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SUGGESTION SYSTEMS FOR ENGINEERING DESIGNERS – A CASE STUDY

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ABSTRACT
Creativity is an important characteristic of engineering design and one can learn much about creative methods for solving design problems in the literature. In reality, however, the spontaneous creativity of engineers also leads to new innovative ideas that are not directly applicable in current projects. Therefore, it is important that companies have the ability to extract and use these ideas to ensure long-term innovativeness. A suggestion system, the most classic of which is the suggestion box, is an approved general way that can enable this transfer of employee creativity; however, the literature provides little information about the applicability of suggestion systems in organizations for engineering design. This paper investigates the applicability and potential of suggestion systems to enable the critical transfer of creativity from engineering designers to the company. This research, performed as a case study, shows that a suggestion system, along with strong leadership, can help transfer creativity of the engineers to future products.

Keywords: Suggestion system, creativity, idea extraction, idea landing, management.

1 INTRODUCTION
To survive a competitive market place, many companies depend on new ideas for technical solutions. These solutions solve current needs that later can be turned into product innovations or improvements of existing products. Clearly, idea generation is a vital part of product development and especially engineering design. An engineering design project also includes challenging problems that require the best possible technical solutions for. In the literature, however, engineering design methodology takes on a rather mechanistic approach to idea generation. Idea generation is described as one of the steps in the design project that looks for solutions to functional or non functional requirements (Roozenburg and Eekels [1], Ulrich and Eppinger [2] or Ullman [3]). That is, creativity is needed at precise moments to solve precise problems that address challenges in the current design project and in the methodology used. However, the creative engineer often uncovers innovative ideas that are not relevant to the current work or cannot be implemented directly. In other words, with respect to creativity, companies face a somewhat different reality than the reality described in the engineering design methodology. Problems and ideas are continuously identified and often solved – anytime, anywhere, and by anyone in the organization. Normally, a majority of the engineers are not working in the creative conceptual phases of an engineering design project or with R&D projects. They are working in later refinement phases or with the support and maintenance of existing products where the primary task is not to invent but rather to perform routine work and minor improvements. Still, many engineers are creative individuals that just cannot stop thinking about new innovative solutions. During routine work, they can stumble onto new problems or new technology and suddenly find a new innovative idea currently not possible to implement directly. For example, an engineer working with documentation may find a colleague's design problem interesting and come up with an interesting solution. In another study [4], we also could show that creative ideas at a design department may originate from a large variety of different sources and situations in a manufacturing company. A product development organization must have the capability of gathering all these randomly occurring ideas. These ideas can then feed the development funnel [5] for further processing and product planning. Much is written in literature about creativity; little is written about transferring the randomly occurring creativity into solutions especially emphasizing engineering design.
A suggestion system, the most classic of which is the suggestion box, is a common way of gathering ideas in an organization. Carrier [6] indicates that suggestion programs actually were introduced as

early as 1896 by Kodak. Suggestion systems have been treated in organizational and management literature for a long time. Since the 1970s, Ekvall [7], [8] has performed extensive research of suggestion systems in several larger Swedish companies. Ekvall also provided a clear definition of a suggestion system: an administrative procedure for collecting, judging, and compensating ideas conceived by employees. He concluded that 60% of employees that ever had a good idea did not communicate it through the suggestion system. If this also applies to engineers, then there might be gold hidden in the minds of the engineers at the design department.

Objective

This paper investigates the applicability and potential of suggestion systems for enabling the critical transfer of creativity from engineers to the company. Usually, suggestion systems are treated from a general perspective including all types of employees. Fairbank and Williams [9], for instance, describe how new technology can be used in suggestion systems. In this paper, we present the results of a case study where we solely have focused on a suggestion system used at the development department of a Swedish company developing and manufacturing electromechanical industrial products. Based on this case study, we will discuss the function and applicability of suggestion systems and describe aspects that that should be considered when using a suggestion system in product development organization.

2 THEORETICAL PERSPECTIVE

When it comes to creativity, the research has come from different perspectives and in different research areas. Psychologists, organizations, and management researchers as well as design researchers have all addressed creativity by addressing how creativity can be increased or stimulated.

Engineering design literature ([1], [2] and [3]) has looked at creative methods and tools for addressing design problems and solutions. What is missing to a large extent in the latter literature, however, is the social and organizational context of creative work. Designers, as all other human beings, are strongly affected by social context and the organization and management culture of the company.

In management and organization literature, the major interest is to describe how companies and other organizations can be more creative, which in the end should lead to more innovations and better competitiveness ([14], [15] and [16]). This is also the most relevant theoretical background of this research since suggestion systems are strongly linked with creativity in organizations. The term creativity management is often used in this area where the enhancement and management of creativity are in focus. In this research, we study the creativity of the product development organization and define it as its ability to deliver new technical ideas that in the end can result in new products or be implemented in existing products that provide profit to the company. In earlier and other research [4], we have studied the actual creativity initiative that is closely related to this research, but here we focus on the organizational context of new ideas and how this context affects the creative ability of the organization and to some degree the individual employee.

van Dijk and van den Ende [10] note that ‘there seem to be much literature on creativity enhancement but little on the actual transfer from employee creativity to practicable ideas’. Similarly, West [12], [13] has pointed out that the focus should be on factors that promote the implementation of ideas into practice and definitely not solely on idea generation. Van Dijk and van den Ende, using theory developed around creativity management, conclude that there are two main categories of factors that affect the transformation of ideas. The first category concerns cultural aspects such as management support, preparedness for changes, mission and strategy, and attitudes of fellow workers. The second category concerns factors such as existence of adequate evaluation procedures, presence of a rewarding structure, and the allocation of means to support and work out ideas. The latter, as we will show, are especially important for engineers. Van Dijk and van den Ende note that many of the factors mentioned above exert their influence by means of their effects on task motivation, but task motivation is also strongly influenced by individual related factors. According to Collins and Amabile [11], it is necessary that motivation to a large degree is intrinsic; i.e., it comes from the individual. Earlier studies of suggestion systems, however, show that some kind of external rewards are necessary; however, according to earlier studies, rewards must not dominate since intrinsic motivation always seems to give the best effects on creativity. Thus, even if culture and organizational factors are most important for suggestion systems, individual factors cannot be neglected because of their influence on the employee motivation.

As already mentioned, we use the creativity transformation model developed by van Dijk and van den Ende [10] as a starting point for this paper. Figure 1 illustrates the transformation of creativity from employees to practical ideas. The ideas go mainly from left to right starting with the extraction of the idea from the employee, continuing with the landing of the idea in the organization, and finally ending with the idea follow-up, which basically is the front end of the innovation process where the ideas are formally processed, e.g., into a project proposal. Thus, it theoretically goes into the development funnel as described by Wheelwright and Clark [5] where resources must be committed for this processing.
Idea extraction is mainly affected by cultural factors while idea follow-up is mainly affected by structural factors in the organization. The most critical phase of idea transformation is the mid phase, idea landing, a phase that is affected by both cultural and structural factors according to van Dijk and van den Ende. In this phase, the employee formally meets the structure of the company and must be supported. Cultural factors must be in place to secure a positive reaction as well as structural factors such as an accessible suggestion system.

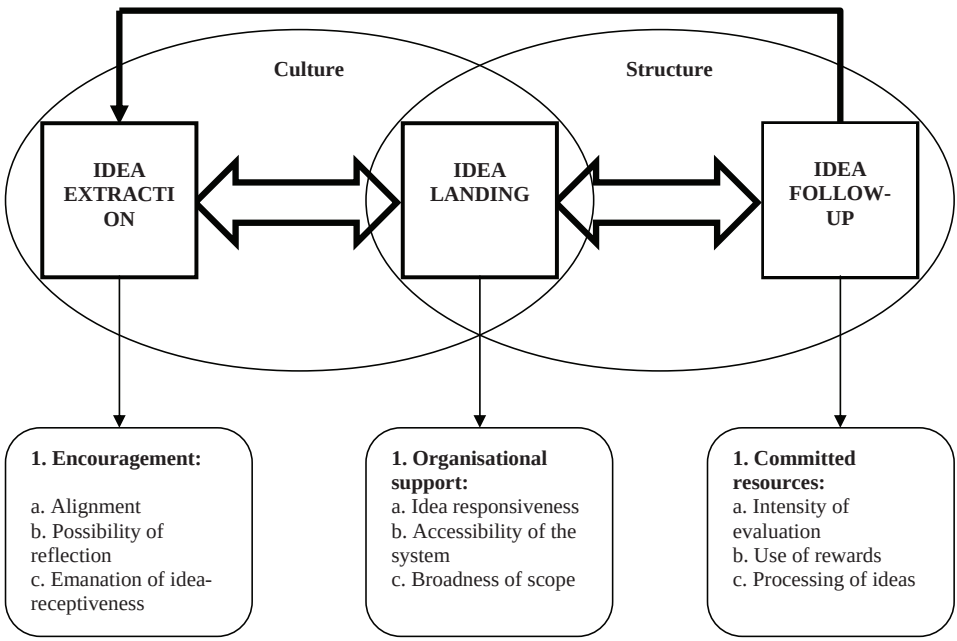

Figure 1. The Creativity Transformation Model of van Dijk and van den Ende [10] with the three phases from employee to practical idea. Below the phases are the specific factors that must be concerned when designing or analyzing a suggestion system.

As shown in Figure 1, the process is not a unilateral process from left to right. The process is instead multilateral involving much interaction that mainly concerns feedback to the employees since the willingness to provide another idea depends on the knowledge of what happened with earlier ideas. Below is a list that identifies each phase in Figure 1 and the factors that mostly influence the transfer of an idea. The major factors – encouragement, organizational support, and committed resources – are briefly described here.
Encouragement. This relates to the stimulation of the employees by bombarding them with company specific attitudes and ideology (alignment), possibility of reflection of ideas, and the employees' view of the company's image of innovation (emanation of idea receptiveness).

Organizational support. This relates to the reaction from management when presenting an idea (idea responsiveness), the actual accessibility of the suggestion system (especially for ideas that fall outside daily routine), and the net the company casts to catch ideas (broadness of scope).

Committed resources. This relates to the commitment of means to facilitate the absorption and processing of the idea in the organization. The quantity of attention and resources determines the intensity of evaluation. Use of rewards is another factor here as well as the visibility of and resources for idea processing.

In this paper, we use this model as the theoretical foundation for our study of a suggestion system suitable for engineering designers working in product development.

3 RESEARCH APPROACH

As stated in Chapter 1, this paper investigates the applicability and potential of suggestion systems to enable the critical transfer of creativity from engineers to the company. To achieve this, we chose initially to perform an analysis of a suitable real product development organization. For the analysis, we use the creativity transformation model developed by van Dijk and van den Ende [10].

A case study was performed at a large industry plant that develops and manufactures electromechanical industrial products. Recently, the company is owned by a large Japanese company. The plant is responsible for the design and manufacturing of several products. The manufacturing rate is several thousands of products each year. This global company is faced with tough competition. Before the acquisition of the company by its current owner, product development and manufacturing took place in the USA, Italy, and Sweden. Now production also takes place in an equally sized plant in Japan. The study only concerns one site where around 130 employees are directly involved in the product development organization. The majority of these employees are mechanical, hydraulic, electrical, and computer engineers.

Due to the tough global competition, there is an increasing demand for product development that has led to a strong focus on precise development lead times and reduced cost. At the same time, the products must continue to increase in quality, a demand the current Japanese have made clear. Therefore, the development organization emphasizes the importance of time management, cost effectiveness, and quality control. Simultaneously, the company has noticed a decreasing trend in the number of patents granted to the company as their competitors show an opposite increasing trend. This makes the company a suitable case for studying employee creativity where all ideas have to be extracted and transferred into the organization to improve the products with new innovations. During 2008, the product development department implemented an improved process for suggestions.

To analyze the effectiveness of the new suggestion system, we conducted interviews and collected the company's own descriptions of the new suggestion system. Twelve engineers (eleven men and one woman) were interviewed. Seven of the engineers had a M.S. degree and the other five had some other engineering background (bachelor or similar). These twelve engineers sent in one to four new ideas (alone or together with others) during the period studied.

The study was conducted during 2007-2008. During 2007, initial studies revealed that because the existing suggestion system was not very visible for the engineers. In February 2008, a new improved suggestion process, developed by the company, was implemented. The new process was then presented at a meeting for the whole product development department. During 2008, 27 ideas were sent in to the suggestion system. In our study, we focus on eight of those 27 ideas.

The choice of these eight ideas was made in collaboration with the company. The company felt they could not force employees to be interviewed, so the major selection criteria became the willingness of the engineers to participate. Despite this, the interviewed engineers represented different groups within the product development department and the ideas represented a great variety with respect to several parameters. The ideas represented different development stages: some ideas had already been rejected while others were under development for implementation and one was close to the manufacturing phase. Because the ideas also had very different scope with respect to technical complexity, we believe that the studied ideas constituted a relevant selection for an analysis of the suggestion system in this product development organization. Some examples of the studied ideas are; a safety feature by

adding a new sensor (concept rejected), a way of reducing vibrations and noise in a transmission (tested but did not perform good enough), a new way of more simply creating tailored solutions for different customers (in further development) and new product configuration concept (resulted in a significant order from a very important customer).

In December 2008, the twelve engineers responsible for these ideas were interviewed for one hour each with open interviews following a brief structure planned in advance. Below are examples of questions we asked:

- Can you describe when and how the idea was presented the first time?
- What reaction did you get?
- Has it been decided if the idea should be processed further? When?
- Who decided?
- Have the ideas been implemented?
- Has an application for the patent been remitted?
- What role did the suggestion system process have for you?

We also asked whether they had any ideas that they had not chosen to transfer into the suggestion system, ideas that the suggestion system failed to extract. In addition, we asked them why they did not share these ideas. Although the interviews were not recorded (the company did not allow this), both the two interviewers took notes. The interviews were then analyzed. The engineers' descriptions of the different phases of the creativity transformation model (as described in Chapter 2) were especially in focus. From a methodological point of view, recording and analyzing the transcribed interviews would be a much better approach for eliminating the risk for bias. We tried to reduce this by noting as much information as possible without judging the value of it until afterwards.

4 THE SUGGESTION SYSTEM AS INTENDED BY THE CASE COMPANY

When the company improved the suggestion system, a new process (as described in Figure 2 below) was developed. When an engineer has an idea that he or she believes is of significant interest for the company, he or she can fill in a special form and register it in the intranet system. The form is rather simple and just a brief description of the idea is necessary. The form then goes to a person with the dedicated task of recording them, making a first analysis of he idea, and then presenting them at a decision meeting. If this person finds it necessary, he contacts the engineer and perhaps suggests how the description can be improved.

Once a month, a group consisting of the managers at the development department plus the product planning manager from the marketing department evaluates the ideas that have been sent in for a decision. If the engineer wants, he or she may also come to this meeting to present the idea. The evaluation of the idea is made from the perspective that it must not only technically work but also be economically sound and fit into the company's strategy and product planning. This group can then reject the idea directly or suggest the idea be further developed. If the group decides the idea could result in a patent, it can be decided that the idea should be further investigated by the company's patent agency. After this investigation, it will be further decided whether to reject or continue with the idea. Even if the idea is not found patentable, the idea may be further developed in a pre-study project, directly implemented into the products, or saved in a database for possible future use. In some cases, the idea concerns ideas that have occurred as a result of present work in development projects. In that case, it is only the patent investigation that is interesting since the idea already is being further developed and implemented for a market launch. The objective with the suggestion system is basically twofold. First, the company wants to ensure that all patentable technical ideas become known and investigated. Second, the company wants to gather as many ideas as possible that can improve their products or lead to new products.

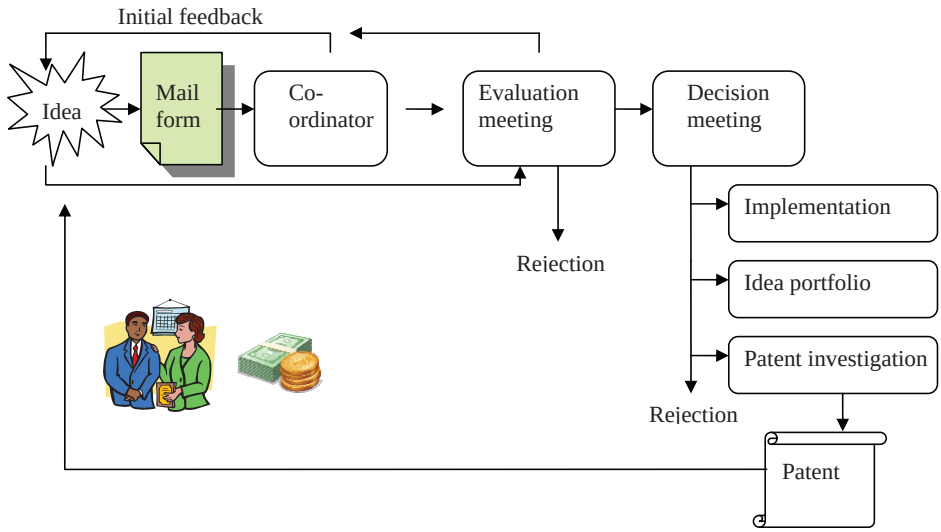

Figure 2. The process for ideas at the product development department in the case organization.

5 THE ENGINEERS' APPREHENSION OF THE SUGGESTION SYSTEM

The interviews gave us not only interesting information about their apprehension of suggestion systems in general but also a very good evaluation of the specific suggestion system of the case organization. The results are here presented in accordance with the creativity transformation model of van Dijk and van den Ende [10], starting with the idea extraction.

5.1 Idea extraction and encouragement

Alignment

A majority of the engineers seem to have been motivated to think creatively and to report their ideas thanks to the company's work with the new process and the recent information meetings that had been held. Some respondents said that they clearly felt an increased interest for innovation in the company. When asked what they felt was the company emphasized, there was a consensus about product quality and short development lead times. There had also been different intensity in the information about the new suggestion system by different managers at the department, a situation that clearly had an effect on the knowledge about the new process. This clearly shows how important it is for the management to be consistent and precise in the communication of what is important for the engineers to focus on. Before the change, there had been less interest among the engineers on creativity for new ideas. It is now important for the company managers to consider how to continue to keep the aligned environment around the engineers by regularly informing them about the suggestion system and new ideas that have been patented or implemented. In the new suggestion process, information will be given by the group managers regularly about the ideas processed. In that way the 'inventors' of the ideas will see that it was worth it to report the idea and the other engineers will be encouraged to also report any ideas. Thus, it is very much in the hands of the group managers of the department to support the alignment of the company's attitude towards innovation.

Possibility of reflection

Different engineers have probably individual preferences regarding the need of discussing their ideas with others. Theoretically, the possibility of finding "sounding boards" for the employees is important for the extraction of ideas [10]. Here we could find large differences in the interviews about how the engineers first had discussed their idea. In one case, the idea simply shows up during a meeting discussing a problem where four engineers attended. In some cases, the engineers had discussed the idea with colleagues. In other cases, the idea had been discussed with the group manager. In one case, the idea was discussed directly with the person who received the idea reports. In one case, the idea was sent in directly without any discussion at all.

What is interesting here is that different groups in the organization exhibit different levels of the openness with respect to discussing personal ideas. Some clearly said that they did not want to discuss with colleagues since they might "steal the idea". Other engineers gave the impression of having a very open climate in the group and trusted the colleagues totally. Most of them trusted the group manager. Thus, it seems like the group managers must work with the group climate regarding the discussion of creative ideas to create a trustful environment that can support extraction of ideas. The new process has other discussing boards possible for the engineers. They can always discuss with the group manager or with the person receiving the idea reports.

What is significant for engineering designers is that the ideas sometimes can be rather complicated requiring the right competence of the discussion partners. Therefore, it is probably important that a suggestion system for engineers involves competent discussion partners such as their own technical group, the group manager, or another person with great experience. The competence must involve not only technical knowledge from design and manufacturing but also about the applications and market conditions.

In addition to the complicated ideas, another barrier that can hinder the extraction of a patentable idea is that many engineers and especially younger ones believe that patentability requires extremely clever solutions. Therefore, they are afraid of being laughed at if they present what they think are "low level" ideas. The truth is that many patents concern very simple ideas. Therefore, it is important for the more experienced colleagues and the group managers to explain that even simple ideas can be discussed. The reaction among some of the engineers regarding theft of their ideas also points out a link between this factor and the "Use of rewards" factor discussed in Chapter 5.3. There is a negative relationship between the size of the reward and openness in the group.

Emanation of idea receptiveness

This relates to the image of innovation that the company has towards the employees. As described in Chapter 3, the company had been considered to be very innovative, but during the last decade it had lost this reputation. The case company desires to signal a change in the image of innovation so they can succeed in the overall goal of increasing the number of patents and product innovations. It is probably necessary not only to communicate the increased interest in creativity as described above under alignment, but also to show the willingness of increasing the resources for realization of new ideas and to focus on upcoming innovations. Otherwise, there is a risk that in increase in the number of ideas now will not sustain the growth and survival of the company.

5.2 Organizational support

Idea responsiveness

Idea responsiveness is the actual reaction given by the manager when presenting an idea. According to the interviews, the idea responsiveness was generally very positive if the idea was presented to the group manager. This openness indicates that the company's willingness to receive creative ideas outside the normal work tasks has been established among the managers of the development department. A methodological problem here with the research is that we have not tried to find engineers that might had have been met by a negative reaction and therefore not reported their idea further. We have solely interviewed a subset of recent users of the suggestion system.

The possibility to come and present the idea orally to the management group was often mentioned as a very positive change compared to the old procedure that was closed for the engineers. The results here actually points out that it often is absolutely necessary for the engineers to come and explain their idea.

As already mentioned, the ideas are often not simple and there might be little or no time to spend on making CAD-drawings or other written descriptions due to high workload.
Without positive idea responsiveness, many creative ideas that fall outside the routine work are not shared with others. One of the interviewed engineers actually described how the reaction he met in another company several years ago had made him completely uninterested in reporting innovative ideas; his attitude, however, has changed since the new suggestion system at the case company was presented.
Several engineers expressed a need for more time to develop ideas and possibly lab resources to test ideas before they share it. This indicates that engineers want to ensure that their ideas really work before they dare to 'officially' share them. In other words, they do not want to be associated with a non-working idea. A possible explanation is that they feel that this might be negative for their image and reputation among the managers and colleagues. On the other hand, one of the objectives with the suggestion system is actually to evaluate all ideas so the promising ones can receive the resources to be further developed and investigated. This means that there is a gap here with engineers who want resources to further investigate their ideas but only want to hand over working ideas and the managers who want to evaluate ideas to prioritize for resource allocation.
When directly asked if the interviewed engineers had any ideas that they had not reported into the suggestion system, four of the twelve (33%) reported a total of about 10 ideas that they kept to themselves. The main motivation why they did not formally report them was that they felt a need to further elaborate and test them before sending them in. Some respondents also mentioned the risk that someone could improve a non-working idea and then report their improved variant.

Accessibility of the suggestion system

As van Dijk and van der Ende [10] point out, an inaccessible suggestion system will undoubtedly diminish participation. Inaccessibility can be manifested in several ways. There could be too little information and knowledge about how to report an idea. There might be difficulties finding the correct forms to fill in and difficulties handing the form in or the actual form might not be suitable for describing the idea. In addition, the process could also require too much paperwork. A slow reaction to the idea can also be a hindrance. The system can also be open to just a limited number of employees.
The case company has a rather open attitude towards how one can describe an idea. There is a form to fill in that should be sent in by e-mail. Any one in the product development organization can send in an idea by e-mail. There is information about the procedure on the intranet. All of the interviewed engineers were satisfied with the way they could access the system. Some engineers actually mentioned that it should not be necessary to know the suggestion process but to know in a simple way where to find the information about it, preferably on the intranet. There also seemed to be a very good knowledge of the process among all the group managers, which also supports high accessibility. Several of the respondents actually emphasized the importance of group managers as information sources and motivators for the suggestion system.

Broadness of scope

This relates to the size of the net the company throws out to get ideas. In this case, this particular suggestion system is limited to the product development department.

5.3 Committed resources

Intensity of evaluation and Processing of ideas

As described earlier, the reported ideas are evaluated once a month. This is rather low intensity of evaluation at least compared with one of van Dijk's and van der Ende's [10] cases (the Dutch firm KPN), a firm that immediately allocated resources, involved the employees, and implemented the idea. On the other hand, there must be a balance between scope (accessibility) and evaluation resources. Our case company has a limited scope –130 employees in the development department – and if compared with the number of ideas handed in during 2008 (from the start up in February); evaluation once a month this seem quite balanced. It is important to balance this since it otherwise threatens the entire suggestion system. Therefore, this requires especial attention during design of the suggestion system. Since engineering ideas sometimes require larger efforts and deep competence to evaluate, it

is a sound idea to have a large evaluation group of the ideas instead of a single person that simply cannot have competence enough to judge ideas from different areas.
The evaluation, on the other hand, gathers all the section managers and the product planning manager so there is no doubt that the competence and resources for evaluation is enough. An idea that is judged as interesting is sent to another management group including the development manager that can allocate resources and decide in what way the idea should be further processed for patent approval and/or further development. Necessary resources for engineering ideas are provided since they often can be costly to implement. It is not known to us through the interviews what strategies were used to decide whether an idea should be implemented or put in the database. According to our respondents, there seems to be a clear understanding among the engineers what kind of ideas should be focused on. It did not seem like the management communicated to the engineers if any particular feature, technical area, application, etc. are in focus with respect to creativity. The only control of the focus was made indirectly using the reward system.

Use of rewards

Engineering designers are normally hired for being creative and finding new solutions in their daily work. Because it is simply one of the major roles of the product development department to invent, it is seldom common with rewards that ideas lead to inventions for engineering designers. At the case company, however, engineers delivering an idea that lead to a patent received a reward of a few thousand dollars. Also a certificate is given to the engineer at some of the large department gatherings. Thus, the company uses both a financial as well as a non-financial rewards only for patents. The interviewees indicate that the engineers like this and that for some of them it actually works as an incentive for creativity. However, the induced creativity by the reward system will only support patentable ideas and probably diminish the creativity or willingness to report other types of ideas. Whether this is a deliberate strategy of the company or not is not clear. At any rate, it is very important to design carefully the reward system since it significantly influences what many engineers focus on.
As indicated earlier, the reward system might also have a negative impact on the idea extraction phase since it can make the engineers afraid and unwilling to openly discuss their ideas. Perhaps, as van Dijk and van den Ende believe, only non-financial rewards should be used. This might be a good idea since creativity is a part of the work of engineering designers.

6 RESULTS AND DISCUSSION

Our study shows that a dedicated suggestion system can be relevant for a product development organization with a typical engineering focus. The role of such a suggestion system is partly to support the creativity among the engineers and to ensure that all ideas are reported and can be evaluated for patenting or implementation. Although engineers are paid to be creative, our study shows that many times the engineers are focused on rather narrow routine work of the non-creative work. A suggestion system can then ensure that ideas developed outside the routine work are gathered. From a patenting point of view, a suggestion system also can motivate and support the engineers to develop new technical solutions during product design projects, minimizing the risk that the company misses patents.
By using the creativity transformation model developed by van Dijk and van den Ende [10], any suggestion system can be analyzed with respect from organizational aspects. In our study, we have paid special attention to a suggestion system from an engineering design point of view. This has revealed a number of results concerning how the different factors of the model should be ‘set’ to better fit engineering design work. In the following sub-chapters, we will examine these results.

6.1 Idea extraction

Our study indicates that engineering designers can be reluctant to report technical ideas that they are not 100% confident will work. To counter this attitude, the suggestion system should support an open climate for discussion and preferably support further development of ideas so the engineers are not afraid to share ideas. The group managers have a vital role creating an open climate for the discussion of new ideas. They also have important roles as motivators to report ideas and communicate the policy

of the company. What also must be focused on here is the explanation of what type of ideas are interesting and that simple technical ideas might be patentable.

6.2 Idea landing

This is a critical phase for the transfer of creative ideas. Engineers often treat their ideas as babies or as a part of their identity. Because they are proud of their work, responses to ideas should be positive even on ideas that might need further development before a decision is made. If the idea for any reason does not fit the company's products, the motivation must be very clear to the engineer who suggested it.

The suggestion system must also be accessible for different types of ideas and situations. Often there is very little time to write down and describe the idea if it is not a part of the current work tasks. Therefore, there should be a system that allows engineers to report easily their technical idea and the possibility to present the idea orally for the decision group.

6.3 Idea follow-up

What is particularly important for engineering ideas is that the resources for evaluation and processing incorporate enough technical, application, and market competence. Therefore, a cross-functional team of managers will probably be suitable for the evaluation of the ideas. In addition, it is important to inform the people who provide the ideas about what is happening with their idea as the patenting process proceeds. Financial rewards for creative ideas are normally not possible for engineers unless they very clearly define a special type of ideas, as for instance patents. However, their negative impact on the idea extraction phase must be carefully considered.

7 CONCLUSIONS

In this paper, we show that a suggestion system can encourage engineering designers to share their ideas, ideas that may receive patents. We describe the factors (6.1 to 6.3 above) that are important for the organization of a suggestion system of a product development organization. The different phases of the process must all be considered and carefully designed to take care of and transform the creativity of the engineers. Otherwise, many fruitful ideas will probably be lost or never known by the company. Many of interviewed engineers (33%) did not share all of their ideas despite a new improved suggestion system for engineering ideas. Thus, there still are places for further improvement of suggestion systems for engineering design.

The study also shows that the general model used as a theoretical foundation definitely can be used for the design and evaluation of suggestion systems dedicated for engineering designers. What may be the most significant finding is how important the group managers are for the extraction and landing of the ideas in the organization. To believe that all engineers always are creative and report all their ideas to the company immediately is a mistake. There are many hindrances to creativity and the extraction of ideas. By designing a suggestion system in a way discussed in this paper and by providing strong engineering leadership, the transfer of creativity from skilled and motivated engineers to implemented solutions in future products can make companies more competitive.

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