Design Science

# Connected creativity – a human centered community innovation platform in the context of product generation engineering

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## Abstract

In this paper, a concept for a community innovation platform is introduced focusing on human behavior of motivation and barriers in the context of product generation development. Building on the state of the art, a three year case study in cooperation with Dr. Ing. h.c. F. Porsche AG is at the core. In the first step of the study, a questionnaire and interviews are used to point out that a new attractive channel for ideas is needed. The three perspectives of users, experts and stakeholders are investigated in order to discover needs and preferences. Based on these findings, in a second step, a software prototype was designed and introduced in a pilot project with more than 200 users. Using a questionnaire and expert workshops, in the final step, this project is evaluated as appealing to the community, and the generated content is demonstrated to be valuable to specific activities of product generation development.

**Key words:** product generation engineering, innovation management, community innovation platform, human behavior, industry relevant methods

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## 1. Introduction

Idea suggestion systems have helped workers to address valuable ideas for continuous improvement in organizations over decades (Power 2011). In the case of Toyota this built up to two million ideas per year (Yasuda 1991). When it comes to innovation capability in a world of connected and interdisciplinary team work, community innovation platforms can build on the principle of idea suggestion systems (Westerski, Iglesias & Nagle 2011) and contribute to an organization's innovation capability by connecting employee's creative impulses within one digital online tool. With Social Media on the rise and used in more and more corporate environments to build networks, share knowledge, spread information and gather feedback, this paper aims at giving insights into how such platforms can be optimally designed and integrated into real engineering environments. In order to enable and simplify transfer from research results to industry application, an industry related case study approach is chosen, which can place researchers in real product development projects in industry. This way, deep insights and empathy for the actual needs, requirements and challenges of industry partners

can be generated. At the same time, this approach implies limitations: Often times, the selection of samples is limited and experiment design has to be aligned to the boundaries of the industry project. For the investigation in this paper, such an industry related case study approach is chosen, in order to facilitate future industry transfer by combining illustration from a practitioner's perspective with scientific methods.

The human perspective plays a crucial role for developing a community innovation platform: While innovation is a key factor to the success of economy, technology, and society (Schumpeter 1934), it is built on small, but creative pieces of knowledge: on innovation impulses (Maul 2015; Albers *et al.* 2015*b*). Innovative organizations are challenged to continuously and systematically generate and support innovation impulses into the next product generations. At the same time, new possibilities emerge for sharing and processing knowledge in virtual online communities. The concept of a community innovation platform inside an organization seems to be well suited for the challenge of processing innovation impulses for design activities. Such a community innovation platform can be considered as a sociotechnical system with interactions between the system elements including users, experts and organizational stakeholders (Albers *et al.* 2015*c*). Human behavior like motivation and acceptance are often neglected, when developing methods and tools to support product engineering. Retrospectively, this can be identified as a reason for their failure in many practical use cases (Zink & Eigner 2013). Community innovation platforms are subject to the same risk.

Thus, this paper focuses on the integration of human behavior research in order to show how to develop a community innovation platform with people at the center.

Most of the relevant research on innovation communities focuses either on the field of innovation and engineering sciences, information technology, or social sciences. This paper aims at integrating findings from these different fields into one approach. The state of the art on these different fields provides a solid basis for the work: Innovation impulses are crucial for the innovation capability of an organization. A community innovation platform can potentially support the generation and management of innovation impulses as a tool for activities of product generation engineering and as a resource for fostering a culture of creativity amongst users. Within the design and integration of a community platform, many degrees of freedom offer a wide range of possible functions. Every platform has to be specifically developed in line with organizational requirements and its potential users. The user's human behavior, motivation for creativity and handling of barriers are crucial for the success of a community innovation platform. Building on the state of the art and looking at the objective of this paper, the following research questions have to be answered:

(1) Which requirements for a community innovation platform can be derived from the perspectives of the involved users, experts and stakeholders?
(2) How is a community innovation platform designed and integrated on the basis of these perspectives?
(3) What can a community innovation platform contribute to an organization's product generation engineering capability?

In order to answer these questions, a three year case study in cooperation with the innovation management of the Porsche AG is carried out which allows for



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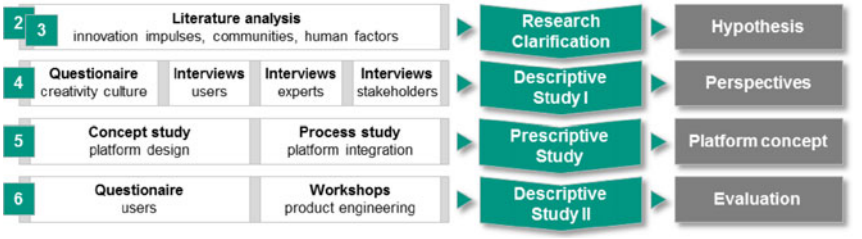


**Figure 1.** Research methodology.

in-depth investigations. Therefore, an approach aligned to the design research methodology (Blessing & Chakrabarti 2009) is used as shown in Figure 1.

## 2. State of the art

### 2.1. Impulses to stimulate Innovation

Innovation is vital for companies, which aim to achieve sustained success. According to Schumpeter (Schumpeter 1934), a product is only an innovation if the invention was successfully established on a market. Henderson & Clark (1990) differentiate four types of product innovation: incremental, architectural, modular and radical innovation. An organization's goal is to introduce innovative products to the market, while only certain subsystems are newly developed in order to reduce cost and risk. Thus, a product predecessor or competitor's product is usually taken as a basis for development of a new product generation. These reference products specify large areas of the basic structure as well as subsystems that are carried over (Albers, Bursac & Wintergerst 2015).

In order to newly develop subsystems, search fields need to be clearly defined. This way, impulses for an effective differentiation from existing reference products can be generated. These are called innovation impulses and are usually transferred to advanced development and later integrated into new product generations. The generation of innovation impulses poses numerous challenges for organizations (Scholl 2004). The open innovation approach provides new impulses for the organization from the outside (Chesbrough 2006). At the same time, own employees from various divisions from an organization can be useful sources for new product ideas (Bansemir & Neyer 2009). However, these impulses have to be considered in the context of models of product engineering and innovation management in order to be integrated into appropriate engineering design activities (Hauschildt & Salomo 2011). With the help of gate keepers, new knowledge can be transferred into the development process (Tushman & Katz 1980). Depending on the kind and source – e.g., new technologies from the outside or own product ideas from the company – this new knowledge is utilized in different phases of the development process (Cooper, Edgett & Kleinschmidt 2002).

In order to holistically foster innovation capability, management of innovation impulses as activities is not enough. It is also a culture of creativity that needs to be promoted through e.g., values or surrounding conditions like communication (Vahs & Schmitt 2011). This cultural environment has an indirect, yet important impact on innovation activities and it can be positively influenced by management



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**Table 1.** Examples of literature on success factors of innovation culture

| | | Haller, 2003 | Hauschildt & Salomo, 2011 | Meyer, 2011 | Sommerlatte, Beyer, & Seidel, 2006 | Vahs, & Burmester, 2005 | Vahs, & Schmitt, 2011 |
|---|---|---|---|---|---|---|---|
| Identity | strategy | | | X | X | | X |
| | values | | | X | | X | X |
| Organization | structure | | X | X | x | | |
| | management | X | X | X | X | X | X |
| | resources | X | X | X | X | X | X |
| Employees | team | X | X | X | | | |
| | incentives | X | | X | | X | |
| Atmosphere | communication | X | X | X | X | X | X |
| | risk culture | | | X | X | X | |
| | ambiance | | | X | | | |

(Sommerlatte, Beyer & Seidel 2006). Further success factors of innovation culture are presented in Table 1.

For further investigation the Corporate Creativity Index (CCI) proposed by Meyer (2011) is used. Thereby four fields of activity can be clustered: Identity, organization, employees and atmosphere.

## 2.2. Human behavior in the context of community innovation platforms

In order to provide an environment for a community to exchange innovation impulses, organizations are facing two main tasks: design of community platform on one hand (Leimeister *et al.* 2009) and its integration within the organization on the other hand (Venkatesh & Bala 2008). Depending on the specific goals and conditions of the organization, the wide range of possible platform functionalities has to be considered and selected in the platform design McAfee (2006). Hinchcliffe (2007) emphasizes six functions, which become more and more



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relevant for organizations: Wikis allow collaborative editing of texts, pictures and documents (as seen in Wikipedia). Blogs enable users to publish personal content and comments (for example in the Micro-Blog Twitter). Mashups include content from different authors and assemble it (like Amazon Marketplace does). Online Communities help users to organize and discuss on a related topic (in different forums on Yahoo). Social Bookmarking lets users share links with others to direct them to interesting content (for example through the platform Reddit.com), while social Networking gives users profiles and a platform to connect with other users (Facebook among many). Furthermore, for the integration of a platform, an implementation process has to be individually adapted according to the requirements within the organization (Kotter 2011). In order to successfully introduce a platform in an organization, several steps of change need to be carried out. Different types of employees need to be led through the steps of knowledge, persuasion, decision, implementation and confirmation (Rogers 2004). For this reason, potential users, experts and stakeholders have to be involved in the implementation (Mohr & Woehe 1998), which is rarely researched thus far from a specific context. Human behavior is a crucial success factor for the design and integration of a community innovation platform (Albers, Maul & Bursac 2013). With a sociotechnical system understanding (Ropohl 2009) three perspectives can be identified: users who generate and discuss impulses, experts who evaluate and transfer impulses into products, and stakeholders who are part of the organizational framework. The user's motivation can be improved with the help of 'the compensatory model of work motivation and volition' which includes three components: explicit motives, implicit motives and perceived abilities (Schattke *et al.* 2012). Explicit motives constitute the reason for a person's actions and a person can express them. In contrast to that, implicit motives are subconscious and lead to behavioral impulses. Perceived abilities are the basis for people to perform actions (Kehr 2004). With regard to implicit motives, three kinds of needs can be distinguished: the need for affiliation (social relationships), the need for achievement (desire for new challenges), and the need for power (control and reputation) (McClelland *et al.* 1987). Implicit motives can be strengthened by stimulating these three needs with the implementation of three corresponding types of specific functions in a community innovation platform.

The first type of function stimulates the need for affiliation. It addresses the desire for relationships and getting in touch with other people. They include communication and connection tools such as user profiles, messenger and chat modules, and features to see who else is online in the network and find new contacts (Schattke *et al.* 2012). The second type of function addresses the need for achievement. It gives users means to face new challenges and develop their own skills. Examples for such functions include feedbacks from experts (Schattke *et al.* 2012), tools for visualization of ideas and following specific topics (Albers *et al.* 2013). The third type of function aims at the need for power and helps users to gain reputation and prestige. Including name and portrait of a user close to each of his contributions or automatically sending a notice to the respective supervisor whenever a new idea is put in the platform can support this. Earning titles and badges like 'innovator of the month' or even becoming a moderator can give more power to users. Competition can be facilitated by rankings and statistics on the achievements, seen by all users within the community (Schattke *et al.* 2012).



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**Table 2.** Examples of literature on human behavior and their scope, relevance and applicability

| | | Focus on Impulse providers | | | | Focus on Impulse receivers | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Schattke, Seeliger, Schiepe-Tiska, & Kehr, 2009 | McClelland, Patel, Stier, & Brown, 1987 | Csikszentmihalyi, M., H. Aebli und U. Aeschbacher (2008) | Deci, Edward, Richard Ryan und Richard Koestner (1999) | Walter, Auer & Gemünden, 2002 | Ruckriegel, Oertelt, & Bullinger, 2011 | Borowiak, & Herrmann, 2011 | Hauschildt et al., 2007 |
| Scope of human behavior | Motives | X | X | X | X | X | X | X | X |
| | Abilities | X | | X | | X | X | X | |
| | Surrounding conditions | X | | | | X | | | X |
| Relevance for an innovation community | Product development / Innovation management | X | | X | | X | X | X | X |
| | Communities | X | | | | | X | | |
| | Organizational change | | X | | X | X | | | X |
| Applicability in research and design | Research variables | X | X | X | X | X | X | | |
| | Design proposals | X | X | | | X | X | X | X |

Looking at a community innovation platform from an expert's perspective, four types of barriers can arise (Walter, Auer & Gemunden 2002): barriers of not-being-allowed often occur, when other activities are prioritized by the managers or activities on the platform are regarded to as leisure activities (Ruckriegel, Oertelt & Bullinger 2011). For this reason, Upper Management communication toward all employees on the importance of a platform is necessary. Barriers of not-wanting must be faced, if there is not enough useful or up-to-date content on the platform (Wildemann 2003), thus topics for the platform need to be carefully chosen. Barriers of not-being-capable are often caused by information overkill (Borowiak & Herrmann 2011). Pre-selection is needed to reduce the amount of information experts have to look at. Finally, barriers of not-knowing must be encountered by a wide range of different communication channels toward potential experts (Wildemann 2003). By overcoming these four types of barriers, the transfer of impulses to the experts can be improved (Albers *et al.* 2014).

In Table 2 some examples of literature on the field of human behavior are listed and evaluated respecting their scope, relevance and applicability for the research of this paper. With regard to the aim of the paper, the models of Schattke *et al.* (2012) and Walter *et al.* (2002) seem most suitable, while others seem helpful to add specific aspects.



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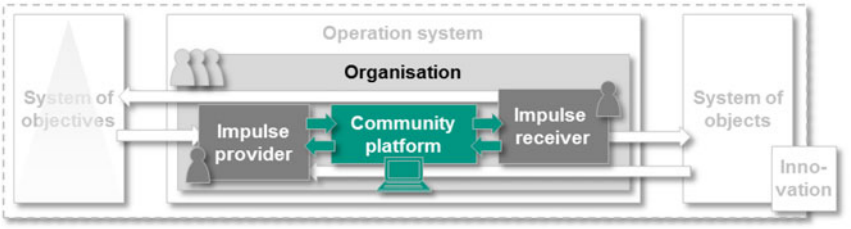


**Figure 2.** Sociotechnical system elements relevant for the design of a community innovation platform.

## 3. Investigation of the perspectives

At first, the initial situation on the culture of creativity is investigated with a questionnaire study. Therefore the perspectives of the users (impulse providers), experts (impulse receivers) and stakeholders (as part of the organization) are subjects to research (Figure 2).

The three perspectives of users, experts, and stakeholders are first examined individually using questionnaires, interviews and observations. The results of the studies are combined in Chapter 5 in order to derive a concept for the implementation of the innovation platform.

### 3.1. Initial situation of the culture of creativity

A culture of creativity is a basis for innovation capability. With a community innovation platform, elements of the culture of creativity can be addressed and improved, such as communication across hierarchies and disciplines, or chances to share new ideas. In order to investigate the initial situation within the organization of the Porsche AG, a six month research study was carried out using a questionnaire on the basis of the CCI model. For this questionnaire, 19 statements were derived from the four fields of identity, organization, employees and atmosphere with the help of three innovation managers. The questionnaire was then given to 228 employees in the form of identical printed versions and they were asked to fill in how much they agree with each statement on a 6 point scale from 0 to 5 (0 = do not agree at all, 5 = fully agree). Responses were handed back in anonymously via the corporate mail system for descriptive analysis. The participating teams and departments represent different activities along the innovation process, such as advanced and series development of body, electrics and electronics, chassis, drivetrain and overall vehicle development, as well as innovation and concepts development, styling, purchasing, finance and project management. In Table 3, the average answers of all 140 respondents on the most relevant questions in regard to an innovation community platform are summarized.

Overall, it turns out, that the employees are open toward new ideas and changes. Innovation is perceived to be a strategically important task and thus, the participants accept ideas from outside the organization. In this context, they appreciate recognition for their efforts more than financial compensation. The communication and knowledge exchange with colleagues still leaves room for improvement, especially the exchange across departments. As a major finding, it turns out, the employees do not find enough time to develop their own ideas



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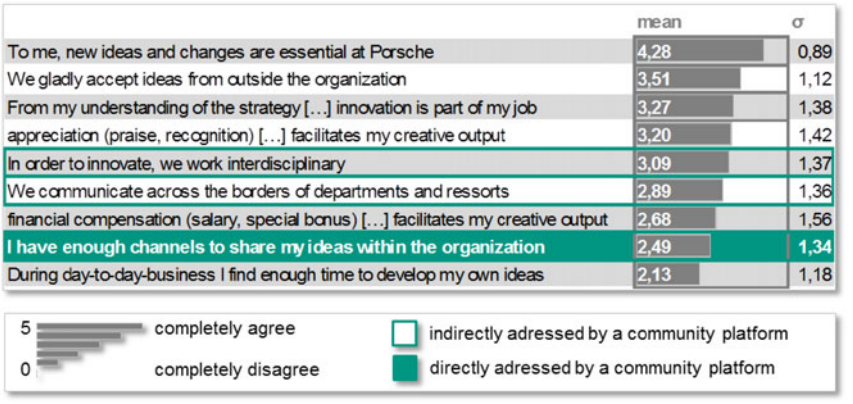
**Table 3.** Results from the questionnaire on a culture of creativity




and also lack channels to share their ideas within the organization and the time to develop own ideas. By appropriate design and integration of a community innovation platform these desires can be addressed. If done right, a community innovation platform can be expected to provide a 'win–win situation' for the users and the organization.

## 3.2. Investigation of the user's perspective

With the help of 20 semi-structured interviews with potential users in a six month case study, motivational aspects have been identified. Two workshops with innovation management experts have been held to identify relevant aspects for the following interviews. In addition, two innovation community platforms for demonstrational and test purposes were introduced to provide interviewees with a deeper understanding of variations in basic features of such platforms. Both platforms have the standard tools of idea evaluation, personal profiles, and rankings. The implementation possibilities varied, for example, in terms of the type of idea evaluation. One platform was implemented with Likes and the other with a 5-star scale. One of the platforms had a mature functionality in the area of social interaction. Whereas, the other additional mechanisms of the idea competition had implemented. On the one hand, such a preliminary demonstration leads to the fixation of the interviewees. On the other hand, it was necessary to create a basis for the participants. This way they could express their wishes more concrete and more realistic. For further details also see Albers *et al.* (2013).

Based on the results of the workshops, questions have been identified and attributed to the model of work motivation and volition and included into a semi-structured interview guideline. Semi-structured interviews with 20 potential users of an innovation community form the basis for the identification of relevant motives. The interview data has been transcribed, tagged and clustered. Furthermore, 15 possible features were derived from an analysis of existing innovation community platforms and literature. They were presented to the interviewees, who were asked to rank these according to how much they would like to use them. The following section provides an insight into the clustered



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results from the interview and user preferences toward functions in relation to the model of work motivation and volition. The interviewees mentioned that 'the projects [the employees are] working on don't leave a lot of time. If [they] spend time working in the community [. . .] it should be valuable for the company.' [Interviewee 15] Furthermore they revealed that 'working in the community is definitely not prioritized.' [Interviewee 5] To summarize, the lack of time demands that ideas can be efficiently added. The relevance of innovation and the suitability of a community platform to contribute to innovation need to be clear.

Specific innovation tasks can draw attention to an innovation community. Even if an employee is convinced that the innovation community is helpful, they need arguments why the particular task on the platform can be important. One interviewee said in a workshop with a test community platform that 'in order to generate an additional value for the company, [he] always tried to solve the given task.' [Interviewee 15] Another interviewee states that 'the main point is what the benefit for the [company] is.' [Interviewee 2] Overall, the users want the tasks to be within a strategically relevant area and on a question with a noticeable impact.

Most interviewees have experience with websites like Wikipedia, Facebook and Amazon. However, they find that 'even small technical difficulties can demotivate potential users.' [Interviewee 16] and '[throw] [users] back in [their] motivation.' [Interviewee 15] Furthermore an interviewee says 'even though [he] consider[s the innovation community] as very important, [he expects] that the access and the handling with the community platform is very easy and uncomplicated.' [Interviewee 16] Also, the 'effort [should be] as low as possible to work' [Interviewee 10] in the community platform and 'ideas [need to] be entered efficiently.' [Interviewee 5] The interviewees agree that they expect an intuitive community platform and comfortable access.

One interview partner is 'sure, that [he] can contribute to some innovation tasks more than to others, based on [his] experience.' [Interviewee 3] Another interviewee 'believe[s] that everyone has his favorite topics.' [Interviewee 15]. The sample of interviewees confirms that individual knowledge of different users, their specific technology or market expertise and each person's personal intellectual skills vary. Depending on the specific task, users felt more or less creative. On the one hand, if a task is too hard for users to contribute at all, they might get frustrated. Thus, it should appear to be solvable. On the other hand, especially achievement driven users might get bored if a task is too simple. For these users the ideal level of excitement is reached, when a task is challenging and pushes them to give their best effort to solve the task.

Furthermore fifteen potential users were asked to rank suggested functions by their personal preference. The result of that analysis can be seen in figure 3.

Except the function 'idea rating', which is a basic function and expected by the interviewees, the distribution of the ranking is heterogeneous. The function for automatic idea 'forwarding to supervisors' is for example ranked first by two employees and ranked last by three others. One possible explanation for such discrepancy is that power motivated users focus on that function, whereas employees who are motivated by the need for affiliation and achievement do not consider this function as important. If the decision whether to implement certain functions in the community platform or not was based on the average rating of the potential users, functions would not be taken into account although they are most important to some users.



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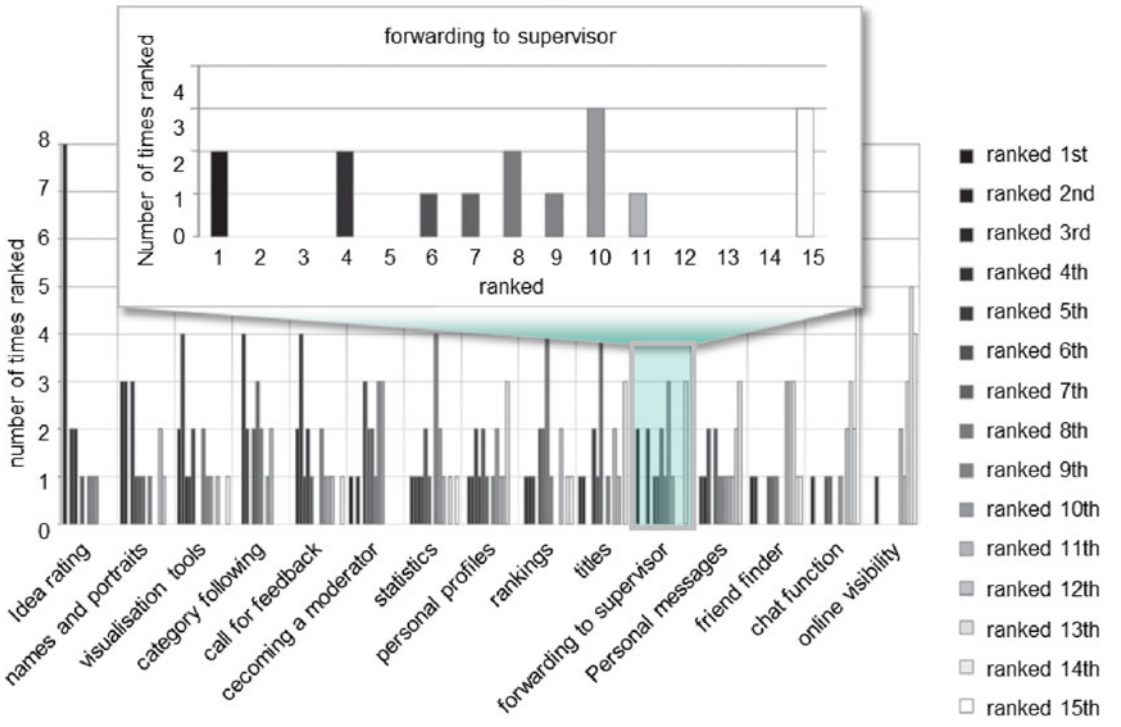


**Figure 3.** Ranking of functions according to personal preferences of interviewees.

With the help of the statistic method of multidimensional unfolding, these preferences can be visualized. The method allows for objects and subjects to be projected in a two-dimensional space by their similarity (Backhaus *et al.* 2006). It can be illustrated that all interviewees and all functions are in one room. Each of the interviewees has the possibility to move the functions in the room. In addition, it can also move freely in space. A compromise between the respondents decides on the positions of the functions in the room. Each respondent positions in such a way that a high rank in an interviewee's preferences is close to him, while a function, which is disliked, is further away from him.

The result of applying this method to all functions and interviewees can be seen in Figure 4. It turns out, that similar functions like the 'chat function' and the 'online visibility' (both stimulating the need for affiliation) are arranged close to each other in the unfolding. The same effect of clustering also applies to the other two kinds of functions that stimulate the need for achievement and the need for power.

For the purpose of a community innovation platform in which participation is voluntary, it is necessary to make sure that all motivational aspects are covered (Albers *et al.* 2013). Thus, users need to be motivated explicitly as well as implicitly, and their perceived abilities (according to Kehr) should be further emphasized. In Figure 5, example statements from interviewees as well as derived requirements are shown.

From the interviews the following implications can be derived: First, in order to foster explicit motives, the relevance of the platform needs to be published



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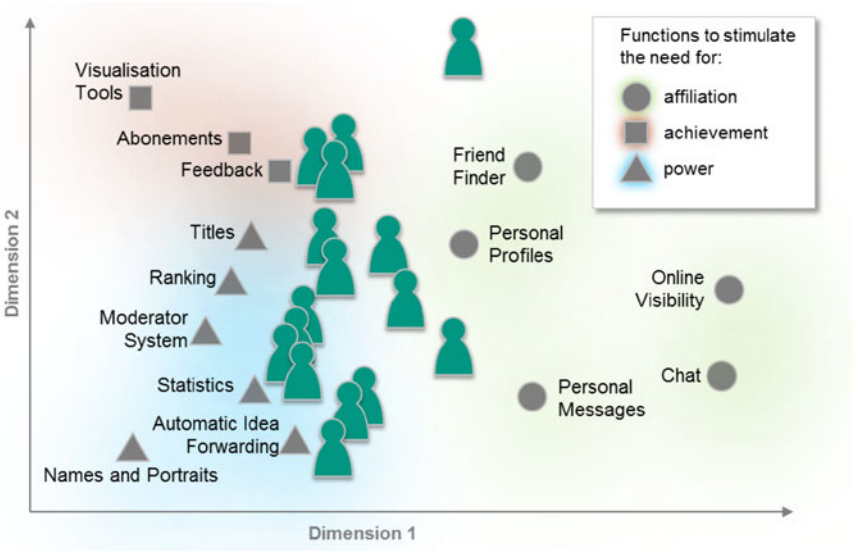


**Figure 4.** Multidimensional unfolding of user preferences toward different functions of a community innovation platform.

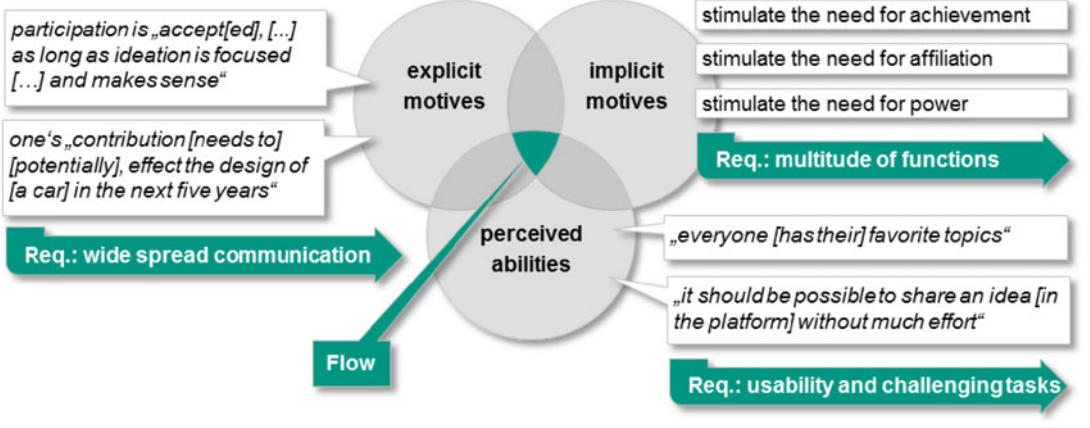


**Figure 5.** Components of user motivation and implications for the design of a community innovation platform.

by wide spread communication across the organization. Second, considering that every potential member of the community is an individual, a community innovation platform should offer a multitude of different functions to motivate all kinds of users: functions to stimulate the need for affiliation (e.g., personal profiles), functions to stimulate the need for achievement (e.g., feedback on own ideas) and functions to stimulate the need for power (e.g., names and portraits next to shared ideas). Third, since every user will define his perceived abilities differently, it is suggested that several innovation tasks with different levels of complexity and different topics are given to the community at the same time.



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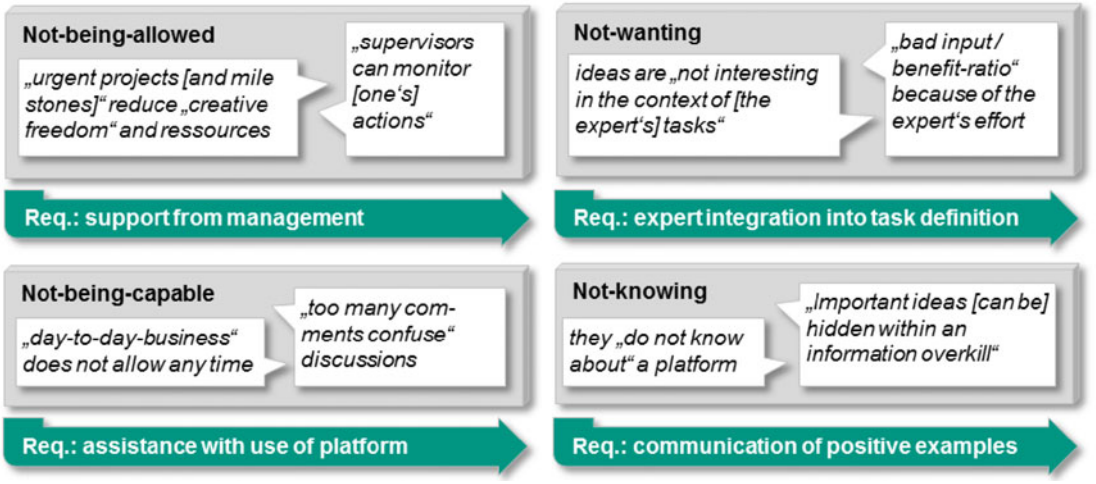


**Figure 6.** Components of user motivation and implications for the design of a community innovation platform.

Furthermore, usability and easy access combined with challenging, but still doable tasks have been mentioned as crucial points by the interviewees.

The result emphasizes the individuality of each potential member of the community. In order to motivate different characters, a multitude of functions should be offered by a community innovation platform. At the same time, not every user needs all of the possible functions. Thus, a platform should let every user decide for themselves whether or not they want to use a function, e.g., whether they want to participate in a ranking system.

### 3.3. Investigation of the expert's perspective

In order to investigate a second perspective in a six month case study, 10 experts responsible for advanced development projects have been interviewed. For this purpose, semi-structured interviews have been carried out analogously to the study in chapter 4.2. An interview guideline was used as a basis and the responses from the interviewees have been transcribed, tagged and clustered. The following excerpts of examples provide an overview of the discussed barriers. Advanced development is crucial for focusing on search fields and thus on a frame for finding differentiators from the reference product. In the interview questions, the four types of barriers (see chapter 2.3) are used to structure the questions. In Figure 6, example statements from the experts to each type of the barriers as well as derived requirements can be seen.

From the statements the following conclusion can be derived: Barriers of not-being-allowed can be mostly influenced by the management by officially supporting the use of the platform. Barriers of not-wanting are often related to the fact that the ideas of the users on the platform do not match the relevant search fields which the experts have identified for differentiation of the new generation from the reference product. Thus, the innovation tasks published on the platform should be defined in cooperation with the experts. Barriers of not-being-capable can be overcome by assisting the experts with selecting ideas and contributions



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from the platform, e.g., by a concentrated 'Top 10'-overview. Barriers of not-knowing about the platform can be influenced by intensive communication of positive examples originated from the platform.

### 3.4. Investigation of the stakeholder's perspective

In order to investigate the stakeholder's perspective, ten organizational units have been identified with the help of a stakeholder analysis: the works council, human resources, idea management, intellectual property department, corporate legal department, employment law department, data protection, IT system administration, IT security and purchasing department. Within a time span of 12 months, workshops have been conducted with representatives of each of these stakeholder parties to discuss objectives and requirements for an innovation community platform. With the method of participating observation in these workshops, the authors could be part of the activities and thus gain deeper insights into interests of the stakeholders. Each workshop included an introduction into the idea of an innovation community platform, a discussion on the objectives of the stakeholder and a collection of requirements derived from the objectives. The most relevant findings are summarized in the following list:

From the discussions, three major fields of implications can be drawn: Legal documents, software design and system architecture (see Table 4).

## 4. Design and integration of a platform concept

Based on the conclusions from chapter 4, a platform concept can be designed and implemented. First, the objectives and requirements, from the perspectives of the users, experts and stakeholders, are linked to the fields of design and integration of a community innovation platform in a matrix (Figure 7). The matrix relates requirements (line by line) to fields of design (column by column) and indicates with three different symbols a decisive, minor or no influence between each two.

### 4.1. Design of the IT software, functions and idea process

Building on an analysis of existing IT software tools for community innovation platforms, a variety of possible core functionalities and alternatives for their realization can be derived (see figure 8). Each of the alternatives will have their own advantages and disadvantages. For the case study, specific alternatives have been chosen based on the requirements from Chapter 4.1–4.4. The following section will explain for each functionality as a category which alternatives are chosen in this case and why.

(1) Profiles for users can either be realized with real names, anonymous accounts or aliases. Each alternative has own advantages and disadvantages. Anonymous accounts might make it easer for some idea providers to share rough ideas early, but looking at their implicit motives (chapter 4.2), real names can address the need for affiliation and also make it easier to legally attribute IP (chapter 4.4).

(2) When it comes to the topics and challenges that users are led to discuss on the platform, there are three main options: An open call for ideas of any kind can encourage more ideas, but one main conclusion in chapter 4.3 is that receivers of impulses want to avoid an information overload.



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**Table 4.** Subjects of discussion from a stakeholder's perspective

| Stakeholder | Requirements | Implication |
|---|---|---|
| Intellectual property | Confidentiality of all content on the platform is mandatory, as patents can only be filed and leveraged as long as an invention is new to public. This is also important, because corporate inventors are guaranteed rights for compensation for their inventions. | Legal documents (terms of use, agreement from management) |
| Data protection | Personal data needs to be stored securely and used for the sole purpose of the innovation community platform only. Especially data possibly relevant for performance assessment must not be accessible to third parties. | |
| Legal | With the introduction of a community platform, the operating company gains obligations and is liable for damages caused with the help of the platform. In order to minimize risks, the terms of use for the platform users need to reduce corporate risks and an emergency response plan needs to be established. | |
| Employment law | Access to the platform must be granted to all users by the same standard, in order to secure equal rights for the employees. | |
| Human resources | In order to avoid conflicts of objectives, management has to approve that employees can use the platform as part of their work. | Adjustments to the software |
| Works council | Employees should be prevented from any disadvantage or negative effects through the use of the platform. Thus, an idea rating system must avoid comparative and possible negative ratings and, instead have ideas collect votes as in Facebook's "Likes" system. | |
| Idea management | Current idea management processes offer rewards for their authors under certain conditions. In order to grant eligible authors the rewards, idea management conditions are to be clearly stated on the platform and a link must forward them to the existing system. | |
| IT system administration | A new system like a community innovation platform needs to be efficient, scalable and compatible with the existing IT ecosystem and infrastructure such as intranet, content management systems and servers. | Compatible software architecture |
| IT security | Unauthorized access from outside needs to be prevented by the implementation of security standards and tested against with the help of penetration tests. | |
| Procurement | For the selection of a vendor for the platform software requirements of purchasing as certificate and delivery conditions need to be met. Also costs and benefits of several vendors need to be compared in order to find a cost efficient solution. | |

Thus, specific, but changing challenges can help to focus input on highly relevant topics, overcome barriers of not-knowing and not-wanting of the receiver of impulses, and at the same time also stimulate their need for achievement. This is done by defining tough but solvable problems as challenges to in line with the users perceived capabilities.

(3) During the idea input from users, it is important to make the current library of ideas accessible to the user so that redundant inputs are reduced. Categories and tags help to classify ideas, but similarity checks based on the words in the idea description are an even simpler way to make users aware if there are potentially redundant ideas already in the system while they start to input them.

(4) Not all community innovation platforms allow discussion and further development of ideas. In this case, a discussion forum for each idea



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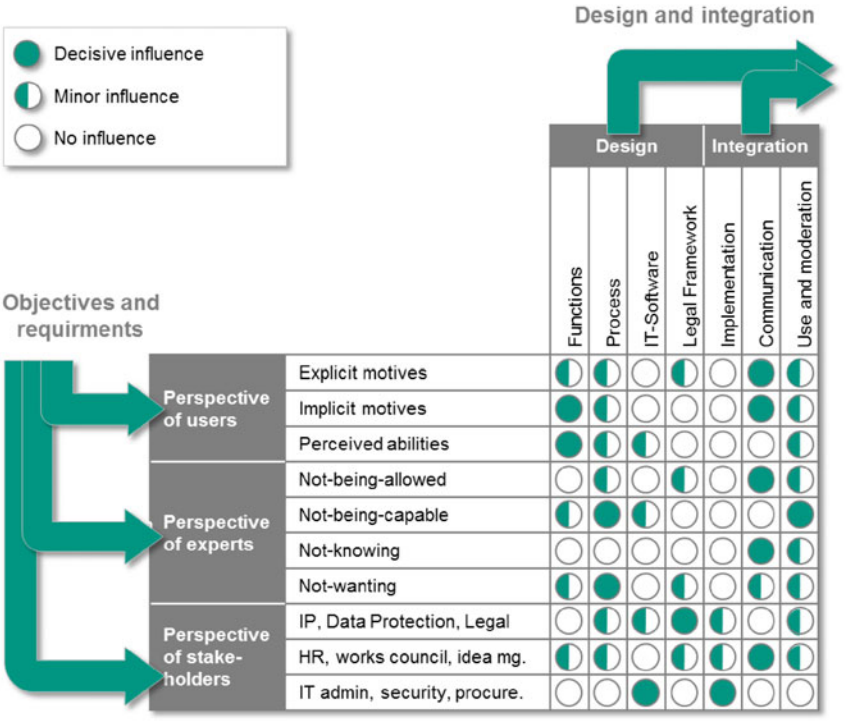


**Figure 7.** Relation between requirements and fields of activity for the design and integration of a community innovation platform.

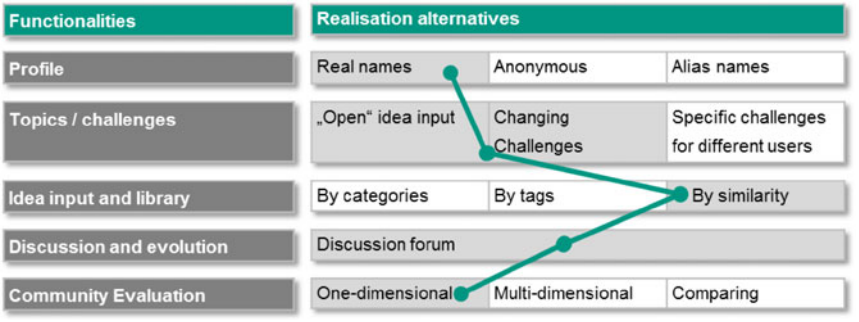


**Figure 8.** Overview of possible core functionalities of the software tools. The green path and the light gray fields highlight which alternatives for realization are chosen.

is encouraged to enable product generation development and add incrementally to the original ideas.

(5) Community evaluation can also be realized in different ways. While on the one hand a multidimensional rating with different criteria might give receivers of impulses more relevant information and filter possibilities (chapter 4.3), it also highlights badly rated ideas – and makes a perceived lack of quality of an idea more visible to all others. A one-dimensional 'Like' function (as in Facebook), on the other hand, can provide only a basic



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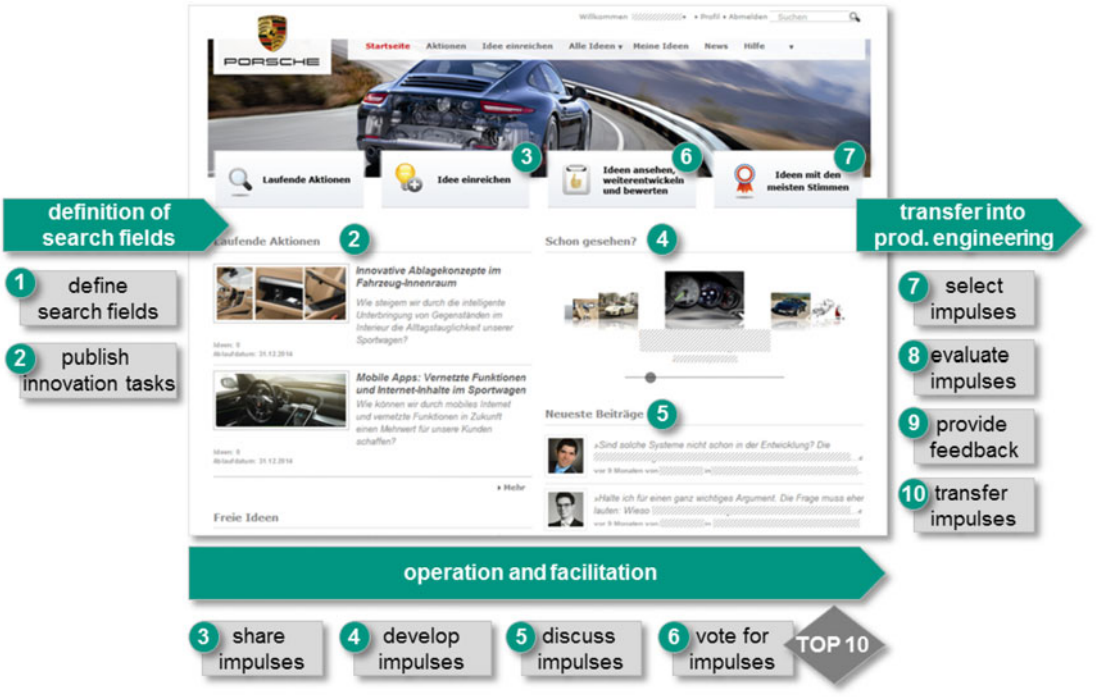


**Figure 9.** Implemented platform design on the landing page.

information, while providers of impulses might still not feel as judged when their idea gets few 'Likes'. They can still reason that their idea did just not get as much attention. Thus, the 'Like' variant of the evaluation functionality was the only one in the case study that was approved by the works council to prevent their employees from possible disadvantages.

Based on these influences, a prototype platform is designed and implemented by Hype Softwaretechnik GmbH (see Figure 9).

As required for overcoming barriers of not-wanting and not-being-capable, the platform presents 'search fields' as innovation tasks defined by experts. Working on the innovation tasks in the community, the users can share their related impulses which can be developed, discussed and voted for by other users.

For the use of the platform, three phases can be distinguished: preparation, ideation and post-processing. In the preparation phase, relevant future search fields (No. 1 in Figure 9) are derived from market and technology trends in cooperation with experts. Based on these, every four weeks two new innovation tasks are selected, defined in a challenging but solvable scope and published on the platform (2). In the ideation phase, the users can share (3), develop (4), discuss (5) and vote (6) for impulses in the context of the given tasks. The post-processing phase starts once the tasks are finished and the ten most voted impulses are selected (7) to be evaluated (8) by the experts. They provide feedback (9) to the users (as required for explicit motivation) and transfer relevant impulses into the development of new product generations (10).



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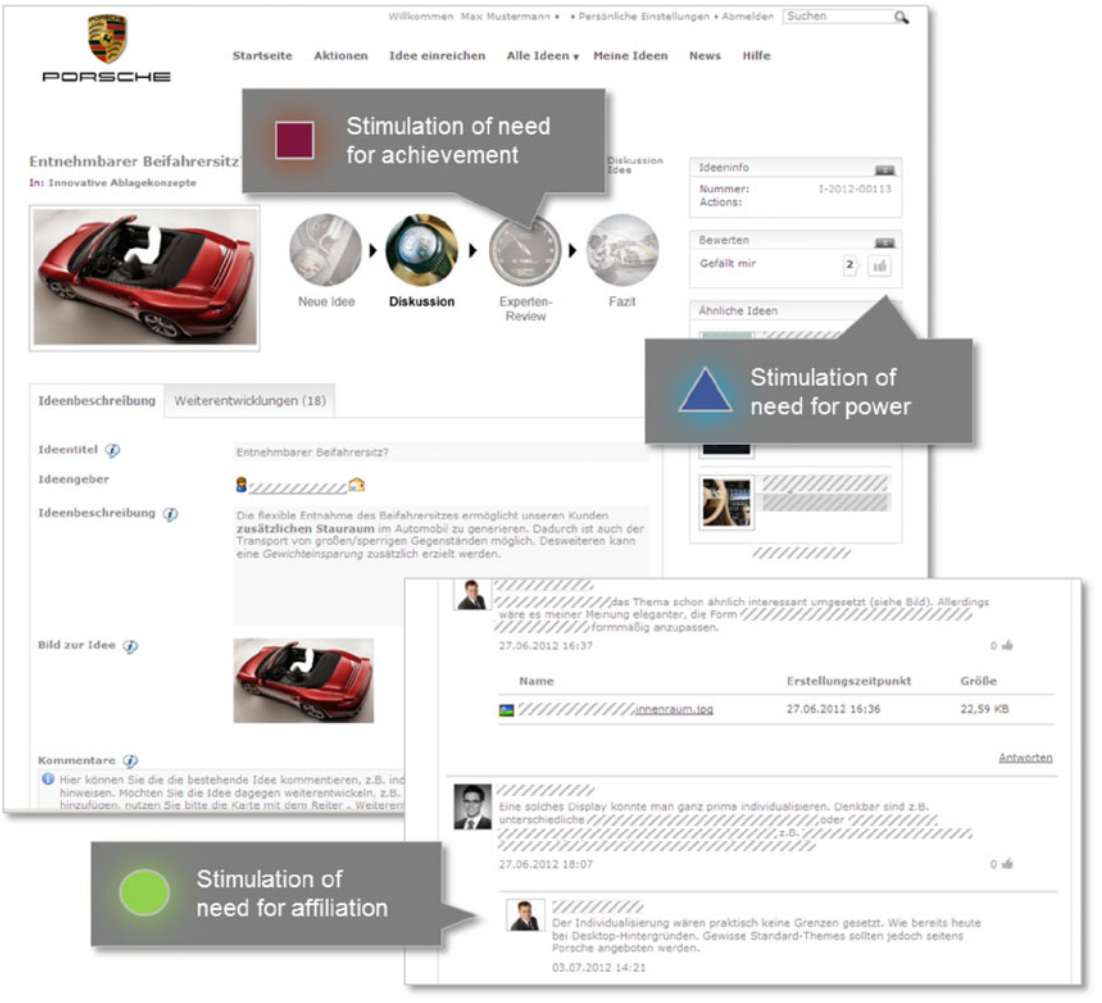


**Figure 10.** Implemented platform design according to concept and process.

Further functions for fostering user motivation are included (see Figure 10) in the platform, three examples are given here:

(1) The prospect of receiving a review from an expert can stimulate a user's need for achievement by potentially learning to increase one's own capabilities.
(2) The possibility to collect 'Likes' as votes, and thus stand out in the community crowd, can appeal to those users who are motivated by power.
(3) Pictures of the authors, comments and links to their personal profiles can stimulate the need for affiliation by helping relationship building within the community.

Other requirements derived from explicit motivation and barriers of not-knowing are relevant for the integration later on in the pilot project, e.g., for a communication strategy that uses different channels (Emails, video, demonstrations and presentations) and is sent out from the management.



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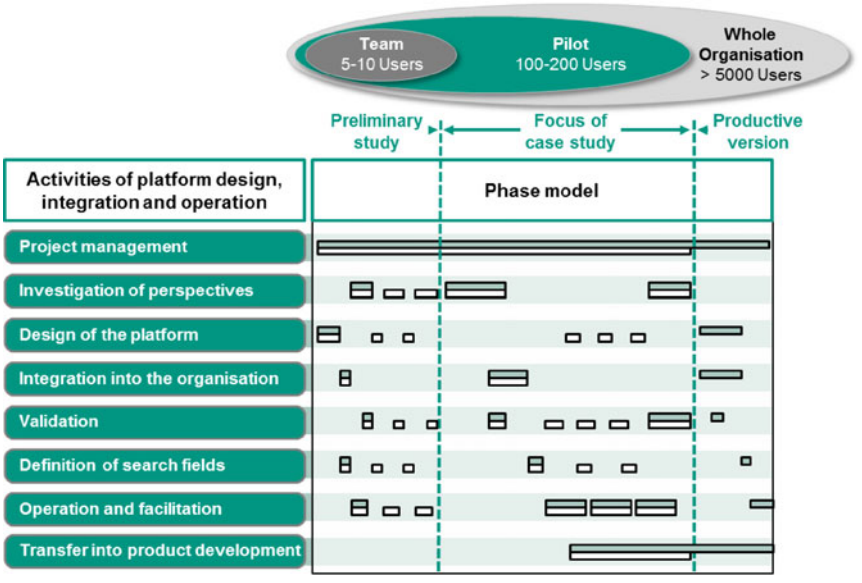


**Figure 11.** Phase model of activities of design, integration and operation of a community innovation platform.

## 4.2. Integration of legal framework, communication, roll-out process as well as use and moderation

Putting humans in the center has shown to be the most important success factor in the project. In order to take the needs of the involved persons into account, a community innovation platform has to be designed and integrated collaboratively and also iteratively, because not all contradictions between different objectives and requirements can be identified beforehand. Especially during the pilot phase, intensive user and stakeholder feedback is to be collected and implemented in several iterations. The iterative character can be seen in Figure 11.

The task of design, integration and operation of a community innovation platform requires a number of activities. The overall project consists of three phases. In the first preliminary study, demonstrators of different software solutions are pre-selected and tested by a small group of users. The second phase includes the platform design, integration and a pilot project which are described in the case study of this paper. This pilot group included over 200 users who generated more than 80 impulses, 50 contributions to further development, 70 comments and 300 votes. At last, a productive version can be applied widely throughout the organization.

Within each of the phases, several activities have to be undergone. Investigation of the different perspectives, design and integration of the platform, and the validation of these steps can be derived from the Design Research Methodology introduced in chapter 3. The further activities of validation, the definition of search fields, operation and facilitation as well as the transfer into product engineering are related to the platform concept described in chapter 5. Retrospectively, the process shows to have an even more iterative character than described in the presented findings. Again, validation can be regarded



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as the central activity of the project. Overall, the interviews, workshops and questionnaires are recommended to create empathy for the perspectives of the users, experts and stakeholders inside the organization. Looking at the experience from the presented three year case study, an early integration and commitment of the Upper Management appeared as a key success factor. With the help of the platform, innovative solutions within defined search fields can be found for new product generations. These solutions contribute to different activities of product generation engineering such as idea detection, variation of principle, and variation of embodiment. During the process, new sources of impulse can be added as best practices and kept in the toolbox for the development of further product generations.

## 5. Evaluation and validation of the pilot project

The developed concept has been introduced to be validated during a pilot project with over 200 users from one division of the Porsche AG. During four months with six different innovation tasks, the community generated more than 80 impulses, 50 contributions to further development, 70 comments and 300 votes. The innovation tasks included: Future baggage and luggage storage concepts, technologies for human–machine interaction, connected mobile apps, individualization of interior and exterior, lightweight technologies and activities for social acceptance. For the evaluation of the project, a questionnaire is used to capture the user's opinion and expert workshops are carried out to evaluate the community's contribution to product engineering.

### 5.1. Evaluation of the platform concept

A community innovation platform can contribute to the innovation capability, on one hand directly through the generation of innovation impulses for product generation engineering, and on the other hand indirectly through improving the conditions of a culture of creativity for the users. In this section, the pilot project's contribution to innovation capability is evaluated from the subjective perspective of the users. All 218 users have been surveyed with the help of a questionnaire on questions of design, integration, potential and conditions of the platform. The methodological procedure was analogous to the study on the culture of creativity described in chapter 4.1. In Figure 12, the average answers of the 64 respondents are shown.

It turns out that the design of the platform appeals to the respondents and they perceive it as usable. They find the topics and ideas on the platform interesting and see an innovative potential for the organization. Regarding the integration of the platform, objectives and the benefit have been clearly communicated and the ideation process seems transparent. However, the users see potential for improvement in terms of the organizational environmental conditions. They feel their contributions on the platform were rarely recognized and day-to-day business does not allow enough time for using the platform. Therefore, an innovation-friendly strategic orientation is necessary in order to recognize inventive efforts, provide freedom for creative activities and shape the organization's culture.



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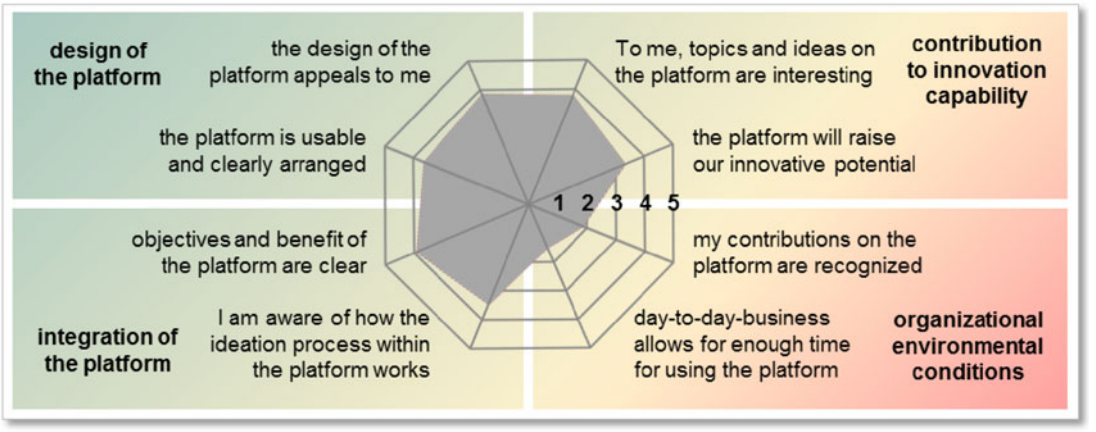


**Figure 12.** Evaluation of the platform (0 = completely disagree, 5 = completely agree).

## 5.2. Evaluation of contribution to product generation engineering

Since innovation impulses effect innovations often with a certain delay, possibilities of quantitative measurement are limited. However, in order to manage innovation processes, it is more important to know what kind of impulses are generated by which sources of impulse. In workshops with product development experts, each contribution from the community innovation platform is matched to an activity within the iPeM – integrated product development framework (Figure 13) (Albers *et al.* 2016*a*).[1]

Furthermore, the results from the following four other sources of impulse are classified in the same procedure: a workshop as a so called 'car clinic' (market research method) with customers, an online idea contest with students, a cross-industry innovation workshop with medical equipment engineers and an online technology scouting platform with suppliers, see Figure 14.

Looking at the community innovation platform, half of the contributions are related to idea detection, especially to the problem-solving steps, alternative solutions, selection of solutions and analysis of consequences, one thread for example focused on the use of drones for car maneuvers. Other sources of impulse are especially valuable for other activities. Customers in a car clinic provide insights into their needs, which is valuable for situation analysis in profile detection, e.g., complaints and needs on the usability of infotainment systems. They also point out specific design issues, which can be used for the detailed variation of the embodiment design. An online idea contest with students was shown to be helpful to identify market trends for a future profile situation analysis as well. In addition, the participating 'digital natives' provide

[1] In the iPeM, general fields of action in the development processes are represented by the activities of product engineering (see Figure 15, vertically arranged). Each of these activities can be further subdivided by the seven steps of the SPALTEN problem-solving process (see Figure 15, horizontally arranged). SPALTEN is a German acronym and means 'to split'. It stands for: situation analysis (S), problem containment (P), detection of alternative solutions (A), selection of solutions (L), analysis of consequences (T), deciding and implementing (E) and recapitulation and learning (N).



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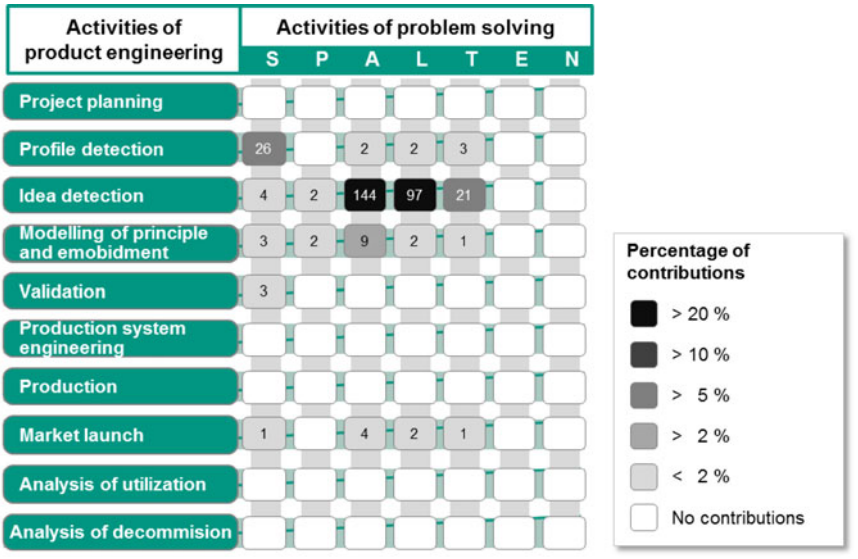


**Figure 13.** Focus of contributions of users on the innovation community platform.

alternative solutions for ideas and variation of principle and can help analyzing consequences based on their own experiences with new products, such as discussing mobile app use during racing. In a cross-industry workshop with a medical technology company, alternative solutions of ideas and variation of principle can be exchanged and transferred with the help of an analogous process, as for example in the design of display mountings or algorithms for picture analysis software. The specialized technical knowledge of suppliers also delivers alternative ideas, principle solutions and the variation of embodiment design, such as new materials and manufacturing technologies. Furthermore, their expertise is helpful when analyzing consequences of the proposed designs. The study shows that different sources of impulse contribute to different activities of product engineering. Product generation engineering faces the challenge of selecting and combining the right sources of impulse depending on the situation and given task.

## 6. Conclusion and outlook

### 6.1. Conclusion

The intention of this paper was to put human perspectives of users, experts and stakeholders in the center of design and integration of a community innovation platform in order to contribute to an organization's product generation engineering capability.

Since this research project is based on one case in one industry, it is limited transferable. This approach was chosen despite the limitations since the introduction of methods in a company takes a long time. However, this single three year case study nevertheless leads to transferable findings that provide a helpful framework at various levels. Researchers in companies with similar size and technical products in the B2C sector can directly transfer knowledge about this



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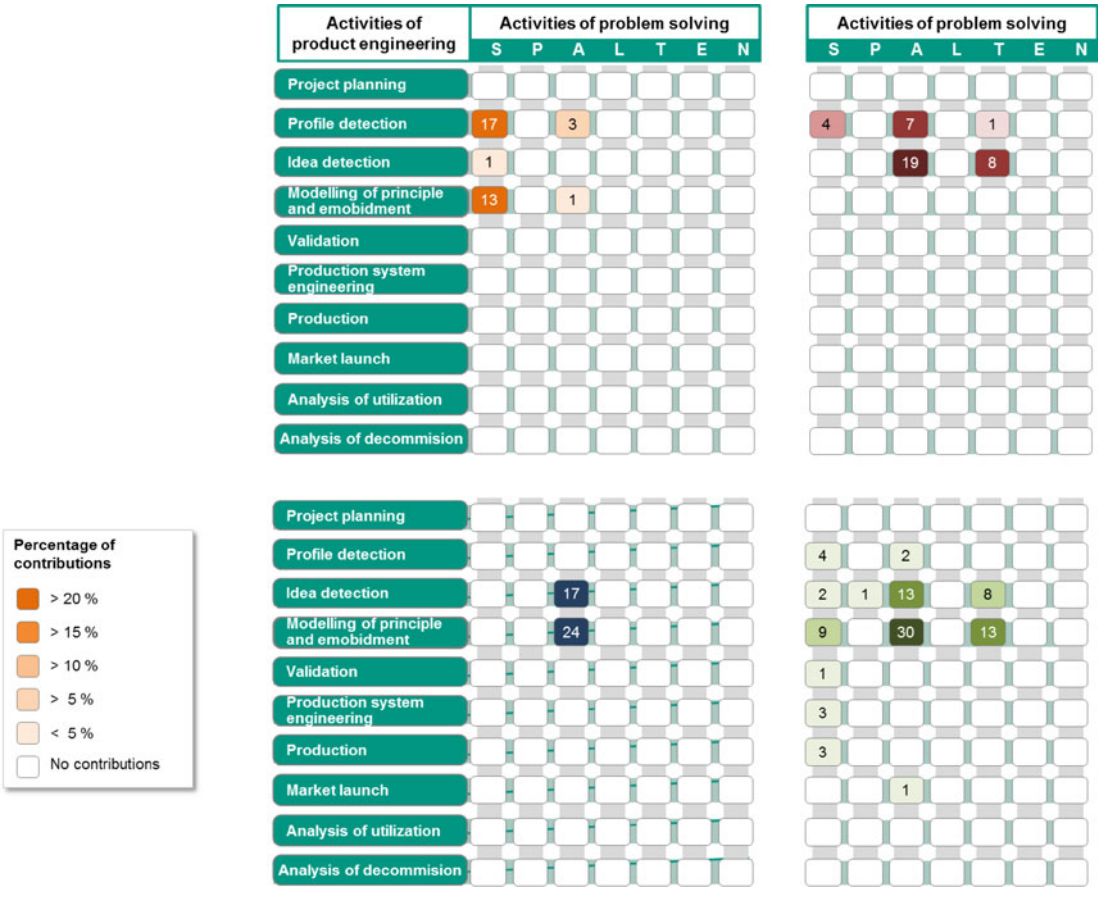


**Figure 14.** Focus of contributions of different sources of impulse.


**Figure 15.** InnoFox Application for situation-specific method selection.

specific platform design. Other organizations that want to introduce a platform can follow the procedure model. Both levels are described in detail below.



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Researchers providing community innovation platforms in similar companies can focus on using a platform with the introduced set of features as a starting point for the further development of the platform. This set includes the use of real names for profiles, open and changing challenges as topics and a one-dimensional like voting for idea evaluation. As a process on the platform should lead from the definition of search fields together with the experts over an operation and facilitation of the user impulses to a transfer into product engineering. When implementing the platform, care should be taken to address the different motives of users such as achievement, power and affiliation. This should be done through functionalities such as illustrating the progress of the idea (achievement), through rankings (power) and forum discussions (affiliation).

On the second level researchers looking into providing a community innovation platform in a different context can use the suggested procedure model. In these cases, first potential users, experts and specific stakeholders need to be identified and their needs and requirements need to be investigated. Therefore this procedure model is suggested:

(1) It should be examined whether the organization has a need for additional channels of innovation impulses from employees. A broad survey of employees based on the CCI is helpful for this purpose.
(2) Potential users of the platform should be surveyed in order to identify motives in the organization and implement functions that address these motives.
(3) Experts should be involved at an early stage in order to identify company-specific barriers in the transfer process (such as the not-invented-here syndrome) and derive countermeasures, such as integration in the task definition.
(4) Further stakeholders of the organization should be identified. Of the 10 stakeholders mentioned in this paper the intellectual property department and data protection in particular are elementary.
(5) Based on the requirements of the users, experts and stakeholders, boundary conditions arise from which the design possibilities with regard to profiles, topics and evaluation mechanisms can be derived.
(6) A final evaluation should be carried out among the users.

In addition to the findings about the research questions, some conclusions could be drawn from the style of best practices for readers who are looking at creating their own community platform: First, it appears crucial to involve passionate employees as first users and promoters as early as possible. Second, the works council and other stakeholders play a decisive role, thus it makes sense to form a working group with all of them on a regular basis. Third, the level of top management commitment and engagement seems to moderate the speed and effectiveness of the integration process. Further best practices are also detailed in Maul (2015).

The various kinds of impulses were primarily generated in different types of sources of impulses. This serves as an insight into the situation-specific selection of sources of impulses and methods in the development process. In addition to the approaches presented in the community innovation platform, other methods for incorporating new sources of impetus were systematically recorded. They have been processed in an application for mobile devices 'InnoFox' and can



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automatically recommend methods, depending on which one is best suited for the respective situation.

This makes it possible to integrate the findings from this paper into the day-to-day business of product developers (see Figure 15) (Albers *et al.* 2015*c*).

### 6.2. Outlook

In further work, the platform will be expanded to make it accessible to other areas of the innovation ecosystem. It is gradually being expanded to suppliers, customers, and universities. However, there is a conflict of objectives between the information published and thus also accessible to the competitors on the one hand and the additional creative impulses gained on the other hand.

Since the findings of this project in cooperation with the Porsche AG are mostly applicable to other large companies, future research faces the question of how to make a community innovation platform approach suitable for small and medium sized enterprises (SMEs).

In addition, KIT is introducing a methodical practical course called ProVIL – Product-Development in the Virtual Idea Laboratory. The students work together with companies on development challenges on an innovation platform. The platform was developed with the presented approach using SAP as a software partner. ProVIL is operated as a LiveLab with controlled boundary conditions. For example, studies with groups and control groups can be used to identify which implementation has a positive effect on the process. ProVIL has already been partially implemented (Albers *et al.* 2016*b*).

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Some of the presented data has been collected in cooperation with supervised students. For the friendly cooperation the authors thank Cornelia Berndt (data in Figure 12), Nick Erd (data in Figure 6) and Andreas Hönes (data in Table 3). Furthermore, the authors like to thank the software company Hype Softwaretechnik GmbH for the excellent implementation of the community innovation platform.

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