HOW DO TASKS AND TECHNOLOGY FIT? – BRINGING ORDER TO THE OPEN INNOVATION CHAOS

**Abstract**

Open innovation (OI) projects comprise various steps from the generation of ideas and their development to the market launch of a product (or service). Each step of the innovation process consists of tasks whose execution results in particular outputs. Following the paradigm shift towards OI, organizations increasingly allow external stakeholders to contribute during these steps by taking over certain tasks. Although the general benefit of OI is considered to be positively influential on innovativeness and competitiveness of a new product, the individual output of each task and, thus, the OI project varies tremendously. Research illustrates a broad range from projects with a focus on just initial idea generation to ones that result in complex strategies and marketable solutions. The question remains, which tasks or sub-tasks are involved in OI projects that lead to one particular output? To answer this question, the present study analyzes existing research on open innovation projects and summarizes the tasks that are performed.

In addition to this process-oriented perspective, the technical side, i.e. the support of innovation tasks by ICT, lacks research. Recent developments, especially regarding social software, present new approaches to support these tasks. Hence, this paper uses its initial findings to develop profiles of fit between tasks and technology. By adapting the Task-Technology-Fit theory by Goodhue and Thompson (1995) this research helps organizations to select the most suitable application for a specific task.

**Keywords:** Open Innovation, Task-Technology-Fit, Social Software, Task.

1 **Introduction**

Open innovation (OI) is a powerful phenomenon that has turned into a rich concept over the past years. It aims at improving the innovation process of organizations (Carbone, Contreras, Herández, Gomez-Perez, & Hernández, 2012) and puts the collaborative creation and development of ideas and products to the fore. In practice OI projects comprise various steps beginning with the generation of ideas and ending with the launch of a new innovative product (Kruse & Geißler, 2012). The majority of these steps include several sub-steps and a chain of tasks, which are executed in order to develop and market innovative products. This study adds knowledge to this field of research from two overlapping perspectives: open innovation tasks and their supportability through social software applications.

Although the general benefit of OI is considered to be positively influential on the innovativeness and competitiveness of new products (Chesbrough, 2006; Gassmann, Enkel, and Chesbrough, 2010), the individual output of each OI project varies tremendously. Bullinger and Moeslein (2010) relate this observation to the degree of elaboration of an idea. Following their research we can distinguish between ideas, sketches, concepts, prototypes, solutions and evolving (Bullinger and Moeslein, 2010, p. 4). Although their model bases these levels on different design elements focusing on innovation contests, it remains unclear, which stage of an OI project leads to one (or more) of the above-mentioned degrees of elaboration, i.e. outputs. A first step towards filling this gap was outlined by Kruse (2013) who aligned OI approaches identified during a literature review on the process of innovation. His
study illustrates that different OI projects and their underlying methodological approaches lead to different degrees of elaboration. Nevertheless, a concise description of a chain of tasks towards such levels of elaboration is still missing.

In addition to that process-oriented perspective, the technical side, i.e. the support of each task and sub-task by ICT, lacks research. Recent developments, especially regarding social software, present new approaches to execute and support tasks on the path towards the launch of a new innovative product. Due to the great variety of social software applications, the specific benefit of each option for solving OI tasks remains unclear.

Against this background, this study fills two gaps in research:

1. by proposing generalizations for processes, which represent the tasks and sub-tasks to be executed during each step of the process of innovation in an OI environment, and

2. by developing fit profiles in reference to the Task-Technology-Fit theory by Goodhue and Thompson (1995) and Zigurs and Buckland (1998), which represent well-fitting OI task and social software application combinations.

As a result, this research introduces an overall process model subsuming OI tasks related to each stage of the process of innovation (Section 3). Based on these processes, a subsequent analysis indicates which OI stakeholders qualify for each task/process and thereby illustrates deviating paths within each step of the overall process, that ask for different stakeholders. Finally, following the aggregation of basic social software end-user functionalities (Section 4), another analysis points out how each task can be supported by the implementation of social software and which application appears to be more suitable to increase innovation performance (Section 5). This also sheds light on blind spots and gaps of current solutions, which should be investigated in future research (Section 6).

2 Related Work

Guided by the purpose of this research, this paper applies the theory of Task-Technology-Fit to open innovation environments and serves to enhance and supplement current knowledge. The theory fills a current gap by first separately defining task, social software, i.e. social software technologies, as well as fit. Due to the limitation of space, a broader focus on dimensions of innovation performance has to be neglected in favor of the previously mentioned basics.

Originally, Task-Technology-Fit is a theory developed for guiding the selection of suitable group support systems for group tasks (Zigurs and Buckland, 1998) or similar technologies for individual tasks (Goodhue & Thompson, 1995). In this paper I explore the adoption of the Task-Technology-Fit Theory for open innovation tasks and social software applications. To do so, we first need to understand how the process of innovation in an OI environment can be divided into tasks. This requires an understanding of what a task is and how it can be distinguished from the process itself. Therefore, the following section introduces the basics on tasks as well as a work definition for the subsequent investigation of the Task-Technology-Fit. This study is not intended to investigate all tasks, which can be related to OI, but those which are crucial for a single or more stages of the process of innovation (cf. Xu, Houssin, Caillaud, & Gardoni, 2010) in the given context.

Task-Technology-Fit is defined in the form of ideal profiles of task/technology alignment along the process of innovation. In addition to that, propositions are presented for predicting the influence of social software on (open) innovation performance and therefore enhanced innovativeness in an OI environment, i.e. success.
2.1 Open innovation tasks

The definition of task relies on McGrath’s understanding of what a group or an individual in a group does (McGrath, 1984). He differentiates between 4 quadrants and 8 types of tasks, which categorizes the steps of a group process and their notions (McGrath, 1984, p. 61f.): (1) generate alternatives (planning and creativity), (2) choose alternatives (intelllective tasks and decision making), (3) negotiate (cognitive conflicts and mixed-motive tasks), and (4) execute (contests/battles and performance tasks).

Since open innovation strongly depends on a collaborative culture (Standing and Kiniti, 2011, p. 293) it also emphasizes team work and group effort rather than just individual effort and reward (Standing and Benson, 2002). Thus, the types of tasks performed in a group environment are similar to those executed in an OI environment (Bergman, Jantunen, and Saksa, 2009) and involve every quadrant of the Group Task Circumplex from generating ideas (quadrant 1) to executing tasks (quadrant 4).

Nevertheless, in contrast to traditional or closed innovation (Chesbrough, 2003) the interpretation of tasks in the subsequent sections assumes some specific characteristic of open innovation tasks and thus refines McGrath’s (1984) understanding. Herzog (2011) summarizes the underlying understanding with 5 principles: First, organizations do not need to become the employer of “all the smart people anymore” (Herzog, 2011, p. 22). In an open innovation environment they should rather try to work with them inside and outside the firm. For solving OI tasks this means that organizations are increasingly involving external experts and customers. Second, innovative efforts do not necessarily require a “firm to discover, develop, and market everything” (Herzog, 2011, p. 19). Open innovation follows the idea that such activities can also be solved outside the firm – internal innovation efforts should be aware of these activities and try to generate a value for the organization out of them. This is closely related to, third, the need to find a better business model instead of being the first one to market an innovative idea. This includes, fourth, not being the firm with the “best and most ideas, but [the one making] the best use of internal and external ideas” (Herzog, 2011, p. 22). Thus, open innovation comprises not only gathering and developing ideas to a quantitatively larger extent and handing tasks to numerous external (co)innovators, but also a strategically more customer-led and market-oriented idea development (Di Stefano, Gambardella, and Verona, 2012). The fifth principle states that intellectual property (IP) management should be handled more loosely in comparison to traditional closed innovation. Although this allows competitors to benefit from the firm’s IP, it also helps them to benefit from their competitors’ IP, if they have opened their innovation process in a similar manner. Hence, OI does not ignore that every single task executed by someone who is not part of the organization could be executed for a competitor as well.

Open innovation tasks in general span a broad range. In contrast to traditional or closed innovation firms do not only search for customer needs or problems to be solved, but also for external stakeholders to be involved in innovation tasks (Kruse, 2013). These external players include, e.g., “inventors, start-ups, small entrepreneurial firms, partners, and other sources of available technologies that can be used as a basis for internal or joint development” (Cooper, 2008, p. 231). Focusing on the phases of the process of innovation and the involved tasks, firms are also seeking external developers, scientists or even “external innovations that have already been productized” (Cooper, 2008, p. 231) in order to integrate them. On the other side, they may provide licenses for IP which they do not utilize and thus skip/avoid tasks which would lead to the commercialization of the IP.

2.2 Towards an open innovation process

To improve the comprehensibility of OI tasks and their interdependencies this section examines possible tasks and sub-tasks and summarizes previous research in that field.

Starting with the generation of ideas as the first phase of the process of innovation (Xu, Houssin, Caillaud, and Gardoni, 2010) Bergman et al. (2009) introduced a structure for tasks that lead to a set of
evaluated and prioritized ideas (Bergman et al., 2009, p. 147). Although they focus on Group Decision Support Systems (GDSS), they identified seven sequential phases beginning with a (1) planning stage, where objectives, an agenda of tasks and the ideation method are defined. After that the (2) ideation takes place. Bergman et al. (2009) suggest a brainstorming session, which in their case comprises a group session of 6 to 10 participants. In a more open context, the size of such a group would not be limited. Other ideation options are, e.g., lead user analyses (von Hippel, 1986), ideation contests (Poetz & Schreier, 2012), focus groups (Cooper & Edgett, 2009), or active search (Herring, Jones, & Bailey, 2009). Subsequently, the participants have to (3) review their ideas, i.e. specify any peculiarities/characteristics and clarify ambiguities/uncertainties, to make sure that the ideas can be prepared for R&D. (4) Managing ideas comprises not only categorizing and commenting/discussing them, but also an evaluation and prioritization. The final (5) selection of the best idea (depending on the specific context) bases on customer voting/rating of the generated ideas and who may also put them in reference to each other. This evaluation allows companies to filter the most suitable idea(s) and hand them over to the subsequent step of the process of innovation (Xu et al., 2010).

| Plan/define, idea generation (brainstorm, search, etc.), review (specify, clarify), manage (categorize, comment, evaluate/rate, vote/prioritize/filter), select |

The central output of this phase are sets of ideas and further descriptions of them. Bergman et al. (2009) close the idea generation process with an (6) evaluation of the innovation process, which, from the author’s point of view, should be a recurring part – not only of the first phase of the process of innovation. Most notably, the execution of a method (i.e., ideation technique) might ask for a review of the method itself if it did not lead to the expected number or quality of ideas (based on a review of the results). Hence, a feedback loop should be integrated between every stage of the process of innovation.

The second phase of the process of innovation (research & development) also consists of sub-steps with distinct tasks. Current literature offers a variety of systematizations or models, which help to distinguish these tasks. One of the most prominent ones is the New Concept Development Model introduced by Koen et al. in 2001, which generalizes this ‘fuzzy front end’ of innovation processes. The authors suggest that after selecting an idea a concept and technology development stage is necessary before starting new product development (here: manufacturing & prototyping). During this part the firm not only develops the business case for an idea, but also considers its market chances, required investments, and potential competition (Koen et al., 2001, p. 51). Based on this estimation, the firm defines the next steps towards the ideas’ transformation into concepts. Following Cooper’s (2008) Stage Gate model, this may also involve the development of initial designs and first prototypes. Nevertheless, the main tasks of this part of the process of innovation are the further development of previously generated ideas. From the organization’s perspective, this may involve (1) (re)adjusting the objectives and deriving R&D tasks during the planning stage, literature (2) research, patent search, resource gap identification as well as material acquisition (Cooper, Edgett, and Kleinschmidt, 2002a, p. 27). From an OI perspective and the external point of view this stage comprises tasks leading to concepts, design sketches, etc. (Bullinger and Moeslein, 2010). Therefore, the range of sub-tasks is very broad and spans the spectrum between creating designs, e.g., for a label of a washing-up liquid (Burmann, Hemmann, Eilers, and Kleine-Kalmer, 2012) over developing concepts for complex information systems in the automotive industry (Kelleher, Céilleachair, and Peppard, 2012) to solving specific innovation challenges/contests (Bullinger, Neyer, Rass, and Moeslein, 2010). Hence, the generalizability of such tasks is challenging. Nevertheless, all projects analyzed have tasks in common, similar to steps (3) to (5) from the previous phase of the process of innovation, which are also part of a general group decision process (Laaksonen, Edelmann, and Suikki, 2001):

| Plan/define, search/create/develop/design/solve, review (specify, clarify, enhance), manage (categorize, comment, evaluate/rate, vote/prioritize/filter), select |

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*Kruse / How do Tasks and Technology fit?*

Twenty Second European Conference on Information Systems, Tel Aviv 2014

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The central output of this phase are sets of drafts, concepts, or designs (in different stages of development) as well as solutions for product developments and further descriptions of the aforementioned.

After the conceptual, content-oriented steps of the process of innovation prototyping and manufacturing involve project-oriented tasks that lead to a marketable product (Boeddrich, 2004). As in the stages before, this comprises (1) planning, selecting, and (2) executing a method, i.e. a method supporting manufacturing and production. Cooper et al. (2002a) associate this step with tasks, such as experimental work, preliminary market assessments, and feasibility tests (Cooper et al., 2002a, p. 27). So before a product enters a market, the open innovation project manager has to make sure that the idea (turned into a concept) is presented to the public opinion. Until then, this involves not only manufacturing prototypes or variants of a product but also (3) customizing and improving existing ones, or combining (pre)products. After that, similar routines as those mentioned in the two previous phases take place, when customers or other stakeholders are invited to (4) categorize the collected product samples, comment them, evaluate them and participate in the (5) selection of the most promising one.

| Plan/define, experiment/produce/manufacture/(co)develop, review (assess/test/combine/customize, improve), manage (categorize, comment, evaluate/rate, vote/prioritize/filter), select |

The central output of this phase are products in early as well as final stages of development.

In the final phase of the process of innovation (marketing & sales diffusion) the open innovation perspective returns to the strategic view when marketing strategies come to the fore. This again involves (1) planning and defining the objectives of this phase. Regarding the recent emphasis, e.g., on viral marketing and consumer-generated advertising (Schultze and Prandelli, 2007) customers become co-marketers when they are involved in (2) generating customer-oriented strategies. Beside the involvement in strategy development, customers integrated into previous innovation tasks may also become first buyers or act as promoters of their own ideas, and turn into sales persons. If presented to a set of alternative strategies, customers again (4) categorize, may comment or evaluate, and vote for strategic alternatives. Subsequently, they also may be involved in (5) selecting the best alternative and (6) be part of the above-mentioned marketing activities.

| Plan/define, (co)develop strategy, review (specify, clarify), manage (categorize, comment, evaluate/rate, vote/prioritize/filter), select, (co)execute strategy (promote, sell, (co)market, etc.) |

The central output of this phase are marketing strategies and in-depth descriptions of how to market the previously developed products. In addition to the already mentioned outputs of each stage, OI projects generate a lot data from evaluating, rating, prioritizing, and categorizing the results of each stage.

Summarizing this section, it shows that there is a multitude of tasks to be solved within each stage of the process of innovation. Despite the lists derived from literature for each stage there is still no particular order in these tasks and sub-tasks. Therefore, the subsequent section (Section 3) sheds light on categorization and structuring approaches for the aforementioned findings.

### 3 Bringing Order to the OI Chaos

As mentioned before, this section offers a first glimpse on potential categorization and structuring approaches for the tasks identified in section 2. After providing and discussing different category systems this section leads to an overall process model which brings the tasks from section 2.2 into an order. Additionally, different characteristics are introduced which help to structure OI tasks.
3.1 Structuring open innovation tasks

Coming back to the Group Task Circumplex (cf. Section 2.1) the tasks identified can now be realigned to the above-mentioned quadrants. Table 1 illustrates the categories comprising the described tasks.

<table>
<thead>
<tr>
<th>Quadrant</th>
<th>Task/Sub-Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>I – Generate</td>
<td>Plan, idea generation, (co)develop strategy</td>
</tr>
<tr>
<td>II – Choose</td>
<td>Search, categorize, enhance concept/design..., combine (pre)products, customize (pre)product, select</td>
</tr>
<tr>
<td>III – Negotiate</td>
<td>clarify idea, specify idea, clarify concept/design..., specify concept/design..., clarify strategy, specify strategy comment, evaluate, rate, vote, prioritize, filter</td>
</tr>
<tr>
<td>IV – Execute</td>
<td>Create, develop, design, solve, experiment, produce, manufacture product, (co)develop product, assess (pre)product, test (pre)product, improve (pre)product, (co)execute strategy</td>
</tr>
</tbody>
</table>

Table 1 Open innovation task categories I (cf. McGrath, 1984)

Although such a categorization helps to identify similarities with regard to the technological supportability of each individual task (in preparation for filling research gap 2), the four categories each still subsume groups of tasks with particularly differing requirements. Therefore, a more detailed categorization is needed.

In reference to Nissen, Kamel, and Sengupta (2000) Pirkkalainen and Pawlowski (2013) developed a life cycle that comprises basic knowledge management tasks and maps them to social software functionalities. Since the acquisition, transfer, integration, and absorption of knowledge plays a significant role in open innovation or innovation processes in general (Cohen and Levinthal, 1990; Gassmann et al., 2010; von Hippel, 1986) the aforementioned research can be adapted to the present context and reused for the categorization of OI tasks. The steps of the life cycle include create, organize, formalize, distribute, identify, apply, and evolve and thus allow a differentiated more task-oriented categorization compared to McGrath (1984) and Table 1.

<table>
<thead>
<tr>
<th>Life Cycle Step</th>
<th>Task/Sub-Task</th>
<th>Research &amp; Development</th>
<th>Prototyping &amp; Manufacturing</th>
<th>Marketing &amp; Sales Diffusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Create</td>
<td>generate ideas (brainstorm, etc.)</td>
<td>create, develop, design</td>
<td>produce, manufacture, (co)develop</td>
<td>(co)develop strategy</td>
</tr>
<tr>
<td>Organize</td>
<td>plan, define, categorize</td>
<td>plan, define, categorize, combine</td>
<td>plan, define, categorize</td>
<td>plan, define, categorize</td>
</tr>
<tr>
<td>Formalize</td>
<td>specify, clarify</td>
<td>specify, clarify</td>
<td>assess, test</td>
<td>specify, clarify</td>
</tr>
<tr>
<td>Distribute</td>
<td>comment</td>
<td>comment</td>
<td>comment</td>
<td>(co)execute strategy (promote, market, sell, etc.)</td>
</tr>
<tr>
<td>Identify</td>
<td>evaluate, prioritize, select</td>
<td>search, evaluate, prioritize, select</td>
<td>evaluate, prioritize, select</td>
<td>evaluate, prioritize, select</td>
</tr>
<tr>
<td>Apply</td>
<td>filter</td>
<td>solve, filter</td>
<td>filter experiment</td>
<td>filter</td>
</tr>
<tr>
<td>Evolve</td>
<td>rate, vote</td>
<td>enhance, rate, vote</td>
<td>rate, vote, customize, improve</td>
<td>rate, vote</td>
</tr>
</tbody>
</table>

Table 2 Open innovation task categories II (cf. Pirkkalainen and Pawlowski, 2013)

Table 2 illustrates how the identified tasks can be aligned to the suggested categories. Step 1 create involves creativity during the generation of new ideas, concepts, and strategies as well as capturing and acquisition of existing ones. The following step organize includes tasks that aim at developing structures (e.g., taxonomies, ontologies) and plans out of the results from creative tasks. Thus, these tasks aim at (re)using or combining ideas, concepts, or strategies. Formalize, as step 3, involves tasks focusing on standardization or harmonization. These efforts aim at explaining and amplifying first results on their way to an innovative, marketable product. Step 4 distribute concentrates on providing access to the results for customers, e.g., as external reviewers, users or future customers who then comment on the ideas and concepts or finally distribute them by themselves as part of the marketing and sales diffusion phase. Apart from the generation of ideas internally, OI also involves the identifi-
cation of external IP that could be marketed or the identification of experts and expert opinions on ideas or concepts which is part of the fifth step identify. The subsequent tasks of the step apply aim at turning concepts, ideas, strategies into decisions and utilizing them to solve problems (Nissen, 1999). These tasks are the basis for the identification of room for improvement. The latter is already part of step evolve, where the developed ideas, concepts, strategies are subject to an evaluation. Here, external experts, users, and customers are invited do grade, rate and vote on the results, which is the fundament for further development or a customization, recombination of solution(s).

For the remainder of this research this categorization shall serve as a link between OI tasks and social software application that support them. To further structure the tasks in preparation for a task/technology alignment, the following paragraphs describe a framework that reflects the Group Task Circumplex and aims at bringing the tasks into a comprehensible order.

<table>
<thead>
<tr>
<th>Plan</th>
<th>Define</th>
<th>Execute</th>
<th>Review</th>
<th>Manage</th>
<th>Select</th>
</tr>
</thead>
<tbody>
<tr>
<td>Idea Generation</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plan steps</td>
<td>Define objective</td>
<td>Define task(s) &amp; method</td>
<td>Execute ideation</td>
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<td></td>
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<td></td>
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<td></td>
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<tr>
<td>Concept Generation</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plan steps</td>
<td>Define objective</td>
<td>Define task(s) &amp; method</td>
<td>Execute R&amp;D</td>
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<td></td>
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<td></td>
<td></td>
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<tr>
<td>Marketing &amp; Sales</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plan steps</td>
<td>Define objective</td>
<td>Define task(s) &amp; method</td>
<td>Execute P&amp;M</td>
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<tr>
<td>Research &amp; Design</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plan steps</td>
<td>Define objective</td>
<td>Define task(s) &amp; method</td>
<td>Execute Strategy Dev.</td>
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<tr>
<td>Management &amp; OI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plan steps</td>
<td>Define objective</td>
<td>Define task(s) &amp; method</td>
<td>Generate strategies</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technology Alignment</td>
<td></td>
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</tr>
</tbody>
</table>

Figure 1: Open innovation tasks aligned to the innovation process

In reference to the steps of the process of innovation (Xu et al., 2010) in an OI environment Figure 1 illustrates how OI tasks and sub-tasks are brought into an order and thus fills the first research gap. These steps and their sequence were derived in alignment with current and historical OI projects and cover different OI approaches as well as strategies (cf. Kruse, 2013). As it turns out, the identified tasks within each step of the process of innovation follow a structure that is similar to the Stage-Gate-Model developed by Cooper, Edgett, and Kleinschmidt (2002a, 2002b):

First, a goal or an objective has to be defined. This step is usually managed by the organization’s (OI) project manager(s). Following the definition of objectives, the project manager derives tasks (e.g., generate ideas, test products, develop strategies) and directions on how to solve these tasks, which are then to be solved by participants of the OI project (i.e., customers, suppliers, competitors, etc.). After handing each task to the crowd or external innovator(s), the solution mainly relies on their creativity. The project manager is responsible for collecting the results and presenting them to the participants again. The latter is prerequisite for a second collaborative step, the evaluation of the results, which involves rating (i.e., giving grades), voting (up- or down) and discussing them. After that, a pre-defined algorithm or again the project manager filters the results based on the ratings and selects those, which are to be handed over the subsequent step of the process of innovation.
4 Bringing Order to the Application Chaos

As Figure 1 points out, OI tasks may comprise simple tasks, such as the collection of concepts generated, e.g., by customers, as well as highly complex tasks, such as the generation of ideas or the discussion of concepts and strategies. Following this notion, supporting applications from a social software perspective span a broad range from easy-to-use and -setup applications to firm-spanning solutions which may cover more than one task.

This finding corresponds with Zigurs and Buckland (1998) who stated that some Group Support Software (GSS) was found to be more appropriate for complex rather than simple tasks (Dennis and Gallupe, 1993), while in others, GSS was more appropriate for less complex tasks and single-solution tasks (Benbasat and Lim, 1993). The same applies to social software.

Nevertheless, the variety of applications in both scenarios remains huge. In order to facilitate the selection of the most suitable tool or system, the subsequent section summarizes social software categories which should all be taken into consideration to support OI tasks.

4.1 Social software categories

Following Pirkkalainen and Pawlowski (2013) social software tools can be divided into several categories. These categories each comprise a variety of ideas and software solutions, but are equal in their purpose as well as their end-user functionality. Therefore, Table 3 comprises only categories and does not differentiate between representatives of each category.

<table>
<thead>
<tr>
<th>Tool category</th>
<th>Purpose</th>
<th>End-user functionality</th>
<th>Example software</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blogging Tools</td>
<td>Communication</td>
<td>Writing, comment, evaluate writings, alerts</td>
<td>Wordpress, Blogger</td>
</tr>
<tr>
<td>Microblogging Tools</td>
<td>Connection/awareness</td>
<td>Writing, comment, share, evaluate writings, inform, manage profile, follow others, direct messages</td>
<td>Twitter</td>
</tr>
<tr>
<td>Social Networking Tools</td>
<td>Awareness, communication, sharing, (collaboration), (identification)</td>
<td>Manage friends/events/groups, writing, share material, manage profile, notification, direct/instant messages, integrate in other systems</td>
<td>Facebook, LinkedIn</td>
</tr>
<tr>
<td>Social bookmarking tools</td>
<td>Identification, collaboration, sharing</td>
<td>Save/share links, comment on links, follow users, notification</td>
<td>delicious</td>
</tr>
<tr>
<td>Wiki</td>
<td>Collaboration, sharing, identification, communication</td>
<td>Collaborative editing, cross-linking, page versioning, commenting, notification</td>
<td>Media Wiki, Wikia, Wikispaces</td>
</tr>
<tr>
<td>Collaborative Writing</td>
<td>Collaboration</td>
<td>Writing, collaborative editing, page versioning, instant messaging, commenting</td>
<td>Google Docs, PiratePad</td>
</tr>
<tr>
<td>Instant Messaging/Chat</td>
<td>Communication</td>
<td>Manage contacts, send private messages, raise awareness, video call</td>
<td>Skype, Facebook Messenger, Whatsapp</td>
</tr>
<tr>
<td>Time management</td>
<td>Collaboration, awareness</td>
<td>Create calendars, shared calendars, organize meetings, make to-do lists,</td>
<td>Google calendar, Asana, Microsoft Outlook</td>
</tr>
</tbody>
</table>
In addition to Web 2.0-oriented tools, open innovation tasks may also be supported by group support systems and applications not depending on the Internet. However, the focus of this research lies on the adoption of social software. A categorization for these alternatives can be found, e.g., in Nissen, Kamel and Sengupta (2000).

4.2 Summary

The findings in sections 2, 3, and 4.1 suggest that open innovation tasks can be characterized similar to the peculiarities of group tasks as introduced by McGrath et al. (1993, p. 407). Table 4 summarizes these characteristics, which help to understand how the Task-Technology-Fit theory can be adapted for OI tasks.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Description</th>
<th>Focus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task production</td>
<td>A set of tasks and the outcomes that are generated by those tasks of a particular set of members using a set of tools for a set of purposes in a specific context.</td>
<td>innovation tasks (Section 3)</td>
</tr>
<tr>
<td>Task structure</td>
<td>A set of collective or shared purposes transformed into a set of projects, strategies for accomplishing those projects, and tasks by which those strategies can be done.</td>
<td>Tasks along the process of innovation in which each phase follows a specific strategy (Figure 1)</td>
</tr>
<tr>
<td>Group composition &amp; structure</td>
<td>A set of members and relationships between them.</td>
<td>OI actors and owners (Section 3)</td>
</tr>
<tr>
<td>Technology</td>
<td>A set of tools, rules, procedures, and resources to carry out their purposes – hardware and software</td>
<td>social software (Section 4)</td>
</tr>
</tbody>
</table>

Table 4 Open innovation task characteristics

The developed open innovation process (Figure 1) and the identified end-user functionalities (Table 3) are now the basis for assessing the fit between technology and OI task. Hence, the subsequent section (Section 5) presents the core of this study and provides an example which illustrates how such a fit could be achieved and how it affects innovation performance.

5 Adapting the Task-Technology-Fit Theory on OI

Achieving a fit between task and technology should be a principle for an effective support of OI through social software applications. The question that remains is: can we specify particular combinations of tasks and applications that will improve innovation performance?

Figure 2 General model of Task-Technology-Fit in OI
By adapting Zigurs’ and Buckland’s (1998) Task-Technology-Fit model, this research aims to identify fit profiles between OI tasks and social software technologies (Figure 2).

The assessment of fit bases on the estimations of 3 social software experts (former researchers, now practitioners) who were interviewed during a single focus group session. The participants were asked to discuss every aspect of support by the given social software applications (i.e., end-user functionalities, Table 3) with regard to the identified open innovation tasks (Figure 1). Each participant wrote down his/her estimation of fit in an Excel-sheet. The rating of fit was divided into a 4-point scale, from 1 (no fit) over 2 (low fit) and 3 (medium fit) to 4 (high fit). Additionally, the participants were asked to provide a statement on the direction of the supportive capability. Since there are examples, where a particular social software application may support the execution of the task directly (e.g., using brainstorming tools to collect ideas) and examples, where the influence has a rather indirect effect (e.g., using wikis for product evaluation supports the collection of evaluations not the evaluation itself), the participants had to state, which alternative was predominant.

5.1 Results

Due to the limitation of space, this section only provides one example that illustrates how the Task-Technology-Fit was assessed during the focus group session and how it helps to select the most suitable social software application to solve the OI task. Following the illustrated approach (Section 5), the description of a fit profile focuses on a very condensed exemplary task: assessing a (pre)product during prototyping and manufacturing. The following paragraphs summarize the results of the group discussion:

Providing an assessment of a product may lead to very different results. It could produce a short statement, e.g., on the quality of a product or result in an in-depth description of the product’s peculiarities, strengths, and weaknesses. Such an assessment may be conducted by an individual or a group of experts. Hence, writing plays an important role but also the collaboration and communication with other contributors. Therefore, a suitable social software application should support the task by allowing (collaborative) text editing, commenting, notifications of changes, and sharing of additional material. Much less important are, e.g., scheduling the assessment, since it is mostly a unique, non-recurring event and exchanging short information chunks, which could only indirectly support the assessment (e.g., if a customer shares her/his thoughts via posting a link on Twitter).

Based on the above-mentioned analysis of the task requirements during the focus group session and the comparison to end-user functionalities of social software, the interviewees rated blogging tools, social networking tools, wikis, collaborative writing tools, shared information spaces, and discussion board as highly supportive (high fit) for the development of an assessment of a (pre)product. Conferencing and messaging tools have an average capability to support the task (medium fit). Microblogging and brainstorming tools possess only a low supportive capability (low fit) while social bookmarking and time management tools exhibit no influence on the execution of the task (no fit). Thus, the experts’ evaluation recognizes the demand for a platform to which customers and other external stakeholders can be invited and where they find the necessary functionalities to write, edit, and discuss.

By applying the same procedure on the remainder of tasks, the discussion during the focus group session resulted in a holistic overview on the fit between open innovation tasks and social software applications (Figure 3).
As Figure 3 illustrates, not every social software application may support open innovation tasks equally. Some applications possess a greater capability and support almost every task of the process of innovation (wikis, shared information spaces). Other applications only offer a very limited support for open innovation (time management tools, social bookmarking tools). Hence, Figure 3 helps to understand the suitability of certain application categories and thus facilitates the selection of the best-fitting application. Moreover, the discussion also revealed that in some cases social software – regardless the breadth of the available application categories – cannot substitute non-social applications or the simple physical meeting. Especially during prototyping and manufacturing, which involves design and construction tasks, social software cannot replace the work bench, CAD tools or the physical contact with the product. Therefore, the adoption of social software can only indirectly support the particular task. The most promising use cases for social software during open innovation projects are idea generation, where it facilitates the collaboration between external and internal stakeholders, and managing the results of the four parts of the innovation process (i.e., categorizing, commenting, etc.).

Nevertheless, although Figure 3 fills research gap number 2 it only provides an approximation to quantifiable fit profiles, which are also subject to contingency.

6 Conclusion

The range of OI tasks between initial idea generation up to evolving strategies and complete solutions is still very broad. In this regard, the present research offers a first step towards a systematization of the chaos caused by the multitude of approaches, strategies, and successful and not successful projects.
By proposing generalizations for processes, which represent the tasks and sub-tasks to be executed during each step of the process of innovation in an OI environment, this paper helps to understand the interdependencies between them.

In addition to that, the developed fit profiles illustrate – in reference to the Task-Technology-Fit approach (Goodhue & Thompson, 1995; Zigurs & Buckland, 1998) – well-fitting OI task and social software application combinations that may have a positive influence on innovation performance. They allow organizations or individuals to purposefully differentiate between available social software applications and help to identify the best-fitting application for a certain open innovation task. Thus, utilizing the fit profiles will help to fulfil open innovation tasks in a more effective way, enabling organizations to increase the overall innovation performance.

Although, the research gaps could be filled, there are some limitations to be pointed out that also illustrate directions for future research: First, due to the limitation of space, this study only provides a small glimpse on the alignment of open innovation tasks and social software application. In this regard, the depiction of fitting social software applications and open innovation tasks (Figure 3) can only refer to social software categories. The lion’s share of these categories cover similar functionalities, but to a different extent. The reflection of research on this issue would help to increase the fit between end-user functionalities and tasks. Moreover, not every application from a single category covers the same features as its competitors (e.g., compare MediaWiki, Wikia, and wikispaces). Hence, a differentiation between actual applications would be helpful for an even more considered decision (cf. CosmoCode 2014). Third, the process model (Figure 1) enhances the general understanding of tasks that are executed during open innovation projects. However, the variety of open innovation tasks, their heterogeneous economic attributes and results do not allow for an unambiguous judgment and universally applicable recommendations for action. Thus, in order to enhance the usability of the framework for future open innovation projects, additional empirical data from use cases would increase the rigor of the model and help to sharpen the order of the identified sub-tasks as well as their level of detail. Fourth, a more detailed description of the open innovation tasks regarding owner (Hetmank, 2013) and type (Elmquist, Fredberg, & Ollila, 2009) could also be a starting point for future research. Such detailing would help to allocate responsibilities for tasks as well as their assignment to individuals, groups, or the crowd. Fifth, the adapted Task-Technology-Fit theory reduces the understanding of innovation performance by indicating that a good fit between task and technology may lead (or leads) to a higher innovation performance. Here, a more differentiated picture is required, which, e.g., provides indicators for a performance measurement. Similar research can already be found in studies on innovation acceptance and sales performance (Hambrick and Macmillan, 1985), achievement of innovation objectives as suggested by OECD (2005), influence on R&D investment (Frenz and Jetto-Gillies, 2009; Sofka and Grimpe, 2010), or on the degree of social interaction (Huang and Li, 2009; Nahapiet and Ghoshal, 1998; Tsai and Ghoshal, 1998). Finally, the adapted Task-Technology-Fit model and the example should be regarded as an impulse for discussions and do not claim to be exhaustive. They provide a fundament for reasoning the selection of supportive applications in an open innovation environment but still lack detail that future research could provide.

References


