SOCIAL MEDIA ENABLED DESIGN COMMUNICATION STRUCTURE IN A BUYER-SUPPLIER RELATIONSHIP

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ABSTRACT
Improving design communication in product development networks can lead to a better design process. This paper presents a new design communication structure in the buyer-supplier relationship better serves the needs of networked product development compared to traditional communication structures in buyer-supplier relationships. Social media tools were used to create the new communication structure. Data was collected with case studies in the foundry industry. A simulation game was played to test the use of social media tools in buyer-supplier relationships. The results show signs of social media tools enabling improved situational awareness, improving transparency, widening the response base, which was used for community sourcing within the product development network, and new social spaces create collaboration possibilities that were not possible before. These benefits help improve, for example, the design by including more points-of-view than before and by preventing challenges in production by increasing the awareness of the upcoming design.

Keywords: communication structure, buyer-supplier relationship, social media, simulation game, design communication

1 INTRODUCTION

1.1 Background
Increasing amount of product development (PD) projects are done in PD networks. Design communication within these networks is an important success factor for the project, since poor communication can lead to mistakes and delays in the project. However, although the business model has shifted to networked business, the design communication structures in these networks have not changed accordingly. Design communication in this paper means communication in the design process, such as the designer communicating the design to manufacturing. Design communication can be studied from different points-of-view, information, interaction, and understanding [1,p.18]. This paper focuses on understanding because communication between people is related to the PD network and the PD project they are in.

Social media gives new opportunities to communicate and new ways to communicate. Kaplan & Haenlein define social media as “a group of Internet-based applications that build on the ideological and technological foundations of Web 2.0, and that allow the creation and exchange of User Generated Content” [2]. Social media can be understood as a version of computer supported cooperative work (CSCW) tools. CSCW tools have been studied in PD networks, and the use of social media in these networks is a natural continuum for these tools. People face challenges in using traditional communication methods (e.g., phone and e-mail). For example, when using a phone there are no records for later use, people may understand the agreements differently, and there might be challenges is reaching the other person due to for example, time difference. Some challenges with e-mail are that too many e-mails becomes spamming and they are not targeted to relevant people. [3] Advances in communication media are making it easier for organizations and their employees, suppliers, customers and stakeholders to participate in the creation and management of content [4]. Social media tools enable real-time collaboration, which eliminates unnecessary waiting for information. In addition, social media tools enable social way of working; more people can be brought to the task in hand. These people do not need to be set beforehand. In fact, social media gives people the opportunity to contribute to the things they find interesting.

The use of social media during the design phase has been studied (e.g., [5],[6]). Nevertheless, previous research has not focused on what social media can offer for design communication throughout the entire design process. Research that has focused on design communication throughout the entire design process (e.g., [1]) has not explored the possibilities of social media. This research fills that gap. Additionally, previous studies on CSCW and social media have not focused on suppliers as a source of information and design aid. Although early supplier involvement has been heavily studied (e.g., [7]), the use of new communication tools in early supplier involvement still needs to be studied. Getting the supplier involved in the project earlier changes the communication structure to better support the design phase. The aim of the paper is to present a social media enabled communication structure for design communication in a buyer-supplier relationship.

In this research, the collaboration between a customer company and its supplier in the foundry industry was studied. The focus has been on design communication and the utilization of social media to promote collaboration in the PD network. One foundry and three of its customers were interviewed. One case project from each firm was selected. We studied the strengthening of an existing buyer-supplier relationship, as was suggested by Hearn et al. [4]. Current communication structures and their flaws were mapped, and a new communication structure was suggested. A new communication structure was tested with a simulation game that mirrored the actual design process. The results indicate that social media tools improve design communication by improving, for example, network transparency and enabling community sourcing within the PD network. The new communication structure enabled by the social media tools provides the possibility to tap into knowledge that was not utilized in the design previously; for example, information about how the casting is taken out of the mold after it has been casted and how it affects the design. This information is used to create a better design.

1.2 CSCW and social media

CSCW tools give people the opportunity to connect within the PD network. Further, social media tools help the designer tap into the information provided by potential customers. Eckert and Stacey [8] present various alternative situations in which the designer needs to interact with other people. According to their studies, CSCW should go beyond efficient document retrieval, video conferencing, and shared workspaces. They suggest that CSCW tools should, for example, enable the less-informed members of a group to establish the context of the discussion quickly and efficiently and support awareness of other participants in remote interactions [8].

Previous research has either focused on getting information from different departments or from the potential customers. In other words, social media enables the designer to ask people how to design, an idea borrowed from software open source objects [5]. D'Souza and Greenstein [9] helped connect the designers with the manufacturing personnel so they would be able to provide critical manufacturing information for the designers. The challenges of traditional CSCW tools have been the difficulty of being aware of what the other person is doing [10] and limited transparency in the development network [11]. Thus, people have problems identifying the relevant people to transfer information to or to obtain information from [11, 12]. Social media tries to tackle these challenges by providing more information visibility. The shift is from information pushing to information pulling. One main challenge from CSCW is still relevant when moving toward social media: a critical mass [13] of users is still needed for the application to be affective.

Chiu [6] states that the uses of CSCW tools will enhance design communication, but the quality of design is not driven by the technology. Design is improved by, for example, effective decision making, negotiation, and evaluation in which design communication contributes [6]. Chiu [6] lists functions needed for CSCW tools to support communication; the system should be able to define participants and their tasks in the process, define data dependency, visualize the design process, and support team awareness. Overall, the use of CSCW tools increases the amount of information available for the user [14]. In addition, Kotlarsky and Oshri [15] argued that companies need to

introduce organizational mechanisms that create social spaces between team members to achieve successful collaboration in globally distributed teams. This could be done with social media tools.

One aspect of social media tools is community sourcing. Under et al. [16] define community sourcing as "means relying for innovation on loosely connected communities of sophisticated users" Community sourcing taps into users to gain knowledge that was previously unavailable for the designer.

1.3 Communication in buyer-supplier relationships

Sequential attention to the product by different departments can lead to failed products [17]. Parallel attention is possible with CSCW tools that can be used for communicating in buyer-supplier relationships. Bandera [18] studied using different CSCW tools in cast component design. Application sharing was used by experts to show the other partners the evolution of the 3D model and to perform simulations. Additionally, video-conferencing was used for elaborating on the 3D model and for discussion with supplying foundry's experts about post-processing of the component. [18] The CSCW tools gave the different partners the possibility to contribute to the project even though the project had not reached their department yet. For example, the foundry was able to discuss design matters before the component reached their production. Rodriguez and Al-Ashaab [19] have highlighted the importance of the real time provision of manufacturing knowledge in collaborative PD tools. Their research emphasizes not only supporting the collaborative PD with a design application, but also providing other applications such as the process engineering application, project management application, and tool making applications [19].

This paper presents the suppliers as sources of information and knowledge. This increased information helps project team members understand the design process more quickly and fully from a variety of perspectives. Therefore, it improves design process performance. Moreover, downstream problems such as manufacturing difficulties can be caught before they occur, when these problems are smaller and easier to fix [17].

1.4 Case: Design communication between the casting user firm and foundry

For this paper, a buyer-supplier relationship in the foundry industry was studied. Data was collected with three case studies, and one of them was selected for further research. The design process in the PD network was mapped with a focus on the buyer-supplier relationship. Further, the communication structure of the PD network was mapped. The communication structure in the network originated from traditional buyer-supplier relationships, where the foundry would supply the order without taking part in the design phase. The designer started to design based on the older version of the product; the feedback given from the end-users and their own production. Even so, the design was solely created by the designer without discussing it with other departments.

Communication between the foundry and the customer started after the design was finished and the communication went through the buyer, who would select the supplier for the project. This lead to correcting design mistakes; the component needed to be re-designed for casting [20], as was discovered in our previous research. The designer stated, "Many times, we have noticed that it [casting design] affects the component's mechanical features among other things. That's why the foundry should be contacted earlier." The designer would discuss matters such as how to get the components out from the mould, division planes, and wearing of the mould with the foundry. These discussions were based on the alleged manufacturing method that the foundry had. The offer to supply the component was based on this assumption, since no design discussions were held before the foundry was selected. This was a risk for the customer because if the alleged method was not possible, the alternative method could be more expensive. As one foundry representative put it, "We go through the manufacturing method that we had planned for the component; it would be a huge risk if it was not applicable." For example, the method could have been designed with material feeds that were unable to put in the component. The foundry personnel also felt that the risks of the component should have been discussed, so that they could prepare for them. For example, if they

would have known the critical measures of the component, they would have designed the manufacturing so that the possible casting flaws would not come to these areas.

Even though, sometimes the designer was willing to ask for advice about the design from the foundry, it took a long time because many times the questions went through the buyer. For example, the designer would have valued active and quick support from the foundry when he needed to make engineering changes to the component. In addition, in the foundry the contact point may not be the person that had the answer to the question, thus the designer had to wait for the answer. Therefore, there was no link between the person asking the question and the person with the answer to that question. On the other hand, even if the designer was the foundry's contact point, he was not aware who would know the answer to his question. Additionally, the designer was not aware of all the questions that he should ask to improve his design.

The lack of transparency was not only a problem during the design phase; lack of transparency lead to lack of situational awareness. People did not know what was going on in the network at that moment. They were informed afterwards. This was a problem when trying to ensure that the project stays on schedule. The designer could not trust that the test castings would be on time because he had no visibility at the foundry. Thus, he had to make phone calls to make sure that the test castings were done in time. After test castings, the machine settings were written down in a machining guideline, which was then used every time to manufacture the component. These instructions did not include anything from the product, only the setting needed for the machine to manufacture the component. Hence, much design information did not reach the shop-floor. This led to, for example, the shop-floor not being able to detect errors in critical measurements.

The anticipation of future problems was valued, but the current communication structure did not support this. For example, when the quality of components in a foundry's production starts to decrease, they should warn the customers of upcoming troubles; the components would not soon fit in to the agreed quality standards. The matter should have been discussed before the quality of the components reached that level. When the foundry noticed problems in their production, they informed the customers of them. The designer tried to come up with a solution, and it was discussed with the foundry via e-mail and phone. E-mail was sent back and forth until a solution was approved by both sides.

In our case studies of the foundry industry, we found that people communicated with each other mainly through e-mail, phone, and face-to-face meetings. Phone was used for urgent matters and face-to-face communication for communicating about complex situations. For example, phone was used in the beginning of the project to discuss financial and design matters with the foundry. Some of the social media tools were tested in the customer company, such as video-conferencing, but it had not become a common policy. This was due to people's inability to see the advantages of it compared to a phone; also, it lacked critical mass because some of the people in the network did not have video-conferencing policies. Social media and CSCW tools were seen as an alternative to phone and e-mail, thus they were used as such. For example, video-conferencing was used in the same way as a phone; one person spoke to another from different locations. The possibilities of social media tools had not been discovered, such as talking to more than one person at a time.

After the design process and communication structure were mapped, the benefits of social media were considered and compared with the challenges in the current communication structure. The following hypotheses for improving design communication in buyer-supplier relationships were made:

Hypothesis 1: Social media tools can create new social spaces that enable proactive handling of production challenges.

Hypothesis 2: The use of social media tools leads to improved situation awareness.

Hypothesis 3: The use of social media leads to a wider response base for questions.

Hypothesis 4: The use of social media tools increases awareness of who knows what.

2 METHOD

2.1 Case description

Three case studies were conducted in different PD networks to collect the data. The data was gathered from the casting industry, including one foundry and three casting-user firms. Three cases were chosen to give an overall picture of the various buyer-supplier relationships the foundry is involved in, since the design communication needs vary between customers depending on, for example, their product or relationship maturity. One case product from each firm was selected to map the current design processes and communication structures within the PD network. Table 1 presents the firms that took part in the data collection.

Table 1. Case companies

	Description	Interviewed people
Firm A	•product: locks •several product families •strict visual requirements •long tradition of casting components •no in-house casting design expertise	•buyer •production manager •designer •design manager
Firm B	•product: locks •PD phase •no previous experience on locks	•buyer •designer
Firm C	•product: speakers •several product families •strict visual requirements •had previously one experienced casting designer	•buyer •production manager •designer (2) •quality management
Foundry	•die casting foundry •small components •small company •long history with Firm A •firms B&C new customers	•top management •sales & design •production manager

Firm A had long tradition of casting components, but due to a generation shift in the company, much knowledge has disappeared. Firm A and Firm C had strict visual requirements for the casting components since they were visible to the end user. Firm B found the design ability of the foundry to be very important because the casting component was a strategic component in the finished product. Firm A did not have strategic casting parts in the past. The casting components were mainly bulk components. However, they have now replaced several components with a casting component, which has made the casting components strategic. Due to the lack of effort on casting components, in the past, the collaboration between Firm A and the foundry started after the design was finished and only minor changes were possible. However, since the component was not designed for casting, changes would have been needed to ensure good quality components. Hence, Firm A was selected to play the simulation game with the foundry to improve their collaboration by, for example, including the foundry already in the design phase, where the changes are possible and cheap to make.

2.2 Mapping current communication structures

The data was collected by process mapping, semi-structured interviews, group discussions, and future dialogue workshop. First, the case companies' PD processes were mapped to identify the current communication structures in the buyer-supplier relationships within the PD process. The current challenges in the PD process were linked with specific communication situations. In addition, a future dialogue workshop [21] was arranged with three casting-user firms. In the dialogue workshop, a good

future picture was built, after which the current situation compared to the future picture. The hypotheses were formed based on the collected data, social media, and CSCW literature.

The interviews, group discussions, and future dialogue workshop were recorded. The recordings were transcribed and added to a research database. The data was analyzed and classified with selected keywords using software which is designed for data analyzing.

2.3 Simulation game

The simulation game was used to test social media tools in design communication. The simulation game was a one day workshop that reflects the actual design process with a focus on the buyer-supplier relationship. The game was played with Firm A and the foundry. It started from the idea of a new product and ended with the shipment of the last batch from the foundry to the customer. "A simulation game combines the features of a game (competition, cooperation, rules, participants, roles) with those of a simulation (incorporation of critical features of reality). A game is a simulation game if its rules refer to an empirical model of reality" [22]. In addition, simulation games have a positive effect on communication and collaboration within the group [22]. The simulation game was developed together with the foundry representatives to obtain industrial relevance. In addition, actual design materials (2D & 3D drawings, tenders) were used to increase the feel of it being an actual project. The game was tested with researchers.

The game was led by researchers, and they started the game by presenting the 'as-is' design process, so that the all the participants knew how the process that was simulated proceeded. The game included two rounds. In the beginning of each round, all players were given personal instructions on how to play the game. For example, the designer had constraints in form of product specifications and the buyer had a budget. All the players had a common task in both rounds: to design and produce 200 000 key casings. In the first round, the project was carried out through conversations. People explained what happens in every stage of the design process. For example, the first round started so that the designer was given a task to design a new version of the key casing, and was instructed to use the given product specifications as the base of the design. In the second round, an actual unfinished design was at the core of the project. The second round also included actual discussions of the design and not just reflections upon them. An actual unfinished component drawing was discussed during the second round. In the second round, social media tools were used. A web-based discussion forum and video-conferencing was used as the tools representing the possibilities of social media. The implementation was based on an open source tool Simple Machines Forum (SMF) and included four different discussion boards. One board was for discussions between the customer and its supplier pool. Second was discussion between the customer and foundry chosen to the particular project. Third was for internal discussion within the customer company. And the fourth was a people pool, which showed the competencies of the people in the PD network. Video-conferencing was used to create social space between the foundry and the customer. All the players were located in the same room and speaking was done in turns. Personnel from the foundry and from the customer sat in different tables to mirror the company boundary. The researchers made interventions to the design process to mirror real-life disturbances; engineering changes needed for the product, worn mold, quality defects in production and supplier selection. Players reacted to the interventions as they would in real life projects, and explained what needed to be done in the situation. After both rounds, a questionnaire was distributed to evaluate the process that had just been played. Questionnaire after the first round evaluated the 'as-is' process and the questionnaire after the second round evaluated the new ways of working. The respondents we asked to rate, if the new way helped them in their work compared to the current process, by agreeing or disagreeing mildly or strongly. Additionally, they were asked to elaborate on their answers. At the end of the day, the simulation game was reflected upon with the players to discuss the matters that had come up during the day and to explore the possible applications of the things learned from the game into real-life.

3 RESULTS

3.1 Benefits of new communication technologies in buyer-supplier relationships

Hypothesis 1 stated that one of the benefits of social media tools is that they can create new social spaces that enable proactive handling of production challenges. During the simulation game, foundry and customer personnel were asked to have coffee in separate locations linked with video-conferencing possibilities. During the coffee break, an intervention was made; the mold was worn and something had to be done. Video-conferencing enabled the people in the network to discuss the matter in real time. The foundry's production manager suggested normal maintenance of the mold since there were still components in the foundry's stock. The customer's production manager wanted to discuss the risk of stopping production, and the buyer wanted to discuss the cost of the maintenance. The foundry's production manager was able to answer questions relating to production, and the foundry's sales department answered questions about cost. All of the players in the game valued the potential of video-conferencing. They felt that challenges were solved faster when all the representatives discussed them at the same time. Decisions could be made easier because all the opinions were heard. The visual contact helped the communication to be more open and richer than on the phone or via e-mail. One of the foundry's personnel stated that "we got off so much cheaper when we only changed the central core of the mold and not the whole mold." Changes to the core of the mold are cheaper than to the mold itself. This was possible because the matter was discussed between the customer and the foundry's production manager. In the past, the customer was informed of the worn mold and it was the customer's responsibility to act since they owned to mold.

Situational awareness was improved with the discussion forum (Hypothesis 2). When matters relating to design or manufacturing challenges were discussed in the discussion forum, everybody was able to see what was going on in the project. For example, if there was a problem in production, everyone could see it and adjust their schedules accordingly. The discussion forum offered one portal for all of the design information and discussions during the design process. The buyer valued the ability to quickly browse through discussions because he had to be aware of the upcoming costs, although he was working on other projects as well. The foundry's personnel valued the information they had not received before, such as discussions about the design and what other people emphasized in their work. They felt that although some matters did not concern them, it was good to be aware of them. Additionally, the foundry's production manager found it easier to handle changes when he could see them being discussed before they reached production.

The discussion forum was also used to get a wider response base for questions (Hypothesis 3). Questions were related to design issues, engineering changes, production challenges, and mold maintenance. With the discussion forum, all the members of the PD network were reached. The designer felt that the discussion forum was an easy way to get quick responses both from the customer company and the foundry. The designers received feedback from foundry's production manager about the designs measurements. In the past, they had not discussed the design. The foundry's manager had only received the finished design. The customer's production feedback about measurement was also given, which lead to correcting a radius that the designer had only copied from an old drawing. The discussion forum helped the different views of different departments become apparent to everyone. This helped prevent challenges later on in the design process. However, it was mentioned that it should be made clear who is responsible for managing the conversation so that decisions can be reached.

The fourth hypothesis is that social media tools increase awareness of who knows what. The customer's production manager valued that the competence areas of the people in the network were visible in the discussion forum. It had a section that listed all of the people in the network, their competences, and their history working with the customer/foundry. The designer stated that he now has a better understanding of the foundry's internal functions. This would help in contacting the correct person when he needs quick answers. Additionally, increased awareness of people's competences enables targeting tasks to the person who knows the most about it. For example, the designer can assign the responsibility of designing the finishing procedures to the foundry's production manager.

The validation of hypotheses showed benefits that could be gained with social media tools. These benefits were implemented in constructing a new communication structure for the buyer-supplier relationship that could help overcome the challenges found in the old communication structure.

3.2 Changing the communication structure

The challenges in the old communication structure in the buyer-supplier relationship were related to informing about challenges and not discussing them and waiting for responses due to information flowing between certain contact points, and information was given sequentially. The designer valued the foundry's proactive handling of production challenges. The exchange of e-mails about the challenge was found to be unnecessary. Previously, the designer was informed of a challenge and would then try to come up with a solution and send the solution proposal to the foundry. After that, the foundry sent comments about the proposed solution. The designer, who is responsible for fixing the problem, felt that the foundry should have first thought of a solution for the problem and then discussed it with the designer, since production problems are more the foundry's expertise area. The responsibility of handling the challenges was shifted to the foundry during the second round of the simulation game. After noticing a problem in production, the foundry's production manager would think of a solution, and these matters were discussed with the customer. A continuous video-conferencing connection was used to discuss the challenges. The video-conferencing was on in the coffee room in both companies to create a social space between the companies.

In the old buyer-supplier relationship's communication structure, information flowed mostly through certain contact points, which became information gatekeepers. For example, if the designer wanted to make a change to the product, he would ask the buyer to contact the foundry. The buyer would contact the sales department in the foundry and the change request was passed on internally to the production manager, who would provide comments about the change. The comments flowed the same way back to the designer. During the simulation game, the discussion forum was used to connect people from different functions. This enabled the designer to tap into knowledge within the network he had not previously been able to access. This can be understood as community sourcing within the PD network.

The PD network forms a community that is built around the product being produced. The people in the network are used as a source of information and knowledge. One of the interviewees explained the need to communicate with more people than before: "It's not important to play the blame game, but to make sure that in the future all aspects are taken into considerations, since the tools of one person are not sufficient." The customer company's designer can internally discuss assembly, product quality, modularity of the product families, harmonizing manufacturing methods, and decreasing the number of parts in the final product with the production department. From the supply chain, the designer can obtain information about, for example, mold design and how to get the casting out of the mold. In the simulation game, there were two solutions for fixing a broken machine proposed by foundry personnel. Top management proposed that they order a new part, but the production manager informed them that they have spare parts. Having information from the shop-floor saved them time that would have been wasted on waiting for a new part. During the simulation game, both the foundry and customer's production managers and the customer's designer discussed test castings in the discussion forum. The customer's production manager wanted to know if the components were measured. The designer had measured them but the foundry had not. The foundry's production manager replied that he had not been aware of the measures and the measurement accuracy the customer wanted. The mutual decision was that the designer would mark the critical measures at the foundry during production.

Traditionally, information in buyer-supplier relationships is given sequentially. The network is not transparent, thus the information is only visible for a department when it reaches that particular department. Consequently, people are informed of what has happened instead of what is going on right now. For example, the customer's production manager expressed challenges in production during the first round of the simulation game. The production manager stated, "The production did not know during the design phase and foundry selection that the components that come from the foundry still

need finishing in our production. This increased the manufacturing costs. In addition, the product was late from the market because we had not prepared the tools needed for finishing." Hence, the use of the discussion forum would have made the network more transparent so that the production manager would have been aware of the finishing procedures that were expected from the production. In addition, had the production manager known about the needed finishing, he could have spoken to the foundry about if it would have been better for the foundry to take care of all the finishing procedures since they had good connections in the supply chain, which had expertise in finishing. In addition, transparency in the PD network during the design phase would enable people to give comments about the design to prevent future problems. The change of communication structure with the help of social media is presented in Figure 1.

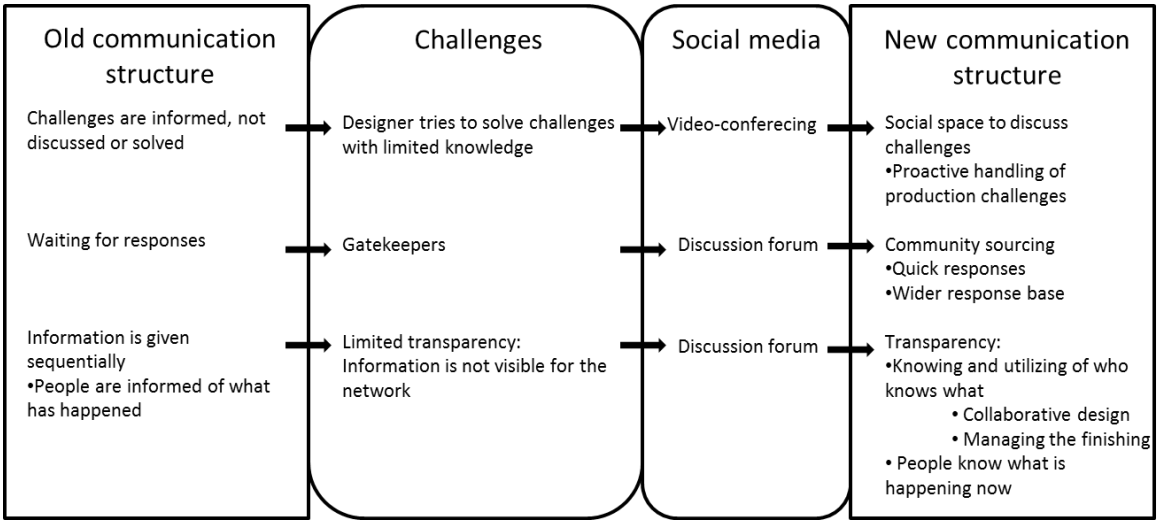

Figure 1. Changing the communication structure with social media

4 DISCUSSION

4.1 Design communication structure

Design communication structures in buyer-supplier relationships have not traditionally supported networked PD. As social media is still a new phenomenon, its utilization in improving design communication still needs to be studied. In addition, utilizing social media in early supplier involvement still needs future research. In this study, the suppliers were included in the design efforts through social media. Community sourcing within the development network was suggested. Just as community sourcing taps into users [16] to obtain insight into what the product should be like, community sourcing within the development network taps into the manufacturing knowledge of the suppliers; for example, how to make the design into a product. This is in line with Khoshafian and Buckiewicz's [12] statement that CSCW increases the amount of information available to users. Community sourcing also provided manufacturing information to the designer, which was valued by, for example, Bandera et al. [18] and Rodriquez and Al-Ashaab [19]. To be able to obtain information from the network, social spaces need to be provided [15] between the network members. This was done in the form of offering social media access. A social space was created by opening a real-time video-conferencing connection between the companies. This created more communication between the members of the network. During the game, all the representatives had coffee at the same time in two locations, but the video-conferencing could be expanded and used to create ad-hoc conversations in the PD network. For example, it could be used for discussing schedules, quality issues, challenges, test castings, etc. If personnel were required to be in the coffee room at the same time every day, video conferencing could also be used to discuss mold and machine breakdowns, make quick decisions, and to keep a monthly PD meeting to discuss the product. The other social space was the discussion forum, which enabled different functions to discuss matters during the design process.

The efforts to validate the hypotheses showed that social media can improve design communication by changing the communication structure in the PD network. The simulation game showed signs of

improved situational awareness, improved transparency, widened the response base that was used for community sourcing, and new social spaces creating collaboration possibilities that were not possible before. Video-conferencing possibilities for ad-hoc collaboration still needs further research, since the ease of getting people to use it was apparent in the simulation game.

To be able to utilize social media in improving design communication between the foundry and the customer design, communication needs to be "supported on organizational, project, individual and information levels" [20]. Organization needs to enable free communication with suppliers and the rest of the PD network and not restrict it with heavy concealment restrictions. On the individual level, social media tools can help increase awareness of the design process. Additionally, social media tools can also promote collaboration between companies by connecting people that traditionally have not collaborated. Information level refers to IT-tools that enable information transfer. Social media tools' usability need to be discussed on a level that does not hinder information exchange.

4.2 Challenges of utilizing social media in buyer-supplier relationships

The first challenge in implementing social media to the foundry industry is that the companies are used to using e-mail and phone for communication between companies. The people in our case studies were not accustomed to using social media tools. For most people, it was the first time they used video-conferencing tools. Hence, resistance to change and the need for practising using tools are challenges that need to be solved. However, for traditional communication tools, such as phone and e-mail, prerequisite for communication is that you need to know, who you need to be communicating with. As Mäki et al. [3] asserted e-mails are not targeted to relevant recipients. To be able to utilize and distribute the information from and to unforeseeable sources, social media tools are needed. For this reason, the foundry industry should adapt social media tools into their processes. If they were more accustomed with using social media tools, the challenges would be different than in the presented cases. For example, in addition to focus being on what are the situations that the tools can be used for, the focus could include actual features needed from the tool.

The second challenge is getting the critical mass to actively use the system. Critical mass can be obtained by making the use of the social media a company policy. Active use is needed so that the time between comments in the same discussion does not stretch too long. The goal is to get all the interested parties actively taking part, or following, the discussions. The third challenge is finding design communication issues that can be communicated through social media. For example, some changes to the product are hard to describe in a discussion forum with a static 2D drawing and text. Richer communication is needed. On the other hand, minor changes to the product, for example, a change in a corner radius, can be easily handled through the discussion forum. The fourth challenge is that when discussing matters that are visible to the entire PD network, a representative from one function can discuss things that make the work harder in some other department. For example, if a designer notifies the supply chain that he needs a change completed, the buyer cannot bargain over the price of the change, since the suppliers know that the change needs to be made anyway.

4.3 Validity of simulation game method and limitations

The simulation game gives the participants a chance to test new policies without making a change to their everyday work. The challenge of the simulation game is that a project that can take two years is squeezed into two hours. Consequently, time cannot be used as an indicator of efficiency. In spite of that, the simulation game reflects real-life, thus its findings can be utilized in real-life. However, the results gained from the simulation game are merely starting points for utilizing the new design communication structure in actual projects. The limitation of this study is that the findings are yet to be validated with longitudinal studies.

5 CONCLUSIONS

Utilizing social media in buyer-supplier relationships can help in improving design communication between the foundry and its customer. Design communication can be supported in the following two

ways: (1) supporting the communication about the design, and (2) supporting the distribution of design information in the design process. Social media tools offer possibilities for community sourcing, network transparency, and creating social spaces between companies. Community sourcing within the PD network is, in particular, a tool for the designer to gain knowledge from different functions to improve the design. The experiences that were gained in this research from the simulation game show that utilizing social media tools in changing the design communication structure was useful, since it brought benefits such as improved situation awareness and comments to the design from people that had not commented before.

The new design communication structure needs to be tested in real projects in the future. This would make it possible to consider time as one measure. Although the social media tools are not currently used in our case companies, they seem to offer benefits for the foundry industry. Future work should include the benefits gained from other types of PD networks and if the presented communication structure is applicable for other industries. Additionally, the challenges of utilizing social media tools in improving design communication still need future research.

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