BARRIERS TO HINDER COLLABORATION WITHIN PRODUCT DEVELOPMENT TEAMS FROM DESIGNERS' PERSPECTIVE AND THE DEVELOPMENT OF A METHOD TO FACILITATE THE COLLABORATION

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Abstract

To be successful in the market, industries have kept trying to increase users' satisfaction with their new products. Under this circumstance, firms have realized the importance of collaborative environment in which different team members closely work together, to meet rising expectations of the users. Although multi-disciplinary teams have been developed with such great optimism, inevitable conflicts are frequently occurred between different team members. However, it has been hardly studied how well the collaboration within a product development team is being done. Therefore, this study aims to reveal barriers to hinder collaborative environment. To figure out the causes of conflicts within the teams, we interviewed design practitioners in multi-disciplinary product development teams. Through the interview five common causes of conflicts and newly emerging conflicts were identified. The findings led to the development of a collaborative toolkit to facilitate the collaboration within a multi-disciplinary team. The usability of the toolkit was evaluated through an expert interview and a focus group interview. The implications and a further study are discussed as well.

Keywords: Collaborative design, Organisation of product development, New product development, Multi-disciplinary design

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1 INTRODUCTION

Since electronic products were introduced on the consumer market, users have experienced convenience as the products enable us to save labour and time in our everyday life (Kim *et al.* 2007). However, consumer electronic products have not always satisfied users' expectations: users often get frustrated due to failure to complete a simple task (Abras *et al.* 2004). These dissatisfaction leads to negative experiences with the product and negative experiences with previous use of products influence the intention of consumers' future purchase (Kim *et al.* 2007).

To reduce such negative experiences and increase user satisfaction, the term 'User-Centred Design (UCD)' which involves users in product development process has been introduced (Norman and Draper 1986, Abras *et al.* 2004). The major activities of UCD include understanding and specifying context of use, the user and organizational requirements, and finally evaluating usability with a sample of target user group (Jokela *et al.* 2003).

Among several UCD methods, collaborative team approach in which various disciplines such as designers, engineers, marketers and manufacturers work together has been broadly used (Ainamo 2007). This is one of most useful UCD methods in a sense that individual discipline does not have all the required expertise to analyse, design, implement and evaluate complex systems in product development process (Dougherty 1992, Van Kuijk 2010). Especially in the new product development (NPD), it is cross-functional linkages between different co-operators that are emphasized within a team to make synergy through the interaction with each other (Pinto and Pinto 1990, Chung 2009). The contextual factors such as rapid technological change, flexible production processes, and global competition encourage to make close collaboration across functions even more crucial for the introduction of profitable and timely new products (Olson *et al.* 2001).

Even though the collaborative teams have been developed with great optimism, few groups have received appropriate training and other support necessary for transformation into collaborative team (Jassawalla and Sashittal 1999). Team members with different backgrounds also start from different underlying principles in the product development process (Mackay, 2003). It results in inevitable conflicts between functionally diverse team members that often interrupt the collaborative environment (Ramesh and Tiwana 1999, Keller 2001, Lovelace *et al.* 2001, Lam and Chin 2005).

These frequent misunderstanding and conflicts could lead to a big loss of company revenues considering the development time and cost which emerge as one of the main concerns to the producers (Kichuk and Wiesner 1997).

To improve collaboration within a multi-disciplinary team, many studies have been conducted. They can be categorised into two groups in terms of their purpose. The one is about core elements that directly affect collaborative environments in product development process (Jassawalla and Sashittal 1998, Jassawalla and Sashittal 1999, Lam and Chin 2005, Bstieler 2006). The other is about how to create better collaborative environments (Cross and Clayburn Cross 1995, Ferraro *et al.* 1995, Kichuk and Wiesner 1997, Roy and Kodkani 2000, Olson *et al.* 2001, Berander and Wohlin 2004, Ainamo 2007, Chung 2009, Pei 2009). These studies provide theoretical foundations to better understand collaborative teamwork in the product development process. Based on the theoretical foundations, this study aims to 1) identify main problems and concerns of current collaborative product development team members from design practitioners' point of view and 2) suggest practical tools to encourage the collaboration in a multi-disciplinary product development team. These tools will help increase the satisfaction of users with their electronic products and this could lead to contented life with our everyday electronic products.

2 METHOD

For this study, in-depth interviews with design practitioners were conducted. The major purpose of the interview was to identify the major problems and concerns between team members with different backgrounds in collaborative environments of each product development process.

2.1 Participants

In order to ensure that the interview results were reliable, a balanced number of product designers were invited to the interview. Three designers were from major consumer electronic companies in South Korea (in-house design team) and the other three designers were from medium-sized design

agencies in the country. They all have experiences in working within collaborative product development teams. To collect as many problems and concerns as possible in collaborative works, people who had more than 4 years working experiences were recruited in the interview. The participants had design practice experiences in diverse product categories such as home appliances, mobile products or heavy equipment (see details in Table 1).

Table 1. of Participants

No.	Type of Design Team	Position	Design Area	Working Experience
1	In-house design team	Chief Designer	Home Appliances	Over 10 years
2	In-house design team	Senior Designer	Mobile Products	8 years
3	In-house design team	Researcher	Heavy Equipment	4 years
4	Design Agency	Representative	Consumer Electronics	Over 10 years
5	Design Agency	Creative Director	Consumer Electronics	5 years
6	Design Agency	Senior Designer	Home Appliances	6 years

2.2 Materials

In order to figure out the problems and concerns of collaborative product development team members, two card sets were developed: product development card set and team member's role card set (Figure 1). Both were designed to effectively gain related collaboration-related issues by visualising the product development process and the role of product development team members.

Figure 1. Product Development Card Set (Left) and Team Member's Role Card Set (Right)

2.3 Procedure

A semi-structured interview was conducted in the study, which is ideal for the exploration of the perceptions and opinions of participants regarding complex and sensitive issues. It also enables the interviewer to explore and clarify inconsistencies of participant's answers (Louise Barriball and While 1994). Before the main interview, introduction of the study was given to all participants. This was followed by asking main questions regarding the collaborative product development. The interviews were videotaped under the participant's agreement (Figure 2).

Figure 2. Interview Scenes of Six Participants

3 ANALYSIS

The interview data were transcribed. Then, the transcribed data were qualitatively analysed to figure out the main problems and the causes of the problems in each product development process. Through the analysis, conflicts in a collaborative product development team were identified and newly emerging conflicts between designers were also discovered (Figure 3). Furthermore, their causes were categorized into five groups.

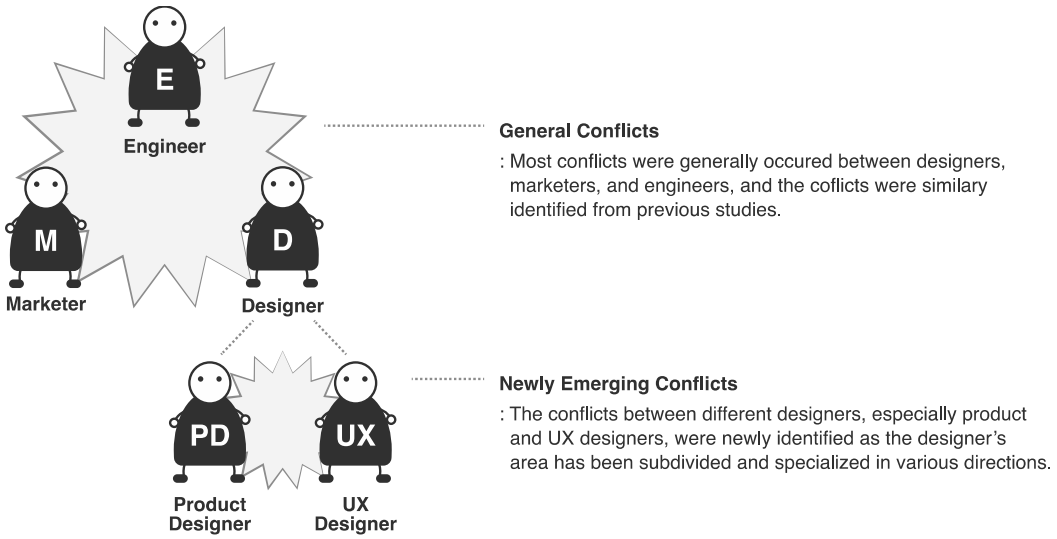

Figure 3. General Conflicts and Newly Emerging Conflicts in Product Development Process

3.1 Conflicts between Designers, Marketers and Engineers

From designers' point of view, major conflicts were identified between designers, marketers, and engineers. Designers tended to consider users in detail while marketers focused on the current market. The difference made designers hard to persuade the marketers when they suggested new types of product. For instance, conflicts between designers and marketers were frequently made when the marketers took priority over the affordable product price. In the meantime, designers tried to keep the initial concept for developing a product. This can be a serious limitation on designers who need to create a new product concept through forecasting the future. Similarly to marketers, engineers also mainly thought about the production cost and product release price based on the company-centred consideration.

Moreover, lots of different factors such as the development cost and different objectives for developing a product provoked conflicts between designers and engineers. Designers try to improve the value of a product, as engineers want to improve the effectiveness and efficiency of the product. From engineer's perspective, the effectiveness does not mean the effective usability. It means the effective development and production. However, many engineers do not like to develop additional

functions or features to improve usability because it means that they need to work more to create solutions. In addition, in case designers plan to suggest products with currently available technologies, engineers make few complains. However, in case particular technology is inexistent, it is expected that designers would have many conflicts with engineers. Additionally, tight development schedule and unexpected changes in product development schemes were one of major problems in collaborative teamwork: in the product development process, each discipline has their own works and if they delay some of their assigned work, it could directly affect the other teams' schedules. Abrupt requests such as form change on their developing products due to some technical reasons could influence the redesign of the whole parts of the product form to keep the initial concept.

3.2 Newly Emerging Conflicts within Designers

Since firms focused on a new kind of design-driven innovation to survive in the competitive environment, the designer's role has become more and more important. This led to the subdivision of design functions into many domains such as product design, interaction design, graphic design, user-experience design and so forth. Under the circumstance, new conflicts have begun to emerge within different designers in multi-disciplinary product development teams. Interestingly such conflicts were identified in the study as well. Especially, many problems were reported between user experience designers and product designers, and major reasons were duplication in work and a lack of understanding each other's role. According to the interview, user experience designers regarded product designers as those who just actualize ideas following the user experience designer's concept guidelines. Moreover, user experience designers thought that they are strongly in charge of advanced research process for product development because they think product designers have little research skill and design strategic ability for product development. On the other hands, product designers regarded user experience designers as those who just suggest ideas in words without any actualization of final products.

In the projects in which user experience designer take initiatives, product designers act like supportive team for the user experience designers in the whole product development process. Under the circumstance, product designers are not motivated to do their best because they think that the reward will go directly to the leading team. Without the project ownership, product designers tend to be passively involved in the project and as a result productive results would hardly be produced.

3.3 Five Causes of Conflicts

3.3.1 Different communication tools

As designer it is often difficult to express the concepts of a new product and their benefits in a quantitative way such as numerical data. However, engineers and marketers easily understand when the data are given in number. The words such as "this is good" and "the aesthetical form will be loved by customers" might not be understandable to engineers as well as marketers although product designers are sure that many consumers would love the concepts. According to the practitioners in the study idea sharing in number caused an inefficient communication environment in a multi-disciplinary product development team (Figure 4). Marketers also had similar problems like the case designers experienced. If marketers are not able to provide definite answers with engineer's language, engineers do not often go ahead as planned favourably.

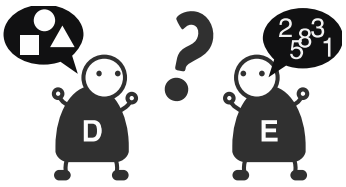

Figure 4. An Explanatory Image of Different Communication Tools

3.3.2 Personality discrepancy

A multi-disciplinary team is a group of combined people who have diverse characteristics and different expertise. Under the environment, it is hard to fully understand each other. One member even does not completely know what exactly the other team members do in a project (Figure 5). One of the hardest things is to develop empathy between each other members. All members have different

preferences and perspectives and this makes it difficult especially when they should choose the most preferred concept among many. Even within designers, some designers tend to prefer extremely advanced concepts while the others are fond of more realistic designs.

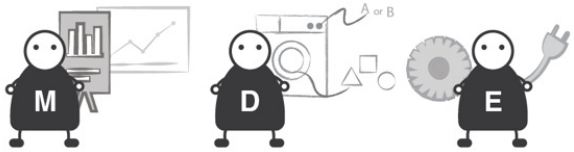

Figure 5. An Explanatory Image of Different Characteristics and Expertise

3.3.3 Political issues

In the product development process all team members are supposed to have equal power to express and share their ideas. Otherwise, it would be difficult to create a collaborative work environment. In reality, designers, however, do not have much power in decision-making. Such lack of power in decision making often led to conflict with other disciplines and the frustration of collaborative teamwork (Figure 6): all of the interviewees agreed that designers should have that power for enhancing collaborative environments. If engineers direct the whole project alone, they probably focus on efficiency and effectiveness of a new product while user-centred design is not seriously taken into account.

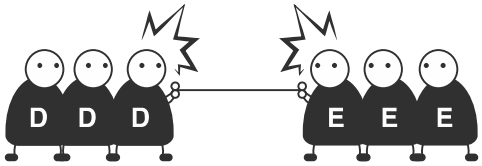

Figure 6. An Explanatory Image of Political Issues

3.3.4 Lack of leadership

In many cases, the success or failure of a new product development project is determined depending on how well the project manager directs the project (Figure 7). During the whole development process, one of the key roles of a project manager is to keep an initial concept throughout the development of the product. If a project manager often changes the concept on his or her own decision, a huge amount of time and cost could be wasted. Additionally, when a project manager is not interested in accepting new ideas, he or she could suppress other team members from creative thinking.

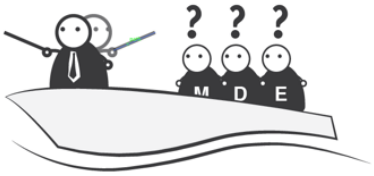

Figure 7. An Explanatory Image of Lack of Leadership

3.3.5 Separated working space

In most South Korean firms product development teams work in separated spaces. Such separated working environment take too much time to communicate each other, and many miscommunications could happen (Figure 8). In addition, different members in a collaborative team hardly become aware of what is happening in the environment: at most they communicate by email instead of face-to-face communication. According to the interviewees, working in a space would be also better for collaborative product development because schedule conflicts could occur due to lack of direct communication..

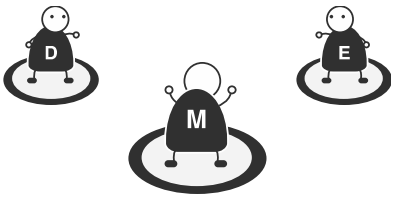

Figure 8. An Explanatory Image of Separated Working Space

4 SOLUTION DEVELOPMENT

An idea storming session was conducted to set the direction of possible solutions for improving collaboration between multi-disciplinary team members. Seven graduate students at the department of industrial design, some of whom have professional experience as designer, participated in the session. First, the introduction and detailed schedule of the session were given for ten minutes. Following the introduction, the participants were divided into three groups to facilitate discussion. An idea generation session was performed with the three groups for forty minutes. In the session, participants were asked to come up with ideas to avoid the conflicts that we found out through the interviews and encourage collaboration. After that idea actualization session was done for another forty minutes to materialize the ideas generated in the previous session. In this session, participants categorized the suggested ideas into several groups and came up with possible solutions.

In the large scaled firm as well as design agency, it takes much time to change the culture of the organization and the product development process. Therefore, as method to improve collaborative product development teamwork and collaboration between designers we developed two paper-based tools that multi-disciplinary product development team members can easily use and share to solve their own problems through understanding different disciplines: Conversation tool for communication within a multi-disciplinary product development team and Empathy tool for understanding between designers.

4.1 Conversation Tool

Conversation card set aims to help individual product development team members such as designers; engineers and marketers understand and communicate each other, which could improve collaboration between them (Figure 9). First, team members gather and select one product development process card, on which conflicts frequently occurred in their team. Then, they can start discussion to find the main causes of the conflict on that stage by using the yellow cards. After this, they can find possible solutions from the blue suggestion card.

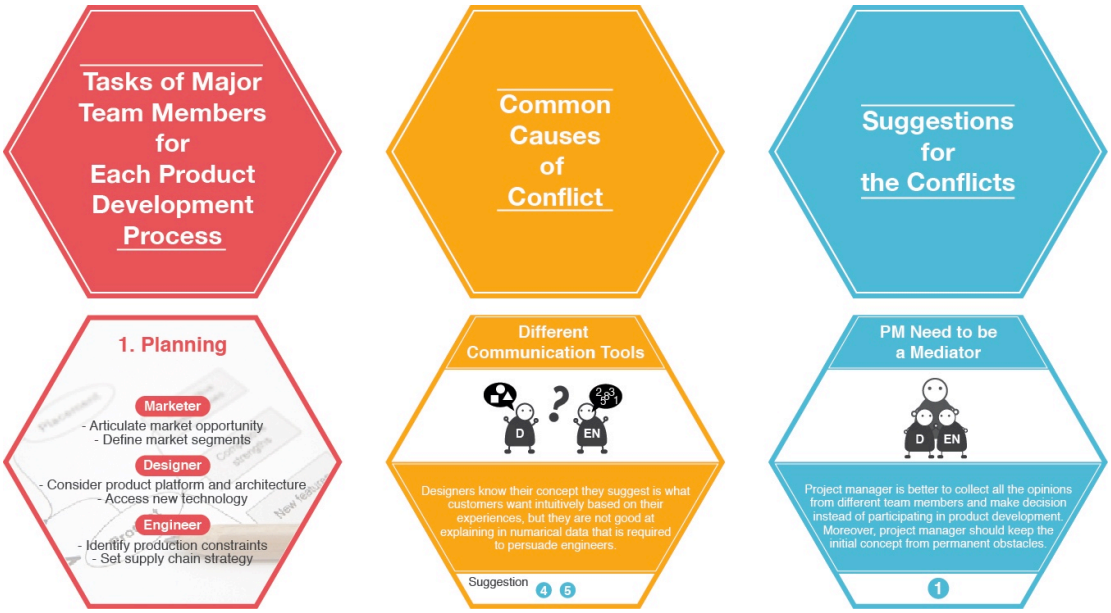

Figure 9. Example of Conversation Card

4.2 Empathy Tool

Empathy card set aims to facilitate an understanding of different roles but close relationship between product designers and user experience designers. This tool has two dimensional hexa-hexaflexagons structure with the front and back, but it also has more faces hidden inside (Figure 10). They become visible by flexing and folding the paper. With this hexa-hexaflexagons structure, much information can be presented and users can also be easily familiar with the included contents in a playful manner. This tool includes six slides with the key information regarding better understanding between product designers and user experience designers (Table 2).

Table 2. The Contents of Empathy Card

Side No.	Contents
Side 1	Different specialties of different team members in product development
Side 2	The main causes of conflicts between product and user experience designers
Side 3	Clear differences between product designers and user experience designers' roles
Side 4	The flexibility of their roles in different product types
Side 5	Assigned roles in each product development process
Side 6	The importance of close relationship between product and user experience designers.

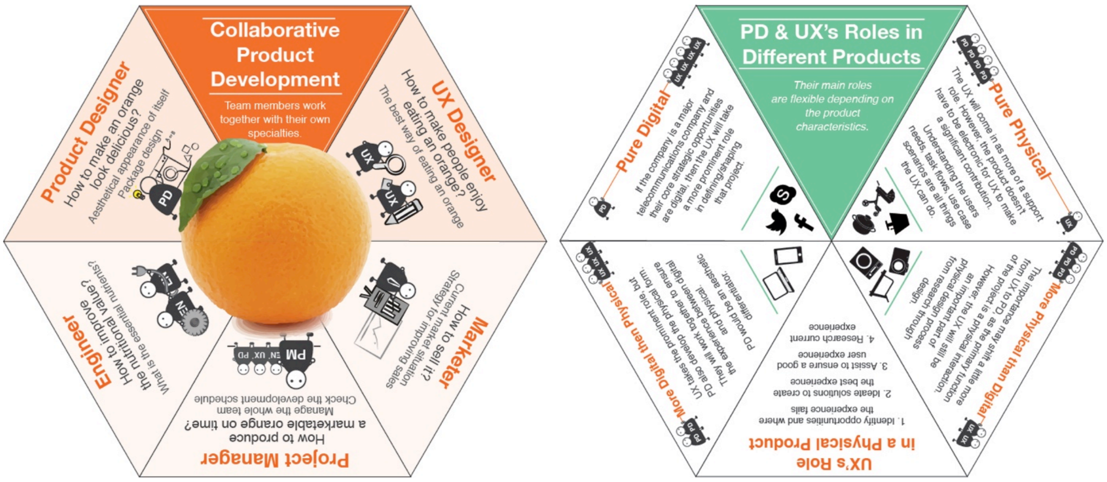

Figure 10. Examples of Empathy Tool

4.3 Evaluation of the Tools

To evaluate the effectiveness and usability of the tools, an expert interview and focus group interview were conducted (Figure 11). In the expert interview, a design tool development expert was recruited with the purpose of getting comments on both conversation and empathy cards. This interview started from the introduction of the project, and both conversation and empathy cards were given to her.

In the focus group interview, five design practitioners who had more than three years working experience in design agencies at the time of the interview evaluated the usability and effectiveness of the tools. Like the expert interview, the introduction of the project and the tools was given. And then the practitioners were asked to use the tools based on their own experiences of conflicts within their teams.

Figure 11. Expert Interview (Left) & Focus Group Interview (Right)

Both the expert and the practitioners gave positive comments that the tools possibly help multi-disciplinary team members in a way to increase a better understanding of conflicts they currently have or they might have soon. In addition, the participants gave several useful suggestions. One is that conversation card set could be hard to use without guidance. Another is that the tool would be more effective if it could be better designed and used for a workshop to facilitate discussion between team members. And more cases need to be collected to supplement the limited number of causes of conflicts according to their comments. An interesting comment on empathy card set is that a project manager also needs to understand diverse roles of designers within their project teams considering some project managers lack experience of working with designers, especially user experience designers. Therefore, the empathy card set needs to be developed into two different levels: one is for beginners who do not know deeply about the different roles and close relationship between product and user experience designers. The other one is for experts who generally understand the relationship, but have difficulties in figuring out the actual solutions to reduce the conflicts and at the same time improve collaborative environment between product designers and user experience designers.

5 SOLUTION DEVELOPMENT

The aim of this study was to first identify current problems and concerns within collaborative product development teams and then develop a solution for design practitioners to make better products in a collaborative manner. Through in-depth interviews with design practitioners, the problems and concerns that hinder collaboration were identified and six causes of such problems were illustrated. Based on the findings, an idea generation session was performed and communication and empathy card sets were developed. The effectiveness and usability of the tools were evaluated with an expert and design practitioners. The key contribution of this study is to help multi-disciplinary product development team members reduce frequent conflicts within their team by getting a better understanding of each discipline. Moreover, they will be able to come up with better solutions by them selves. The tools will help increase the satisfaction of users with their electronic products and this could lead to contented life with our everyday electronic products.

While this research has achieved the research aims, it seems to require broader feedbacks from other multi-disciplinary team members who are rather than designers: for example, engineers, marketers, and other related stakeholders to be properly used by practitioners. To do so, additional workshops and interviews are necessary with collaborative team members in more various firms.

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