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OPEN INNOVATION AND IDEA GENERATION IN SMES

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ABSTRACT
Previous research in the field of open innovation is dominated by research on large and multinational corporations, research in the software industry, and in the consumer goods sector. However, few articles report on studies from small and medium-sized companies (SMEs) in the business to business (B2B) sector. This research gap is addressed by exploring how SMEs may engage in and organize inbound open innovation seminars most efficiently. The article outlines the results from an open innovation seminar conducted with basis in real-life challenges for a Norwegian SME. The results indicate such seminars may be an efficient and cost-effective way of providing SMEs ideas and information concerning new markets, new technologies, and new product ideas. Specific described and designed innovation challenges produced the highest quality ideas, based on the quality criteria novelty, usefulness, and feasibility. Factors such as personal motivation and capabilities, in addition to mutual trust and respect are believed to be important when organizing open innovation seminars as described in the article.

Keywords: open innovation, creativity, idea generation, SMEs

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1 INTRODUCTION

A major concern for manufacturing companies operating in high-cost countries is how to successfully position themselves better in the global market place. One answer may be to dramatically improve their capabilities to innovate, develop, and produce successful new products. These improved products must research the market place earlier than competitors' ones, before new technologies are available to the "mass" market, and before the market changes (Welo 2011).

Small and medium-sized enterprises (SMEs) in particular depend on their innovation ability to sustain their competitive advantage, although their success rate in innovation may be lower than desired due to factors such as high risk level, high complexity, and the inherent uncertainty in the innovation process. Moreover, SMEs suffers by the "liability of smallness" (Gassmann, Enkel et al. 2010; Parida, Westerberg et al. 2012), meaning they may have limited time, financial resources, smaller R&D departments, less multidisciplinary competence and also often have less structured R&D processes. In sum, these factors pose great challenges for SMEs struggling to find its place in the global market place. However, if SMEs find new ways to boost their innovativeness despite these challenges, the SMEs advantages of being less bureaucratic, faster to react to changes, and having more specialized knowledge (Parida, Westerberg et al. 2012), may together help SMEs to develop and sustain their competitive advantage. Open innovation is suggested by other researchers as one path in which SMEs may collaborate in networks to overcome their "liability of smallness"(Christensen, Olesen et al. 2005).

Research literature in the field of open innovation is dominated by the work of Chesbrough who defines open innovation as "*..the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation respectively"* (Chesbrough 2006). It focuses on how companies can cooperate across company boundaries to create and successfully commercialize innovations. In this field, research has to a large extent been dominated by research on large and often multinational corporations, research in the software industry, and in the consumer goods sector (Gassmann, Enkel et al. 2010; Ili, Albers et al. 2010). Moreover, few articles are available on "how to do" open innovation, as most articles adopts the management perspective and practices (Parida, Westerberg et al. 2012).

With this background, this article reports on an empirical case study with the purpose of exploring how SMEs may engage in open innovation activities, more specifically, how SMEs best can organize inbound open innovation seminars and the efficiency of such. The article outlines the results from an open innovation seminar conducted with basis in real-life challenges for a Norwegian SME, and how this SME later have utilized the results from the open innovation seminar. A "how to do" description which goes beyond the traditional managerial focus is provided and should be useful to both researchers and practitioners despite the limited generalizability of this study.

2 THEORETICAL BACKGROUND

2.1 Open innovation

Open innovation as a phenomenon is receiving increasingly attention and is today becoming more and more important to both practitioners and researchers. The important book of Chesbrough from 2003 represents a paradigm shift from a closed towards an open innovation model. Open innovation means that firms more and more rely on external sources of innovation and by realizing that ideas, resources, and individuals flow in and out of organizations (Chesbrough 2003). According to Enkel et al. (Enkel, Gassmann et al. 2009), three core processes can be differentiated in open innovation:

1. The outside-in process (inbound open innovation) in which the companies own knowledge base is enriched through the integration of suppliers, customers, and external knowledge sourcing. This enrichment of a company's knowledge base may increase innovativeness.
2. The inside-out process (outbound open innovation) is when a company can earn profits from bringing ideas to the market, selling intellectual property (IP), and multiplying technology by transferring ideas to other organizations and environments. The assumptions is that other organizations may be better suited to commercialize a given technology or idea than the company itself.
3. The coupled process is called co-creation with complementary partners through alliances, cooperation, and joint ventures. The idea is to combine the outside-in and inside-out open

innovation processes, and by doing so, jointly develop and commercialize innovation. In the electrical, electronic, IT, and other high-tech business, nearly 50% of all R&D projects are joint projects involving co-creation (Enkel, Gassmann et al. 2009).

2.2 Open innovation in SMEs

Strong internal R&D capabilities have traditionally been associated with innovativeness. Being a SME, the "liability of smallness" may be managed by opening up the innovation process and by looking to the surroundings of the company for ideas, technologies, and knowledge (Gassmann, Enkel et al. 2010). Acknowledging that knowledge is distributed, SMEs may use firms in other industries, users, suppliers, academia, alliance partners, artists, events , and "the internet crowd" as its extended and virtual R&D department (von Hippel 2005; Verganti 2008; Gassmann, Enkel et al. 2010). This opportunity has only to a limited extent been described in the research community, most recently by Parida et al. (2012).

By accessing network partner's external resources, SMEs may take advantage of wider market opportunities through developing new technology combination (Baum, Calabrese et al. 2000). To fill in and close their internal technology gap, accessing and utilizing technology developed elsewhere is another option for SMEs (Grønlund, Rønnberg-Sjødin et al. 2010). SMEs are likely to experience such technology gaps as they often have a narrow and specialized focus on technological development. Another benefit from utilizing such technology is that the new technology will be tested in-house and may contribute to both the speed and quality of innovation activities (Van De Vrande, De Jogn et al. 2009). Recent research has also revealed that open innovation may be beneficial to SMEs as technology sourcing is linked to radical innovation performance, whereas technology scouting is linked to incremental innovation performance (Parida, Westerberg et al. 2012). This finding corresponds to a previously finding of Larsen and Salter (2006) who suggest that companies that are open to external sources and search channels are likely to have a higher level of innovative performance.

2.3 Open innovation and idea generation

Altogether, research literature unanimously points to advantages for SMEs when it comes to technology revealed in relation to open innovation. But what about the generation of new product ideas? Companies find it increasingly challenging to develop successful new products, and the generation of new ideas is one of the initial important tasks in the new product development process. This fuzzy front end is of particular importance as it determines a company's potential to find promising new product ideas and ways of producing this product at a reasonable cost (Soukhoroukova, Spann et al. 2012).

Traditionally, a company's designers, engineers, and marketing personnel are the ones who take on innovation activities and the tasks that require creativity (Ulrich and Eppinger 2008). These professionals try to be creative in solving relevant problems. The main assumption behind this approach is that company professionals, unlike users and customers, have the experience, knowledge, and expertise required to come up with truly new and useful ideas. Consequently, due to their knowledge, their ideas should most likely succeed in the market place (Ulrich and Eppinger 2008).

Through the dissemination of internet-based technologies, new and promising methods which may support the idea generation phase in innovation and new product development, have emerged. These technologies enables companies to draw on the efficiency of markets and "wisdom of the crowd" (Soukhoroukova, Spann et al. 2012). Crowdsourcing, that is, outsourcing the entire idea generation phase to a crowd of users is becoming increasingly popular (Poetz and Schreier 2012). Internet-based innovation communities for open source projects is yet another example (von Hippel 2005), as is innovation contests on internet or idea competitions (Soukhoroukova, Spann et al. 2012),

Common characteristics for this research are the focus on large companies and corporations, and the focus consumer products with a large crowd of users; hence internet may be a suitable tool. There seem to be a limited research involving SMEs which manufacture industrial products in the business to business (B2B) sector. Hence this article will explore how a B2B SME can use inbound open innovation to improve and boost its idea generation phase, both for new technologies and for new products. This will be done in the context of an open innovation seminar in the context of real-life problems.

The results from this new empirical research will contribute to the limited body of knowledge within the field of open innovation concerning SMEs. At the same time, the method and the results offers an "how to do" description for companies aiming to improve their innovation abilities.

3 STUDY METHOD

3.1 The case company

Selecting an appropriate sample is important in case research, and involves criteria like relevance to research questions, if the phenomenon to be studied may appear, and if it is feasible and ethical (Karlsson 2009; Yin 2009). Against this background, a company that met the following criteria was selected for conducting the study: 1) it had to be a SME in the B2B sector, 2) it had to have a real need to innovate, 3) it had to be willing to contribute with internal innovation professionals, and 4) it had to be willing to evaluate all ideas generated to assess the overall quality of the generated ideas.

The chosen case firm is a family owned SME with little bureaucracy, effective internal communication, and short time from decisions are made to actual implementation. It is known to be innovative within its market, and its success is based on highly complex, sophisticated, and automated production of polymer based products from injection-moulding processes. Injection-moulding involves making products from plastic granulates which are injected at high pressure into a tool or a mould, which again gives the part the desired shape and characteristic. Being a SME located in a small fjord town of Norway, continuous innovation in products, technology, and markets are essential for the survival of the company. Their CEO frequently participates in several research and innovation networks; *"In order to become best within our field, we have to find the best and work with the best"*. In addition to academia and universities, the company collaborates frequently with suppliers of machines, tools and raw materials, industry and trade associations, in addition to participation in research projects. According to the CEO, the company practices both inbound and outbound innovation, although inbound innovation activities dominate.

The company employs 31 people, and its products are sold to sectors as furniture, aquaculture, offshore, automotive, and lighting. The case company is a marked leader within its field, but seeks to explore new products and markets for improve robustness and future survival. In 2011 annual turnover exceeded 50 million NOK.

Technology innovations are one of three major types of innovation projects within the company. In such projects, the customer typically brings a "built to print" design to the company, and hence, only smaller changes to the design are made to prepare the product for manufacturing. Other types of innovation projects involve both product and technology innovations. In this case, the customer only brings a rough idea to the table, as it lacks the ability and competence to design products itself. In such cases, the company becomes the customer's R&D department. The third type of innovation projects which is being increasingly explored, also involves both technology and product innovations, but is a company, not customer, owned and driven process. Company owned and developed products are believed to make to company more financially robust, especially in times of financial crisis. Therefore, coming up with good ideas for new products are of highest importance. One company owned product is already successfully in the market place.

The innovation projects are typically organized multidisciplinary, with design engineer, polymer engineer and construction engineer. Based on the challenge ahead, the team is supplemented with sourcing engineer, plant manager, automation engineer, process engineer and other technical personnel. 3D printers and computer simulations are the most frequently used tools in the early phases of new product and technology developments. Full scale testing is rarer, but may be applied in later development phases when the ideas are more mature and developed.

Everyone in the company, including production workers, are encouraged to propose ideas for new products or technologies based on the problem at hand. In low risk projects, the project group itself typically decides which ideas to pursue or not, based on experience and democracy. Criteria such as customer need and satisfaction, cost/benefit, manufacturability, and quality are used for narrowing down the number of ideas in this phase. In high risk projects, however, the CEO is involved in the decision making and has the final say on which ideas should be further developed or not.

3.2 Idea generation

Before starting the data collection, a detailed research protocol describing data collection methods and work shop procedure was developed and pretested with academic faculty. The study method was influenced by the recent work of Poetz and Schreier (2012), but adapted to a B2B context and seminar event. To our knowledge, no similar processes have been described in literature before.

The research is mainly based on a full day seminar conducted May 2012, involving 32 managers and four other professionals from 16 different companies. In addition, two in-depth interviews were conducted with managers from the case firm. During the seminar, the participants were divided into six groups. Two and two groups were given the same challenge to work on, meaning a total of three different questions were used as a basis for the idea generation phase. The groups worked with the following innovation challenges, which had been developed by the case company in advance based on real-life needs (Table 1):

Table 1. Innovation challenges for inbound open innovation

	Innovation challenge	Type of inflow quest
Group 1+2	A) The case company is leading within complex and automated injection-moulding from plastic resin. Today's customers are mainly within the furniture, aquaculture, and offshore sector. Which other markets may be explored with today's products and technologies, and which other products may be produced with today's technology?	-Market information -Product ideas
Group 3+4	B) A specific aquaculture product shall be produced in small series at first. However, the product and process should be designed in a way which allows for up-scaling from several thousand to several million units per year. How should the product and process be designed to allow for this?	-Technology information -Product ideas
Group 4+5	C) Explore this given product which may be produced in all sizes, colors, material coatings etc. How can this product be utilized in other products or markets?	-Market information -Product ideas

The idea generation phase followed the main steps:

- Warming up: drawing as many circular objects one can think of in 1 minute. Share and explain.
- Self-organization of the group: finding a leader within each group through democratic process.
- Individual brain-writing: writing down all ideas to the innovation challenge. One idea a sheet.
- Collective brain-writing: write down more ideas on others' sheets inspiration from their original idea. Write down entirely new ideas or just improvements/alterations to the first idea.
- Selection process: (+) for good ideas, (!) for inspirational ideas, and (-) for bad ideas. Select the ideas with most (+).
- Collective brainstorming on the best ideas with "what if" questions (ex. what if it was much smaller, bigger, softer, harder….etc.).
- Collective brainstorming on the (!) ideas with "what if" questions (ex. what if it was much smaller, bigger, softer, harder….etc.).
- Selection process based on the wildest, the most feasible, and the most profitable ideas.
- Plenary presentation of these three ideas (These last two steps in the idea generation phase was not necessary for the case company, but important to the groups to round off the seminar).

As a preparation to the idea generation phase, the open innovation seminar started with a presentation of the case company's innovation process. A general presentation of other manufacturing companies in the same geographical area was also included. Following these, the entire group was allowed to visit the production facilities, to see the technology and products, and to talk with production workers. The seminar then continued with an introduction to creativity principles and techniques before the actual work with the innovation challenges groups. Figure 1 on the following page illustrates a typical organization of people during the group exercises.

Figure 1. Group exercise exploring ideas with "what if" questions

3.3 Description of user sample

In order to investigate if any of the groups where more capable of generating better ideas than the other groups, it is important to know the main characteristics of the participants in the work shop. The participants where predominantly male (80.6%). Another important user characteristic was the pre-positive relation to innovation and product development. The participants were either top executive managers (25%), R&D managers (36.1%), or marketing managers (11.1 %) coming from various Norwegian manufacturing companies. A continuous high innovation rate (product/process/market) is the main key, and common features, to survival and success in these companies. In addition, some project managers working with community and industry development (16.8%) participated. The remaining 11% were project members and researchers from various R&D projects. 77.8% of all the participants came from the private industry, whereas 75% were partners in an already existing industrial network. All in all, the seminar participants should be more than average interested in innovation, development, and technology.

3.4 Evaluation of ideas

The quality of all ideas generated was assessed by the top executive from the company, the CEO. The CEO is the person who generally decides which ideas that should be pursued in high risk NPD or technology projects, and has furthermore extensive technical and market knowledge. Before the evaluation, all ideas were grouped thematically by the researchers to allow for easier comparison. Moreover, an initial sorting was made based on whether the idea constituted a real idea and not just general comments on the topic, and whether the ideas were sufficiently described so that they could be evaluated properly. Also, equal ideas were sorted out. In total, 62 out of 272 ideas were excluded from further analysis based on these criteria. The remaining 210 ideas were then presented in a random order to the executive, grouped based on the workshop sessions.

Simply generating a large number of unique ideas have no real value for companies. Following previous research, the quality of ideas may be assessed by the following quality criteria identified in literature to evaluate ideas (Rietzschel, Nijstad et al. 2007; Heslin 2009; Poetz and Schreier 2012):

- Novelty, how new the idea is compared to existing products, processes, or solutions available to the problem.
- Usefulness, the value of the idea in terms of solving the underlying problem (in our case, to respond to the problem statement given in the workshop).
- Feasibility and effectiveness for implementation, how easily the idea can be developed and transferred into ac commercial solution (technical, ethical and economic aspects).

All three variables were measured using a 5-point rating scale, where 1 = low usefulness/novelty/feasibility and 5 = high usefulness/novelty/feasibility. For further analysis, a three-way interaction term (novelty x usefulness x feasibility) was created to allow for an overall comparison of ideas between the three samples.

4 RESULTS

Altogether, the high number of ideas generated indicates high efficiency of the open innovation seminar. Innovation challenge A (market information + product ideas) had a total of 121 unique ideas out of 159, innovation challenge B (technology information + product ideas) had a total of 31 unique

ideas out of 45, and finally innovation challenge C (market information + product ideas) resulted in 58 unique ideas out of 68. Purely based on the number ideas produced for each innovation challenge, group 1+2 were most efficient, followed by group 5+6, whereas group 3+4 produced the lowest number of unique ideas.
As previously discussed, generating a large number of unique ideas have no real value for companies, it is therefore more interesting to look at the quality rating of the ideas. Table 2 presents average scores on ideas within each innovation challenge, and the standard deviation associated with it.

Table 2. Unique ideas pr. Group

	Idea Quality							
	Novelty Mean	Novelty SD	Usefulness Mean	Usefulness SD	Feasibility Mean	Feasibility SD	NxUxF Mean	NxUxF SD
Challenge A (Group 1+2)	3.39	1.54	2.88	1.14	3.98	1.2	43.53	31.45
Challenge B (Group 3+4)	4.50	0.85	4.40	0.96	4.50	1.06	91.07	36.08
Challenge C (Group 5+6)	3.26	1.56	3.00	1.46	3.51	1.60	40.09	35.88

Moreover, the three-way interaction term (novelty (N) x usefulness (U) x feasibility (F)) represents the total quality of the ideas. Based on these criteria, innovation challenge B received by far the best score for its ideas. Innovation challenge B is also the challenge with the best standard deviation values. This result indicates that either the group participants were better equipped to bring new technology and product information to the table. It could also indicate that the innovation challenge was better described or more comprehensive. Innovation challenge B was the most specifically described challenge included in the seminar.
From a company perspective, a relative high mean value statistics for all innovation challenges indicates that the open innovation seminar was efficient for the case company, and a useful way of organizing the inbound information flows, both concerning new markets, new technologies, and new product ideas.
The following Figures 2, 3, and 4 demonstrate the percentages of scores as a function of all the answers within each innovation challenge. That is, the percentage of 1-ratings, the percentage of 2-ratings, the percentage of 3-rating etc. for each quality criteria.

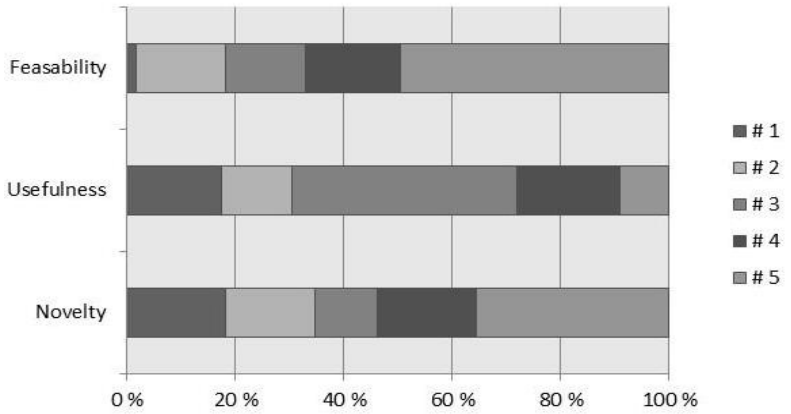

Figure 2. Results innovation challenge A

The results from Figure 2, 3, and 4 demonstrate that innovation challenge B received the highest number of 5-ratings for all quality criteria. Innovation challenge C received the highest number of 5-ratings for its feasibility of solutions proposed, but received lower scores for usefulness and novelty. More or less the same results are reflected in innovation challenge A, but in addition, innovation challenge A receives the overall lowest rating for usefulness. Altogether, the results from Figure 2, 3, and 4 confirm the results in Table 2.

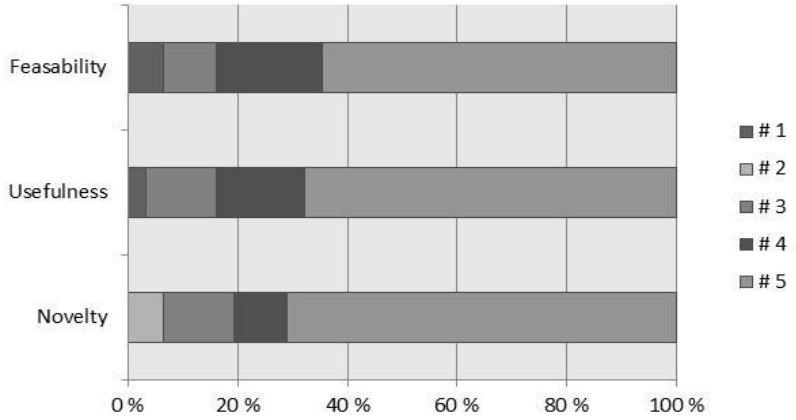

Figure 3. Results innovation challenge B

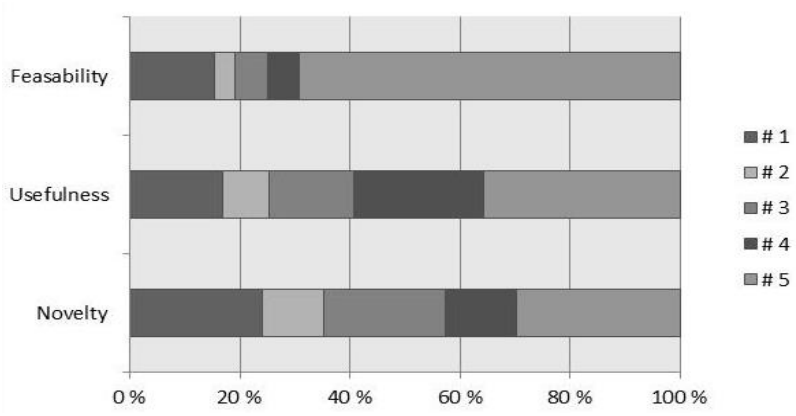

Figure 4. Results innovation challenge C

From a theoretical perspective, the results indicate that closed and clearly defined innovation challenges like challenge B will generate fewer ideas than more open challenges as described in challenge A and C. The most open innovation challenge, challenge A, was found to generate most ideas. However, fewer ideas generated were in our case found to produce higher quality ideas.

5 DISCUSSION

How can SMEs best organize inbound open innovation seminars? Altogether, the open innovation seminar as described in this article has proved useful in providing the case company with a large number of ideas for new markets, new technologies, and new products, all with more than average quality. The results from this empirical study, indicates that specific and clearly designed innovation challenges will produce the best results based on the quality criteria novelty, usefulness, and feasibility. However, if the aim is simply to produce a large amount of ideas, then more open and less clearly defined innovation challenges will produce the best results.

In addition to the differences in innovation challenges, the composition of the groups may also have influenced the results, although on paper, the groups were composed equally. Group 1+2 who produced the most ideas, were the groups that overall produced the least useful ideas. Group 5+6 had the overall lowest average three-way quality score (40.09), although the three-way quality score was not much better for group 1+2 (43.53). In comparison, group 3+4 averaged on 91.07 for the same quality score. All the groups had the same mix of R&D managers, top executives, and other professionals in managing positions. Moreover, most participants had engineering background, either on master or PhD level. All groups were also a mix between industrial (78%) and academic professionals (22%); hence any differences in overall idea quality may be attributed to different personal and individual motivation and capabilities rather than group composition, in addition to the described differences in the innovation challenge. However, as no difference in group enthusiasm, motivation, or capabilities was observed during the seminar, the superior performance of group 3+4 is most likely primarily influenced by the innovation challenge.

This seminar is to our knowledge also the first in-bound open innovation seminar in the B2B sector to be hosted in Norway, which may have influenced the overall high motivation and enthusiasm to the participants. Considering this, in addition to the high number of top executives and managers participating, the motivation and willingness to be part of such seminars in the future may be limited. Based on two interviews, a seminar frequency of maximum 1-2 each year is proposed.

An important limitation of this study is the fact the most of the managers participating in the seminar already knew each other from an existing industrial network. As no competitors on products or technology were present, it was possible to conduct the seminar in an atmosphere of mutual trust and respect. This is an important factor which may have contributed to the success of the seminar.

When evaluating the results, it is important to remember that only one top executive evaluated the overall quality of the ideas. This person's personal beliefs, preferences, and background will constantly influence the choices that are being made. This CEO is however, trained in technical engineering, in addition to being a manager for many years, hence, he should have a good feeling for what works and what doesn't. Moreover, in this specific company, the CEO is the person who generally decides which projects that should be further explored or not. Therefore, for other companies, it may be more relevant to have other persons evaluating the ideas based on who is the decision-maker.

The case company itself had not previously participated in an open innovation seminar as described in this article. The CEO was positively surprised by the overall amount and quality of the ideas, although some ideas were too far from core business to pursue. Hence, the CEO recommended that good ideas not suitable for their company should be included in an "ideas stock exchange" so that other companies may benefit from them, similar to that described in the recent article of Soukhoroukova et al. (Soukhoroukova, Spann et al. 2012). Some ideas from innovation challenge B have already been included into several prototypes and are currently being tested. Moreover, some of the more general ideas resulting from challenge A and C will be included for discussion for this years' main strategy process. The CEO further concluded that for a SMEs who suffer by the "liability of smallness", coming up with new ideas to improve technology, explore new markets, and products is challenging. Inbound open innovation seminars as described here, may be one solution to this problem.

6 CONCLUSION

In this empirical study, open innovation in the context of SMEs in the B2B sector has been explored.

There is strong support from previous research that SMEs in particular, may benefit from open innovation to overcome their "liability of smallness". As SMEs have several advantages to large companies like less bureaucracy, faster to react to changes, and having more specialized knowledge, these capabilities combined with open innovation strategy may together help SMEs to develop and sustain their competitive advantage.

The empirical results from a one day inbound open innovation seminar involving 32 managers and professionals from 16 different companies suggest that such seminars may be efficient and a useful way of providing SMEs ideas and information concerning new markets, new technologies, and new product ideas. The results further indicate that specific designed innovation challenges may produce the highest quality ideas, based on the quality criteria novelty, usefulness, and feasibility. If the aim is to produce a large amount of ideas, however, then more open and less clearly defined innovation challenges may be most fruitful. Another factor which may have influenced this result is personal and individual motivation and capabilities of the group members, although group composition was kept as equal as possible.

From a company perspective, it seems clear that managers in SMEs in the B2B sector may benefit from adopting open innovation seminars as described in the article. It is fairly simple to implement, but requires a network of industrial partners that are willing to contribute. Doing so, the SMEs may receive significant benefits for a limited cost. The SMEs should, however, be prepared to "pay back" the favor to other SMEs in the network when required. Spillover ideas not suitable for the SME should be entered into an "idea stock exchange" for utilization by other network partners.

In conclusion, this study adds to the limited body of research concerning SMEs and open innovation activities. A "how to do" description which goes beyond the traditional managerial focus is provided and should be useful to both researchers and practitioners despite the limited generalizability of this study. For further research, the authors will perform more open innovation seminars with SMEs for comparative analyses with this study. Other open innovation activities will also be explored to discover which activities are most suitable for SMEs in a B2B context.

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