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DESIGN TEAMWORK IN DISTRIBUTED CROSS-CULTURAL TEAMS

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ABSTRACT
In the recent decades, design teamwork in international teams has been taken into account to meet the requirement of product development with different cultural backgrounds in the context of globalization. The aim of this research is to explore the effect of different design teamwork modes (competition, collaboration, cooperation) on design process and support designers to improve design teamwork (design quality and team satisfaction) in the distributed cross-cultural teams. A case study was designed and conducted to investigate the effect of three different teamwork modes in distributed design teams with Dutch and Chinese students. In this research, it is found that different teamwork modes affect design quality and team satisfaction in international teams. In addition, cultural differences also have influence on design teamwork. The result of this study can be used for improvement of design teamwork, it is important for designers to be aware of cultural differences and make use of teamwork modes in design process.

Keywords: teamwork, collaborative design, uncertainty, cultural differences

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1 INTRODUCTION

In the context of globalization, teamwork plays an important role in industrialization (Kleinsmann et al., 2010). Due to product development for different markets, it is necessary to work with people from different background (Cheng and Kvan, 2000; Hennessy and Murphy, 1999). Considering the complexity of product development, teamwork is put into practice to solve the complex problem and meet the requirement of different markets. In the view of global industry, western countries and eastern countries have much more potential to collaborate with each other (Molina et al., 2005). Teamwork usually comes with mutual benefits and shared learnings (Chung, 2009). Due to the globalization of the economy and industry, design teamwork has become culturally and geographically distributed (Schadewitz, 2009). Design teamwork in different cultures requires an understanding of cultural context. Therefore, it is necessary to identify the influence of cultural differences and the requirement of design teamwork.

Limited research has been found related to teamwork for design process in international teams. Consequently, design teamwork in international teams is taken into account and the research is needed to support teamwork with different cultural background. This research investigates the influence of cultural differences on design teamwork and explores the suitable teamwork modes to support designers to improve design teamwork. The central problem in this research is to explore and identify the influence of cultural differences and teamwork modes on design teamwork, so as to support designers to improve design quality and team satisfaction.

In order to motivate and improve cross cultural design teamwork, it is necessary to be aware of cultural differences and take advantage of different teamwork modes. The aim of this research is to explore the effect of different teamwork modes on design process and support designers to improve design teamwork in the context of international design teams. Three different teamwork modes are analyzed to investigate the dynamics of design teamwork. This design research objective is to support cross cultural design teamwork. In the context of cultural differences in international design team, the research question is **how different teamwork modes (competition, collaboration, cooperation) affect design teamwork (design quality and team satisfaction) in distributed cross-cultural teams of Dutch and Chinese?**

1.1 Design teamwork in international context

Teamwork is a complicated activity and difficult to establish and sustain in an international team. Teamwork is successful when an international project is accomplished by a collective team instead of a set of individual (Kvan, 2000). Therefore, design teamwork requires high effectiveness and efficiency of working together in order to achieve the design project. As to design teamwork, it has been undertaken to support distributed project both for education and industry context (Cheng and Kvan, 2000). That means design teamwork is becoming more important in both education and industry.

Design teamwork requires multidisciplinary knowledge and multiple skills and expertise (Christensenl and Yasar, 2007). Designers have to recognize their capacity for contributing to effective teamwork and concept generation in design process. However, designers with different background cannot guarantee a successful teamwork if their ideas, perspectives, and knowledge are not properly shared with each other (Chung, 2009). For teamwork, designers undertake projects via internet and interact on shared digital files. Online applications are developed to support and facilitate the teamwork (Kvan, 2000). Technical equipments for communication and visualization are set up to facilitate distributed teamwork. Designers are motivated to interact with communication tools and deal with the technical issue. Considering the best fit between design teamwork and technology, such as communication and visualization, technical methods should be tailored to specific project and team, rather than a general solution (Cheng and Kvan, 2000).

1.2 Cultural differences influence

Culture has impact on all kinds of aspects of design, because culture is closely related to design. Culture insight can be integrated into product development consciously and unconsciously (Razzaghi, Ramirez and Zehner, 2009). For the conscious way, designers deliberately aim to find design solutions according to cultural preferences of the users. For the unconscious way, designers put their own cultural concerns into design solutions. Due to the diversity and change of user needs and preferences,

design gets more complicated. It is necessary for designers to be aware of cultural differences in their design, as well as enhance the cultural appeal for users (Razzaghi, Ramirez and Zehner, 2009). Due to the cultural differences of designers and users, development of design teamwork depends on their norms, rules and languages (Ostwald, 1995). Designers make efforts in understanding cultural differences and increasing their experiences in global product development. When products and services are exported, the foreign consumers get an insight into cultural identity of the original producers, even their lives, needs, wishes and habits (Zec, 2002).

Culture is considered to be a significant issue in industrial design. Cultural values play influential roles over all aspects of life and designers are not exempt from the cultural effects. Therefore, it is worth noticing that designers are required to meet the needs of users, and culture needs are among those requirements. Designers have been aware of that cultural value and symbol is becoming more significant than physical products (Razzaghi, Ramirez and Zehner, 2009). Therefore, cultural differences play an important role in the product development process. The concepts created by designers are partly based on their cultural background and social value. In other words, their own culture can influence their works (Press and Cooper, 2003).

The importance of cultural awareness has been recognized by designers; however, it is often neglected in the design process by companies due to some reasons (Razzaghi, Ramirez and Zehner, 2009). Because of time and budget constraints, it is hard for designers to pay enough attention to cultural insight into the design process. In addition, people with diverse backgrounds act as hindering factor of cultural differences and lead to misunderstanding and contradiction. However, cultural differences can act as a source of change and innovation (Chung, 2009). The hindering factors of cultural differences are limited and most of them could be reduced. Although hindering factors have negative influence on design teamwork, they have the potential to become a driving force for supporting factors and improve design teamwork. Design teamwork in international team plays an important role to transfer the hindering factors to the supporting factors. This research is about understanding the cultural differences in design teamwork and support more effective design teamwork in international teams.

1.3 Case selection: China and Netherlands

In the globalization of the economy and industry, it is increasingly important for westerner design practitioners and education to draw a closer view on the characteristics of Chinese design education. Considering the situation of industrialization in China and globalization in the world, distributed design teamwork plays an important role in transnational teamwork. This research focuses on teamwork in the case of bi-national team of Dutch and Chinese designers.

China is on the way of industrialization, and has become a leading manufacturer in the world. There were four stages on the history of Chinese industrialization: (1) Materials exportation, (2) Cheap labor for manufacturing, (3) Expertise of manufacturing, and (4) From manufacturing to creative design. In the first stage, due to the availability of resources, the output of raw materials was predominant, such as steel, coal, wood, cement, chemical fertilizer, etc. In the second stage, as the result of large and rapidly growing population, there existed abundant cheap labors for manufacturing. In the third stage, the industrial technology was developed in order to get sufficient technology. In the fourth stage, as the manufacturing technology was improved and design education was developed as well, “made in China” is in the process of becoming “Designed in China”.

In the context of globalization, distributed teamwork is become popular and necessary for global market. More and more companies value their global strategy and pay more attention to the distributed teamwork.

China has large market in the world, while Netherlands has good quality of design. Design in the Netherlands, namely Dutch design, is famous for design esthetic and particularly product design, which is characterized as experimental, innovative and humorous. Dutch designers have the ability to make design simple and playful and they are good at making use of materials and give them new value. Dutch design are primarily known for graphic design and identified for product design as well. Dutch design is strongly supported by design education and many well-know designers are recognized in the world. Furthermore, Dutch design is effectively supported by government. As design has become an integral part of product development, companies pay more attention to design value and put design at a significant position.

2 THEORETICAL BACKGROUND

2.1 Design teamwork modes: competition, collaboration, cooperation

In this research, it is investigated three different teamwork modes, which are competition design, collaboration design and cooperation design. Design teamwork modes are used to support designers to construct an understanding of design problems and potential solutions (Ostwald, 1995). According to the definition of collaborate, collaboration means work together to solve joint problems and find solutions. As to the definition of cooperate, cooperation means work along with others to get mutual benefit. It is also found cooperation is an older concept than collaboration.

In the international design teams, hereby a joint design course is taken. With the cooperation design mode, one sub-team collects information from target market and another sub-team dominates the design ideation. Afterwards, the first sub-team gives feedback and suggestion to these preliminary design ideas. Finally, the second sub-team makes improvement and final decision and the first sub-team works out the prototype. With the collaboration design mode, both sub-teams collect data in a collaborative way, and then make a collaborative ideation for target market. After discussion, the design solution is improved and the final case will be chosen. With the competition design mode, both sub-teams collect data separately. Then, designers from each sub-team make an idea generation independently. Next, they present and discuss to choose the better idea or to mix them into a final design idea, and improve it together as the final solution.

2.2 Measurement: design quality / team satisfaction

In order to improve design teamwork and achieve the design project, design quality and team satisfaction are introduced as elements to measure the aspects of design teamwork. Design quality focuses on final result, which is a measurement of design solution. Team satisfaction focuses on design process, which is a measurement of teamwork quality. Design quality and team satisfaction have crucial influence on design teamwork. This research investigates design teamwork (design quality and team satisfaction) in the context of cultural differences. Cultural differences are considered as a significant issue in design teamwork, which is used to optimize the design quality and team satisfaction in the design process.

2.3 Factors: project uncertainty / team uncertainty

The success of design teamwork depends on the definition of project, team composition and proper design method and process, especially team composition and project definition, in accord with the common target and expectation (Cheng and Kvan, 2000). Considering the influence on design teamwork, project uncertainty and team uncertainty are the main factors have the effect on design teamwork.

Project uncertainty includes project definition and management. Project definition is a crucial factor for project uncertainty. The brief and requirement of design project can lead to variety of teamwork and designers have to choose the suitable teamwork modes. Project management has an effect on design teamwork. Due to the diverse of target group and design process of different projects, the uncertainty of project has to be taken into account to choose the suitable teamwork modes in design ideation. The tasks of design project and process management are also the factors of project management, which should be considered in design teamwork as well.

Team uncertainty includes team dynamics and team communication. Team dynamics is an important factor of design teamwork. It is found that team dynamics is crucial to design process and teamwork (Miranda et al., 2007). The research about team dynamics also can be found in the field of teamwork (Cross et al., 1995). Team composition and personal character are related to team dynamics. Furthermore, team communication is also a crucial factor of design teamwork. Designers are required to share information and also communicate with each other (Kvan, 2000). Distant communication between designers supports distributed design teamwork. Communication tools facilitate designers to collaborate more conveniently and make it possible for designers to benefit from sharing information and working together (Cheng and Kvan, 2000). Considering the communication for design teamwork, the most important issue is interaction, both interaction with the communication tools and interaction between designers. In the international team, people from different countries with diverse cultural backgrounds have different meanings of the same word in communication. For example: an answer “yes" to a question can mean: I hear you, I understand you, I see your point, I agree with you.

3 METHODOLOGY/APPROACH

3.1 Research design

In the context of distributed design teamwork, the joint design courses with cultural and geographical difference in distant communication are increasing and becoming popular. In order to answer the research question, a joint design course was conducted as a case to study in-depth the design teamwork (design quality and team satisfaction) in the context of cultural differences. It is an effective way to observe design process and interview design team to explore supporting and hindering factors of cultural differences in design teamwork. The analysis focuses on the relation between cultural differences and design teamwork. The experiences of the joint design course have clarified the significance and usefulness of design teamwork. The joint design course involving Dutch and Chinese designers explored significant cultural differences in the way of concepts ideation. While the diaries recorded their cultural differences reflected on design process and linked to their own cultural values. The observation and analysis of the diaries indicates that Dutch and Chinese designers solved the design problems in culturally divergent ways.

Furthermore, a revised case study was conducted to investigate the influence of three different teamwork modes in international design teams. In this design course, Dutch and Chinese student designers work together in three different teamwork modes to investigate the possibility and efficiency of cross cultural design. By considering the supporting and hindering factors of design teamwork modes, it is useful to investigate the influence of three different teamwork modes in international design teams. The interaction between Dutch and Chinese student designers is a crucial element for distributed design teamwork. The quality of interaction between Dutch and Chinese student designers is concerned to investigate the influence of different teamwork modes.

Cultural measurements and value survey are used to investigate the team composition and personal character of designers. For distant communication, it is different between information distribution and interaction. After that, co-creation is used in a joint design project to explore design opportunities and solutions to support designers in design teamwork. In addition, the design solutions are applied with evaluation and reflection.

3.2 Research model

As the research design framework (Figure 1), design teamwork is considered as the main research object. With regarding to the influence on design teamwork, project uncertainty and team uncertainty are considered as the main factors to influence design teamwork. In order to improve design teamwork, design quality and team satisfaction are considered as the main elements to measure the design teamwork. In this research, teamwork modes (competition, collaboration, cooperation) are introduced to investigate the effect on design teamwork in international teams. Given cultural differences in international design team from China and Netherlands, the research focuses on how different teamwork modes affect design quality and team satisfaction. Compared with different teamwork modes, the research investigates the strength and weakness of them, so as to find suitable teamwork modes for different situations with project uncertainty and team uncertainty.

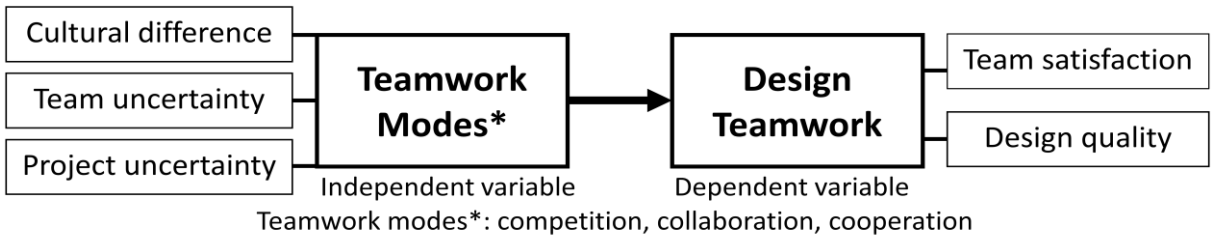

Figure 1. Overall theoretical model

3.3 Data collection

In this research project, a joint design course is conducted to investigate the influence of three different teamwork modes in bi-national design teams. A case study approach is chosen to study in depth the teamwork quality and design result in the context of cultural differences. Both Dutch student designers and Chinese student designers take part in this design course. Since both designers are located at

different time zones, they have to work at unusual time and communicate in their joint hours. Due to the geographic difference, designers use web communication tools for discussion and presentation. In this design course, both Dutch and Chinese designers work together in different teamwork modes.
Before the design course, some cultural measurements are used for team composition. Considering the cultural diversity and balance of designers in each team, both Dutch designers and Chinese designers are divided into teams on average. Culture and value survey is used to measure designers' personal cultural character. Team role questionnaire is used to identify their suitable team position. In the process of design course, self-reflection diary was used to study in depth the change process of design teamwork. It requires designers to manage both teamwork and design process. Participant observation is implemented with note taking to get the first data in design process. It is also complemented by semi-structure interview to get more impression and reflection from designers. During the course, project plan and weekly diary are made in each team so as to record the specifics in design process. They are helpful to improve the course design and integrate research into design education. At the end of design course, design quality is evaluated measured, containing teamwork satisfaction and design result. User acceptance model is used for design result.

3.4 Teamwork modes

In this joint design course, Dutch and Chinese designers are divided in to three team categories to reflect three different teamwork modes in bi-national design team. Mode 1 is cooperation design. In a joint team, Chinese designers collect information of Chinese elderly people first, and then Dutch designers dominate the design ideation. Afterwards, Chinese designers give feedback and suggestion to these preliminary design ideas. Finally, Dutch designers make improvement and final decision and the Chinese designers work out the prototype. Mode 2 is collaboration design. In a joint team, both Chinese designers and Dutch designers collect data in a collaborative way, and then make a collaborative ideation for Chinese market. After they discuss and improve the design solution, the final case will be chosen. Mode 3 is competition design. In a joint team, both Chinese designers and Dutch designers collect data separately. Then, designers from each nation in the design team make an idea generation independently. Next, they present and discuss to choose the better idea or to mix them into a final design idea, and improve it together as the final solution.

3.5 Team composition

In the design course (Figure 2), there were 7 Dutch students and 18 Chinese students. All of the 25 design students were divided into 5 teams, and each team has both Dutch and Chinese students. That means two teams comprise 2 Dutch students and 3 Chinese students, while other three teams comprise 1 Dutch student and 4 Chinese students. Meanwhile, three design teamwork modes (competition, collaboration, cooperation) are allocated to all the teams in sequence, namely competition mode for 2 weeks, collaboration mode for 2 weeks, and cooperation mode for 2 week. Both Dutch and Chinese designers worked together with different teamwork modes in distributed teams over distance. Accordingly, videoconferencing was used for the formal sessions with presentation, and email and Skype were used as the team communication media.

3.6 Course description

This design course takes six weeks, including two iterations. The design case is to design a display to facilitate the after-stroke recovery period and motivate elderly recovering from a stroke to move. At the beginning of design course, all the designers are divided into teams, and each team contains both Dutch and Chinese designers. Meanwhile, it is considered the diversity and balance of cultural differences in each team, which are assured by grouping students based on their cultural measurements beforehand. The detailed learning activities are listed below. The first week is for kick-off and preparing for teamwork. Each design team is designated a teamwork mode. Afterwards, they choose a specific target group and consider the problems and product opportunities for the target group. The second week is in the first iteration. Each design team works in their own teamwork mode, and considers the solution of problems and design features. They create several possible ideas and original solutions. The third week is the middle presentation. All the design teams present their conceptual design, and get feedback and suggestion with each other. The second iteration contains the fourth week and fifth week. Each team still works in their own teamwork mode. They improve their design concept and design details in the fourth week and make usability evaluation of final design for target market.

They make final decision and reach an agreement on design solution. In the last week, all the teams write design report and make prototype, and then present their final design. In the end, the evaluation is given, including comments from lecturer and feedback from panel.

Figure 2. Design course in international teams

3.7 Data analysis

Data collection sources (validity)

This case study mainly investigates design maintenance and achievement to improve design teamwork (Figure 3). In this study, reflection diary and panel feedback were used to measure the maintenance and achievement. In specifically, reflection diary was used as evidence of maintenance and panel feedback was used as evidence of achievement. Besides, other sources of evidence, such as participant observation, semi-structure interview, user acceptance model, were also used to study design teamwork.

During the six weeks of design process, all Dutch and Chinese design students worked both in individual level and team level. Every week, design students made reflection diary individually and teachers gave panel feedback to each team. The former directly recorded the design process and the latter indirectly improved the design result. In specifically, the reflection diary includes weekly diary and iteration diary, while the panel feedback includes feedback on discussion and presentation.

In this study, the evidences of reflection diary were collected at individual level and the evidences of panel feedback were collected at team level. Based on the evidences from reflection diary and panel feedback, design maintenance and achievement have been investigated with the teamwork of design students in international teams. In this way, construct validity can be established for this study.

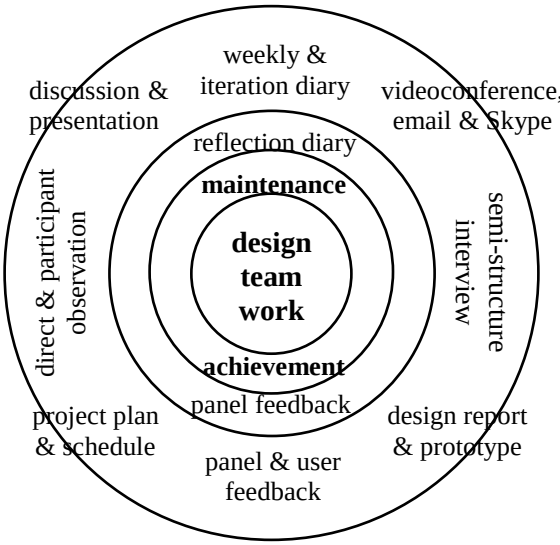

Figure 3. Data collection sources

Facilitator and participant (reliability)

Together with the sources of evidence collected during the process, the operation guidelines were also addressed to make the study standard with generalization. In this way, reliability can be demonstrated for this study. In this study, researchers/teachers were act as the facilitator and design students were considered as the participant.

During the design process, this study had six sessions and five weeks consisting of two iterations, that are the first and second weeks as the first iteration and the other three weeks as the second iteration. In the beginning, all the participants were divided into teams, and each team contained both Dutch and Chinese design students. Team balance with cultural diversity in each team was considered by grouping participants according to their cultural measurements beforehand. In the first session of kick off meeting with team composition, the facilitator gave presentations about theory and design challenge, as well as design process. In the first week, the participants in each team worked in competition modes and chose a specific target group. In the second session of question hour, the participants in each team discussed their questions or ideas with the facilitator and submitted their weekly diary. In the second week, the participants in each team continued working in competition modes and considered the problems and design opportunities. In the third session of middle presentation on first iteration, all the teams presented their conceptual design and got feedback with each other. The participants also submitted their first iterative diary as well. In the third week, the participants in each team worked in collaboration modes. They considered design solution with features and created possible ideas with original solutions. In the fourth and fifth session of question hours again, the participants in each team discussed their questions or ideas with the facilitator and submitted their weekly diary. In the fourth week, the participants in each team continued working in collaboration modes. They improved design concept with details and made usability evaluation of final design. In the fifth week, the participants in each team worked in cooperation modes. They made final decision with design solution and also wrote design report and made prototype. In the sixth session of final presentation on second iteration, all the teams presented their final design and got evaluation from facilitators. The participants also submitted their second iterative diary as well.

4 RESULTS

The joint design course was a considerable complex course for design students. It required not only to work together with distributed international design teams, but also to design for target group in different cultural context. In addition to cultural differences, three teamwork modes were introduced to guide the distributed international teamwork. Consequently, the participants had to take into account the project information from design brief and division of teamwork modes. For the project, they had to work with another culture and also work for another culture.

4.1 Design quality and team satisfaction

The results of this study show that different teamwork modes have effect on design teamwork in distributed bi-national teams, including design quality and team satisfaction.

- In competitive mode, it is required to work in parallel to have different solutions for same task. Team members work separately during design process and compare with different solutions in order to know each other better. As a result, it is difficult to make final decision, but design quality is improved accordingly. Team communication and team satisfaction is based on competition.
- In collaborative mode, it is required to have more time to work together during design process. Team members have more chance to share information and discuss ideas. Team communication play an important role in teamwork and team satisfaction is improved accordingly. As a result, design quality is also developed and design solution is more acceptable by team.
- In cooperative mode, it is required to divide the work in order to work continuously and efficiently. Team members take advantage of their skills to develop design solution and improve design quality. Team communication is based on explanation and understanding, which leads to team satisfaction during design process.

4.2 Project uncertainty and team uncertainty

With regard to the effect on design teamwork, two additional factors were identified: project uncertainty and team uncertainty. Project uncertainty is to what extent the team understands the design

challenge. Team uncertainty is to what extent the team knows each other's strength. Compared with different teamwork modes, the research investigates the strength and weakness of them, so as to find suitable teamwork modes for different situations with project uncertainty and team uncertainty. Based on the data from case study, the following results regarding teamwork modes can be found.

- Competitive mode better fits teams with high uncertainty. Competitive design team can keep independent idea generation and outstanding design solution, but it leads to repetitive work and difficulty of choosing or combining design concepts.
- Collaborative mode better fits teams with low uncertainty but projects with high uncertainty. Collaborative design team can take timely feedback and adjust the design direction, but it requires much time to work together for discussion.
- Cooperative mode better fits teams and projects with low uncertainty. Cooperative design team can work continuously and the separate tasks are clear, but one side has to wait for the other to complete the previous step.

5 CONCLUSION

In this research, it is found that different teamwork modes affect design quality and team satisfaction in international teams. In addition, cultural differences also have influence on design teamwork. In order to improve design teamwork, it is important for designers to be aware of cultural differences and make use of teamwork modes in design process.

5.1 Uncertainty

Based on the analysis and findings, this research has found the correlation of different teamwork modes in sequence for different project uncertainty and team uncertainty (Table 1). For both low team uncertainty and low project uncertainty, cooperative mode is fit for this design process. For low team uncertainty but high project uncertainty, it is better to start with collaborative mode and then work with cooperative mode. For low project uncertainty but high team uncertainty, it is better to start with competitive mode and then work with cooperative mode. For both high team uncertainty and high project uncertainty, which is most difficult, competitive mode could be used in the beginning and then collaborative mode could be used subsequently, after that cooperative mode is fit for the design process finally. According to these results, it is also shown that cooperative mode is most efficient and effective during design process, competitive mode has benefit to decrease team uncertainty and collaborative mode can facilitate to decline project uncertainty.

Table 1. Different teamwork modes in sequence for project uncertainty and team uncertainty

Uncertainty	high project uncertainty	low project uncertainty
high team uncertainty	competition→collaboration→cooperation	competition → cooperation
low team uncertainty	collaboration → cooperation	cooperation

5.2 Time sequence

With regard to time sequence, the results show that different project uncertainty and team uncertainty need different teamwork modes during design process (Table 2). In the initial stage with high project uncertainty and high team uncertainty, competitive mode could be used to decrease team uncertainty. In the middle stage with high project uncertainty and low team uncertainty, collaborative mode could be used to decline project uncertainty. In the final stage with low project uncertainty and low team uncertainty, cooperative mode could be used efficiently and effectively during the process.

Table 2. Different teamwork modes during design process with time sequence

time sequence	uncertainty	teamwork modes
initial stage	high project uncertainty & high team uncertainty	competitive mode
middle stage	high project uncertainty & low team uncertainty	collaborative mode
final stage	low project uncertainty & low team uncertainty	cooperative mode

5.3 Future study

As the research progresses it is expected further design exploration of cultural differences and establishes the strong links between culture and design. This research takes the initiative for further study of design teamwork in other countries and cultures.

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