integrated, (2) the expertise of these stakeholders concerning the product to be improved and (3) the extent of confident information that the involved stakeholders might receive without harming the project and/or the company.

In order to answer our research question, we combined these findings in a consistent model according to the principles presented in the research design part. Thus, we made the following assumptions:

1) The resultant product of a stakeholder integration method application depends on
    a. the expertise of the involved stakeholders and
    b. the quality of the questions asked with respect to the information obtained
2) When applying formalized methods, the quality of the questions asked are assumed to be "optimal". In this case, the resultant product quality depends only on the expertise.
3) The knowledge of all involved stakeholders shows in a certain extent a cumulative behaviour.
4) The optimal solution for a given problem can be obtained by involving the (theoretically existent) Lead-User according to [von Hippel 1988]. An increased solution quality is not possible.

These assumptions can be combined in a graph with the dimensions of the identified important stakeholder characteristics, as shown in Figure 4. Based on the data of our study we assumed that a logarithmical scale of involved stakeholders is appropriate to represent its effects on other factors.

In Figure 4, the dotted lines symbolize a suboptimal resulting product, which can be either achieved by integrating one stakeholder with a suboptimal expertise or by integrating various stakeholders with an even lower expertise. The solid line marks the border where an integration of more stakeholders or stakeholders with a higher expertise does not make sense, as the defined optimum cannot be surpassed. For example, integrating 10 experts on a topic would not increase the result quality in comparison to the integration of just one expert.

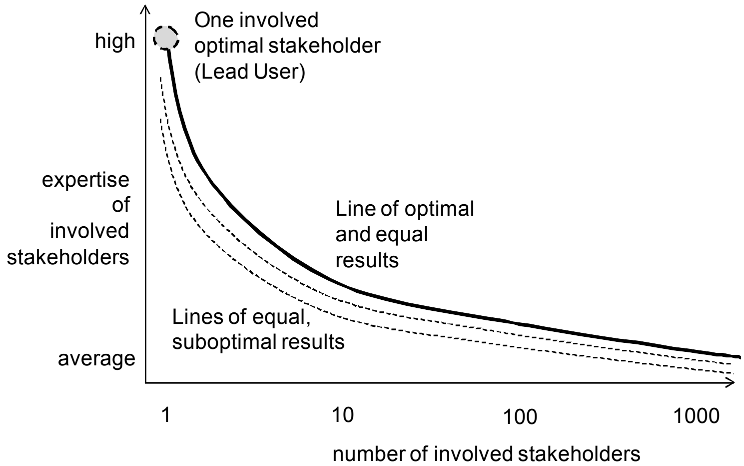

Figure 4. Model of result quality as a function of expertise and number of stakeholders

In the next step, we located the typical CI methods in this figure to facilitate the method selection and to validate our model. Figure 5 presents this first rough localization, derived from the described data basis of our study. It seems plausible that these methods do not pass the line of optimal and equal results, as the efforts would increase and the quality remains constant.

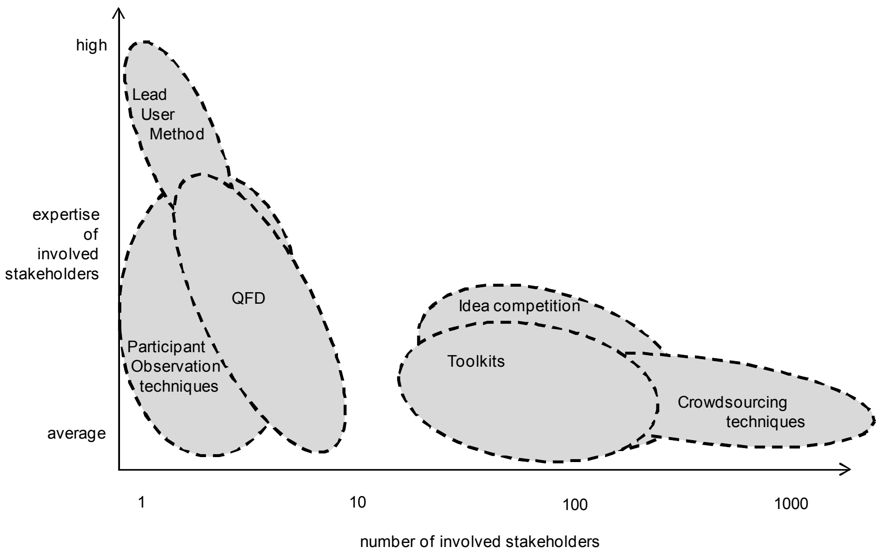

Figure 5. Estimation of some method's necessary expertise and number of involved stakeholders, based on our study's data

Figure 6 demonstrates an exemplary application of our decision supporting model. As first input factor we chose the expertise estimation of the stakeholders to integrate. The resulting intersection point with the line of optimal results indicates (a) the recommended CI methods and (b) the number of stakeholders to be integrated. These outputs have to be seen as very rough orientational values as they base on very tight assumptions and on a – still – weak data basis. Of course, the model can be combined with more than one input factors, as our second example in Figure 6 proves. There, the available stakeholders are strictly limited to five, which might be caused e.g. by confidentiality reasons. In this case, (a) the recommended CI methods change to *QFD* and *Participant Observation* and additionally (b) the result quality drops.

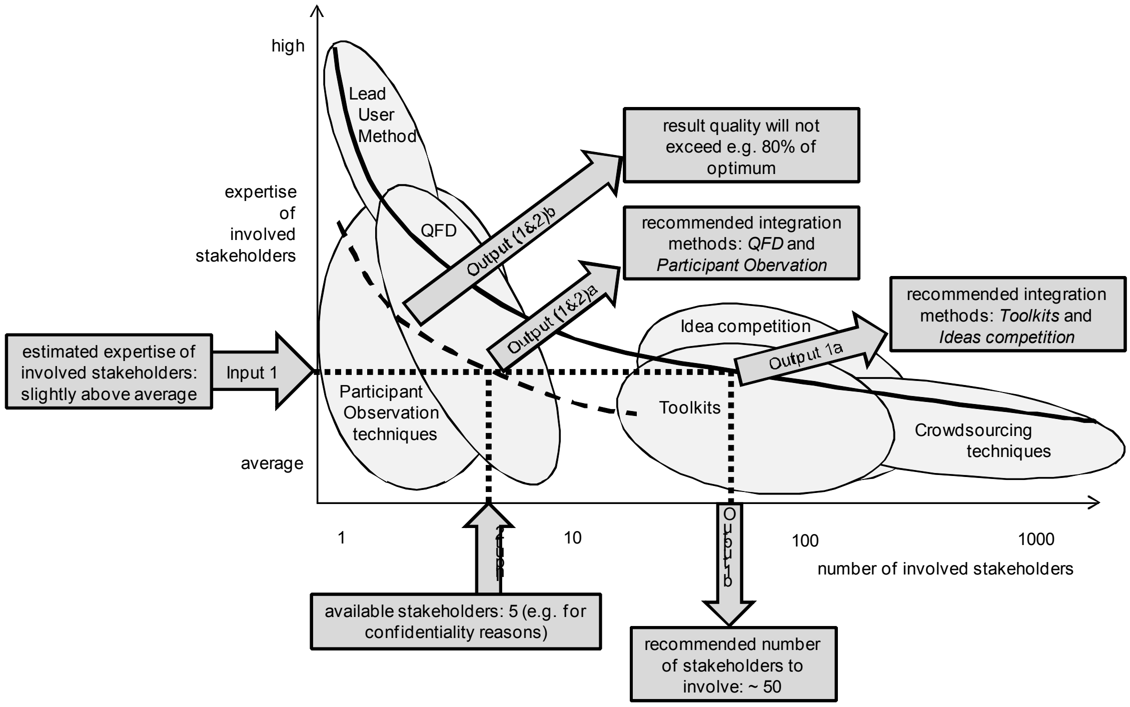

Figure 6. Exemplary application of our model (Two examples: *Input 1* and *Input 2*. Corresponding results marked as *Output*)

5. Discussion and interpretation

As already indicated before, our model bases on extremely simplified relations between the main factors. In addition, the method map as depicted in Figure 5 bases on a relatively thin data basis and needs to be complemented by a complete list of all known CI methods and their position in the map. The values of the identified characteristics have to be validated in further research, be it observations of real integration projects or interviews of past projects. Hence, all results have to be understood as cursory values that require a sound analysis in individual cases. Nevertheless, this model provides a deeper understanding of the factor's relations and with this it makes method selection easier especially for inexperienced method users.

Another important finding that can be derived from the model is the independency between the number of involved stakeholders and the required resources for the company. The interviewees of our study tended to refuse the application of high-number-involving methods as they presumed these to produce higher costs.

6. Conclusion and outlook

In order to allow industrial application and to proof the scientific coherence of our model, various tasks have to be studied in the near future:

1. The model still lacks of a comprehensive definition of the blurry term "expertise". Furthermore it is unclear who will classify the expertise of stakeholders.
2. A consistent integration of confidentiality aspects is still missing in the model, even though our study results indicated that there is a strong need to address this topic from the industrial viewpoint.
3. Other characteristics, e.g. as introduced by [Reinicke 2004] might play an even more decisive role than those identified in our study as they might be easier to quantify. Further research has to prove or disprove our proposed selection of characteristics.

In order to enrich our data basis and to successively complement the list of applied CI methods, the team of the research project AKINET currently works on the development of the interactive web portal www.innogratar.com. The structure of the online database will build on the proposed model of this contribution. Thus, every authorized user of the portal will be able to enrich the data basis with his or her experiences and case studies of CI projects. Moreover, it will be possible to characterize the own industrial situation before applying CI methods and with this information, comparable case studies will be presented. Finally, all fitting methods for the specific situation will be proposed, together with elaborated instructions for their application.

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