Design teamwork in distributed intercultural teams : competition, collaboration, cooperation

Design Teamwork in Distributed Intercultural Teams

Competition, Collaboration, Cooperation

Jinfan Man

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Summary

In the past decades, the creation and development of new products has become a truly global activity. This requires people from different cultures on different locations to closely work together. In the view of global industry, western and eastern countries have much more potential to teamwork with each other. Due to the globalization of the economy and industry, design teamwork has become culturally and geographically distributed. Therefore, design teamwork requires high effectiveness and efficiency of working together in order to execute the design project. Designers have to recognize their capacity for contributing to effective teamwork and concept generation in design process. There is a clear need for practical implications to improve design teamwork in distributed intercultural teams. 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 distributed design teams from Netherlands and China.

This research investigates the impact of cultural difference 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 difference and teamwork modes on design teamwork, so as to support designers to improve design quality and team satisfaction in distributed intercultural teams. In the context of cultural difference in international design teams, the research questions contain two parts, how different teamwork modes affect design quality and team satisfaction? and how to support designers to improve design teamwork?

The design research approach has four main iterations, which are exploratory iteration, creative iteration, reflective iteration and confirmative iteration. The correlation between teamwork modes and design teamwork is considered as the main research object. There are also many factors have effect on design teamwork, such as cultural dimension, project uncertainty and team uncertainty. At each iteration, one case study is designed and conducted to investigate the effect of cultural difference on design teamwork and how different teamwork modes affect design teamwork in distributed intercultural design teams. In these case studies, Dutch and Chinese design students work together to investigate the possibility

and efficiency of distributed intercultural design teamwork. Design quality and team satisfaction are considered as the main elements to measure the design teamwork. Panel feedback and reflection diary are used to measure design quality and team satisfaction.

This research has investigated the importance of teamwork modes and the sequence of their usage. In this research, it is found that different teamwork modes have effect on design teamwork in distributed intercultural teams. Different teamwork modes are fit for different design teams and projects. Competition mode better fits teams with high uncertainty. Collaboration mode better fits projects with high uncertainty. Cooperation mode better fits teams and projects with low uncertainty. Different teamwork modes are used in time sequence for different teams and projects during design process. Different teamwork modes affect design quality and team satisfaction. Cultural difference also has impact on design teamwork. In order to motivate and improve design teamwork, it is necessary to be aware of cultural difference and make use of different teamwork modes in distributed intercultural teams.

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Chapter 1 Introduction

This chapter starts with the explanation of the theoretical background to provide the context information of this research. Based on the theoretical background, this chapter explains the motivation and objective of this intercultural design research. With the illustration of research framework, research questions are formulated about the effect of teamwork modes on design teamwork in distributed bi-national design teams. In historical perspective, the transformation of product creation process is discussed from local-for-local to global-for-global. China and Netherlands are chosen as representatives of eastern and western culture to study distributed bi-national teamwork. Finally, the relevant terminologies are listed followed by the structure of this research thesis.

1.1 Theoretical background and context

This section starts with the discussion of globalization and localization to show the design teamwork in international context. The appearance and consequence of globalization are explored for product development. Distributed intercultural teams are introduced to show the distributed teamwork and the benefits or obstacles in international teams. In order to investigate the design teamwork, cultural differences are discussed with related to design teamwork. Teamwork modes are also introduced to investigate the influence on design teamwork.

1.1.1 Product creation in historical perspective

As the development of globalization and intercultural teamwork, industrial structure and growth pattern have varied gradually from simplicity to complexity. The economy has also improved and increased along with industry development. Based on the global industrial development from historical perspective, it will reveal the transformation of product creation process in view of market distribution and design manufacturing. In the history of industrialization, product creation transferred from local-for-local to global-for-global. As the globalization of industry and economy, the process of product creation, that is the phases of concept design, development, engineering, production and use, changed accordingly from locally centralized to globally distributed.

In order to illustrate the changing process of product creation, the evolution of Philips in Netherlands was taken as an example. At the first historical stage, all the phases of concept design, development, engineering and production were centrally located in the Netherlands. Meanwhile, the use phase was applied only for Western European and North American market. That first stage was local design for local market. At the second historical stage, the design and development phases were kept originally in Western Europe. As the result of cheap material and labor market, the engineering phase moved to Southeast Asia and the production phase moved to China. In that time, the use phase extended to global market, however, the product for Asian and South American market was old version for Western European and North American market. At the third historical stage, the design and development phases were still centrally kept in Western Europe, while the engineering and production phases were distributed located in Eastern Asia. In that time, the use phase for global market was same new version for all the markets. The second and third stage was local design for global market. At the fourth historical stage, the use phase was distributed located in global market, including Western and Eastern Europe, North and South America, and Asia-Pacific area. As a result, all the phases of concept design, development, engineering and production were also distributed located in global market. That fourth stage was global design for global market.

In that historical process, product creation and consumption changed from centrally located to distributed globalized. It is necessary to take distributed design teamwork into account and designers with different cultural backgrounds have to teamwork effectively for the different markets. In this research, the Netherlands and China were chosen as case for western and eastern culture to study the distributed teamwork in bi-national design team.

In the context of global trend of product development and economy transformation, the business aspects of industrial product design has been changed during the historical process. The main phases of business design lifecycle consist of creation (conception, design), realization (engineering, production), commercialization (marketing, sales), and utilization (use, service). The major change of business design in historical perspective is from local-to-local to global-for-global. At the first stage of local-to-local, all phases of business design, from conception to usage, are centralized locally. At the second stage of local-to-global, only the market phase becomes global, and other phases, such as conception and production, are still local. At the third stage of global-to-global, most of phases become global, but still centralized for collective goal. At the fourth stage of global-for-global, all phases of business design become global, and distributed for independent goal.

In terms of the stages change of business design, this study with design students is designed in the situation of the third stage with global distributed team and collective centralized goal. Accordingly, the real case with design companies is in the situation of the fourth stage with global distributed team and independent distributed goal. As compared with the third stage and fourth stage, this study in the third stage of global-to-global has central control and collective goal in same company with parallel competition. While real case in the fourth stage of global-for-global has self-control and independent goal in different companies with sequent competition. More specifically, design students in this study work in the centre without escape, and design companies in real case work in the network with freedom.

1.1.2 Globalization and global consumption

During the last decade, intercultural teamwork increasingly plays an important role in the context of globalization. As the development of economy and industry, the appearance of globalization indicates the necessity and requirement of teamwork within different cultures. The consequence of globalization for design teamwork in cultural context contains making and using aspects that are creation and consumption.

As globalization became a common term in business and media, it is largely visualized as a few ubiquitous global brands (McCort and Malhotra, 1993). These brands have become the symbols of globalization. Theoretically, globalization can be regarded as the process of global comprehension that leads to global consumption homogenization (De Mooij and Hofstede, 2002). In fact, globalization involves not only global consumption homogenization, but also the collaboration of globalized transnational firms.

However, the spread of the symbols of globalization does not indicate the homogenization of consumer habits or values. Instead of homogenization, globalization is the reason for the revival of localization in the world (Luna and Gupta, 2001). There are limited number of global products and global brands, and there are no global consumers leading to homogenization of consumption. With localization for different cultures, intercultural studies have been done to measure value differences and compare consumer behavior across cultures. Culture influences the values and habits of consumer, therefore, cultural values are regarded as an integrated part of the consumer, not viewed as an environmental factor (De Mooij, 2004).

People from different countries have different value orientations that cause variation in preferences of products and brands. For effective international marketing and communications people must understand these differences (Solomon et al., 2006). Therefore, analysis of the

effect of culture becomes increasingly important because value differences are stable over time and become manifest with increased wealth.

Globalization is the international process to integrate product and service, and interact on culture, economy and society in the world-wide context. Globalization not only involves international flows of production and transportation, but is also associated with interaction of ideation and technology (James, 2009). As a consequence of globalization, personal views and feelings, as well as behaviors cross local and national boundaries (Woodward, Skrbis and Bean, 2008). In the domain of socio-cultural consumption, a representative survey has investigated the attitudes and behaviors of personality, and the opportunities and threats of community, as well as the value of global and local humanity (Calcutt, Woodward and Skrbis, 2009). As regards the creation and consumption of global market, the effect of market globalization has been examined, including the development of market-driven values and the creation of consumer-driven lifestyles (O'Sullivan, 2003). In the mass media, globalization has drawn attention of the public to the value of the global market (Turay and English, 2008). As regards the trend of global development, it brings people together to a global market with transnational business (Tibbitts, 2005). Therefore, international institutions attempt to understand globalization, so as to manage the complicated process on the phenomenon of globalization (Hawkins and Muecke, 2003). On one hand, the phenomenon of globalization has become ubiquitous to understand the world, but this concept goes along with its instability. On the other hand, the consequence of globalization generates uncertainty about values in various aspects, and the experience of the past becomes meaningful to understand the present (Cowen, 2004).

1.1.3 Bi-national team of China and Netherlands

Based on the discussion about globalization and cultural influence, China and Netherlands are chosen as representatives to study distributed bi-national teamwork. For cultural aspect, designers should take consumers from different culture into account in distributed bi-national teams. With regard to globalization in creation and consumption, designers in different culture have to design with and for consumers from different culture and market. Therefore, designers have to teamwork in distributed intercultural teams.

The major trend of international historical perspective goes along with Chinese industrialization. Accordingly, design in the Netherlands and manufacturing in China both adjust to their strategy and adapt to this global trend. Design in the Netherlands values

product quality and realize cultural influence, while manufacturing in China changes the role from material processing to design manufacturing.

China has large market in the world, while Netherlands has good quality of design. China is on the way of industrialization, and has become a leading manufacturer in the world (Conroy, 1992). There were four stages on the history of Chinese industrialization: materials exportation, cheap labor for manufacturing, expertise of manufacturing, and 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". 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-known 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.

In the globalization of the economy and industry, it is increasingly important for western design practice and education to draw a closer view on the characteristics of Chinese design. Considering the situation of industrialization in China and globalization in the world, distributed design teamwork plays an important role in transnational teamwork (Jefferson and Rawski, 1994). This research focuses on teamwork in the case of bi-national team of Dutch and Chinese designers.

1.1.4 Team perspective in design teamwork

In the context of globalization, teamwork plays an important role in industrialization (Kleinsmann et al., 2010). The context of product development has become increasingly globalized and consequently related business processes become unavoidably complex. Due to product development for different markets, it is necessary to work with people from different backgrounds (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 teamwork with each other (Molina et al., 2005). Teamwork usually comes with mutual benefits and participant learns from each other (Chung, 2009). Therefore, the research about teamwork in international design team is needed to support teamwork with different cultural backgrounds.

Teamwork is a complicated activity and difficult to establish and sustain in a team project (Kvan, 2000). Teamwork achieves success when project is accomplished in team, which cannot be accomplished in individual (Vera, West and Kvan, 1997). Therefore, design teamwork requires high effectiveness and efficiency of working together in order to achieve the design project (Craig and Zimring, 2000). Moreover, design teamwork 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. Teamwork takes advantage of multiple skills and expertise from team members. Design teamwork requires the knowledge of multidisciplinary and the use of multiple skills (Christensenl and Yasar, 2007). In other words, it is required teamwork of people with different skills and expertise. Designers have to recognize their capacity for contributing to effective teamwork and concept generation in design process (Chung, 2009). However, designers with different backgrounds cannot guarantee a successful teamwork if their ideas, perspectives, and knowledge are not properly shared with each other (Rosenman et al., 2007). For teamwork, designers undertake team projects via internet and interact on shared digital files. Online applications are developed to support and facilitate teamwork (Vera et al., 1998). 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 (Qian and Gross, 1999).

1.1.5 Cultural perspective in design teamwork

As the globalization of 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 difference and the requirement of design teamwork.

CHAPTER 1

The International Council of Societies of Industrial Design (ICSID) defined design as a 'crucial factor of cultural and economic exchange', and emphasized that design is promoting 'cultural ethics' or 'supporting cultural diversity' (ICSID, 2002). The members of the Cumulus International Association of Universities and Colleges of Art, Design and Media signed the Kyoto Design Declaration in 2008, where they committed themselves as being responsible for building sustainable societies (Cumulus, 2008). In this statement design is recognized as an approach to social, cultural, environmental and economic development for generations.

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 (Julier, 2001). 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 difference in their design, as well as enhance the cultural appeal for users (Stewart, 2005). Due to the cultural differences of designers and users, development of design teamwork depends on their norms, rules and languages (Détienne, 2006). Designers make efforts in understanding cultural differences and increasing their experiences in global product development (Xie, Song and Stringfellow, 1998). 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 (Orr, 2004). Therefore, it is worth noticing that designers are required to meet the needs of users, and culture needs are among those requirements (Nakata and Sivakumar, 1996). Designers have been aware of that cultural value and symbol is becoming more significant than physical products (Jassawalla and Sashittal, 2002). Therefore, cultural differences play an important role in the product development process. Furthermore, cultural differences are identified in the way design concepts are developed and the links between differences in culture context (Wu, 2011). The concepts created by designers are partly based on their cultural backgrounds and social value (Snelders, Morel and Havermans, 2011). In other words, their own culture can influence their works (Press and Cooper, 2003).

The importance of culture insight has been realized and recognized by designers; however, it is usually not taken seriously in design process by companies due to some reasons (Razzaghi

and Ramirez, 2005). For example, companies have to control the time and cost of product development, it is hard for designers to consider culture insight into design process. In addition, people with diverse backgrounds act as hindering factor of cultural differences and lead to misunderstanding and contradiction. However, hindering factors can act as a source of change and innovation (Nahm and Ishikawa, 2004). The hindering factors of cultural differences are limited and most of them could be conducted (Ramesh and Tiwana, 1999). 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. Teamwork in international design 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.

Cultural differences affect the design teamwork in international teams. It is found that cultural differences have influence on design process (Razzaghi et al., 2009). Some researchers have explored cultural differences for teamwork (Hofstede et al., 1990; Smith and Malina, 1999). Distributed design teamwork in different cultures requires an understanding of cultural context in communication. Communicating with people in different cultures also requires an understanding of the cultural context. Thus, it is important for designers to draw attention to teamwork and understand the cultural differences in team design ideation, which requires designers to learn not only design skills and also intercultural communication for design teamwork. Unfortunately, cultural differences act as barrier to improve design teamwork and limited research has been found to solve design teamwork problems in the context of cultural differences. There exist problems of teamwork with people from different cultures. Design teamwork has to confront cultural differences, which hinders distributed communication (Ostwald, 1995).

1.1.6 Teamwork in distributed intercultural teams

Teamwork is regarded with not only cultural attribute but also distributed attribute in distributed intercultural teams. 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.

In the distributed intercultural teams, international teamwork is regarded as important and essential process. International teamwork can help to break cultural and linguistic barriers, and also to across disciplinary and political boundaries (BISO, 2008). On the one hand as the benefits, international teamwork can give new insights beyond a view of culture to solve

unexpected problems (Bainbridge, 2007). The distributed intercultural teams have the potential to find out the solution from various perspectives. On the other hand as the obstacles, international teamwork also faces a variety of challenges and hurdles (Chan et al., 2006). The distributed intercultural teams encounter the difficulties and have to facilitate teamwork to manage them. These issues can be addressed with the benefit of the experiences and reflections of team members in the distributed intercultural teams. Team members discuss their insights and approaches, and then provide their suggestions and solutions to optimize the contributions of international teamwork.

Distributed teamwork may be complex and reflect different expectations of team members (Finnemore, 1993). Their work habits may vary, including workloads, division of work, vacation and deadline. The concept of agreement and disagreement may also differ in different parts of the world. Thus, working in distributed intercultural teams entails collaboration and negotiation across different cultural backgrounds, work habits, public concerns and issues (Castleman and Lemen, 1998). Distributed teamwork, focus on the challenges across boundaries, can break the barriers and optimize mutual benefits. Therefore, team members in distributed intercultural teams should understand the boundaries and identify the value of distributed teamwork, so as to improve and facilitate teamwork.

1.1.7 Conclusions of introduction

In conclusion, this chapter introduced the theoretical context of distributed intercultural design teamwork. In the process of globalization, product creation and global consumption were discussed in historical perspective. Besides, team and cultural perspective were also discussed in international design teamwork. Based on the theoretical context, the relevant research gap was found by literature study and field research. According to the research gap, this research established the research objectives and proposed the research questions.

1.2 Research framework, objective and question

This design research objective is to support distributed intercultural design teamwork. In order to motivate and improve design teamwork, it is necessary to be aware of cultural difference and make use of different teamwork modes. The aim of this research is to explore the effect of different teamwork modes (cooperation, collaboration, competition) on design process and

support designers to improve design teamwork (design quality and team satisfaction) in distributed intercultural design teams.

1.2.1 Research question

Based on state of the art, globalization and distributed teamwork has been researched in the field of economy and industry. While the research related to teamwork for design process was still not sufficient in the context of international teams. Consequently, design teamwork in international teams needs to be researched. The central problem in this research is to explore and identify the influence of cultural difference and teamwork modes on design teamwork, so as to support designers to improve design quality and team satisfaction in distributed bi-national teams.

This research investigates the influence of cultural difference on design teamwork and explores the suitable teamwork modes to support designers to improve design teamwork. Three different teamwork modes are analyzed to investigate the dynamics of design teamwork. In the context of cultural difference in international design teams, the research questions contain two parts, how different teamwork modes affect design quality and team satisfaction? and how to support designers to improve design teamwork in distributed intercultural design teams?

1.2.2 Research framework

As the research design framework (Figure 1-1), the effect of different teamwork modes on design teamwork is considered as the main research object. In this research, three teamwork modes (cooperation, collaboration, competition) are introduced as independent variable to investigate the effect on design teamwork as dependent variable in distributed bi-national teams. Meanwhile, design quality and team satisfaction are considered as the main elements to measure the design teamwork.

Reflection diary and panel feedback are used to record team satisfaction and design quality. In general, reflection diary records the team process at individual level, and panel feedback improves the design result at team level. Design students make reflection diary individually and teachers give panel feedback to each team. In specifically, reflection diary includes weekly diary and iteration diary, and panel feedback includes feedback on discussion and presentation.

Cultural difference and team composition are considered as extraneous factors. Two cultural measurements were used for team composition. Value survey module was used to measure

designers personal cultural character. Team role questionnaire was used to identify their suitable team position. With the two cultural measurements, very different Dutch and Chinese were teamed up over distance. Given cultural difference in distributed bi-national design teams from China and the Netherlands, the research focuses on how different teamwork modes affect design teamwork.

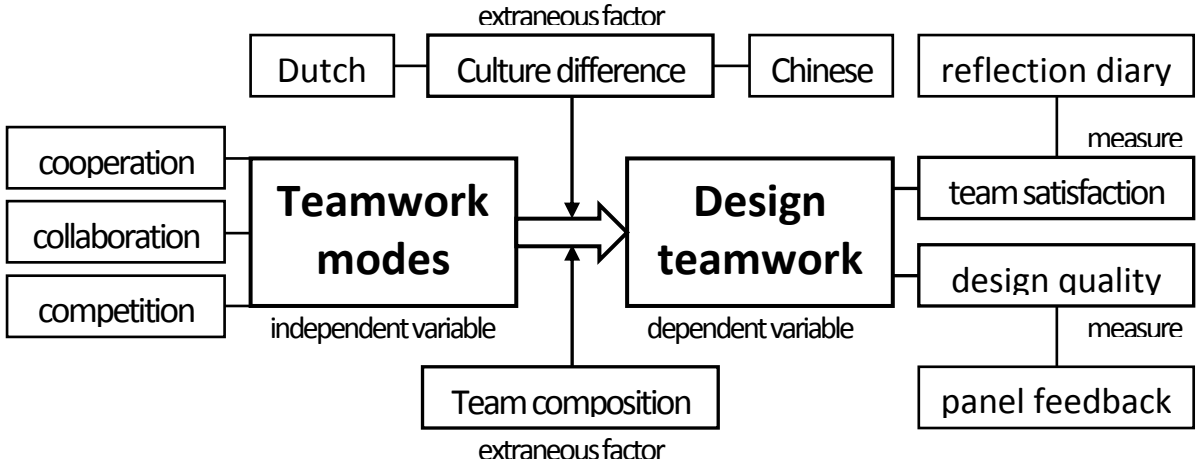

Figure 1-1. Research framework (effect of teamwork modes on design teamwork)

1.2.3 Research approach

With regard to the research framework, the suitable research approach is considered for the research objectives and research questions. Qualitative research method and longitudinal field study are used to investigate the distributed intercultural design teamwork in international teams. As the research approach, the design research process has four iterations, which are exploration iteration, creation iteration, reflection iteration, and confirmation iteration. In line with four design research iterations, iterative case studies are implemented with different variables and research objectives in distributed intercultural design teams. In the iterative case studies, the impact of cultural difference is explored in distributed intercultural teams, and then teamwork modes are introduced to investigate the effect on design teamwork, and also differently combined to improve design teamwork, and finally teamwork approach is proposed to facilitate distributed intercultural teamwork.

The research is designed to investigate the impact of design teamwork over distance and cross culture in distributed intercultural teams. Different design teamwork modes are used to investigate the impact of design teamwork and facilitate teamwork effectiveness and efficiency. Design teamwork (design quality and team satisfaction) is considered as the main research object. Teamwork modes (cooperation, collaboration, competition) are introduced to

investigate the influence on design teamwork. There are also many factors have effect on design teamwork, such as cultural difference, project uncertainty and team uncertainty.

1.2.4 Research hypothesis

In the design research, this research aims for the effect of teamwork modes on design teamwork in distributed intercultural teams. The research is based on the global-for-global stage of product creation process, that is about cultural difference and distributed team, which is set up in the context of binational design teams from China and the Netherlands. Based on the research framework, teamwork modes are regarded as independent variable and design teamwork is regarded as dependent variable. More specifically, three different teamwork modes are used for different design teams in different ways for design teamwork, so that team satisfaction and design quality are used to measure design teamwork. Furthermore, project uncertainty and team uncertainty have effect on design teamwork as well. In line with the research framework, team uncertainty for team process and project uncertainty for design result are varied in the time sequence from high level to low level, and also different for different design teams and projects. Therefore, designers can use different teamwork modes to facilitate the uncertainty of team and project for team process and design result, so as to improve design teamwork in distributed intercultural teams.

As to the research hypothesis, it is proposed explanation in scientific research, but hypothesis is not scientific theory, which requires to be tested by research method. In this design research, it can be related to teamwork modes, e.g. competitive mode can lead to no collaboration, cooperative mode can be used in earlier design phase. As the research approach, based on the data from observation and interview during design process, as a result of data analysis, it is found the cycle of competitive mode and collaborative mode are used in the earlier design phase repeatedly to know the team and understand the project, and then cooperative mode is used to improve the design teamwork.

1.2.5 Design teamwork modes

In this research, it is investigated three different teamwork modes, which are cooperation design, collaboration design and competition design. Design teamwork modes are used to support designers to construct an understanding of design problems and potential solutions.

In the international design teams, 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.

In this joint design course, Dutch and Chinese design students are divided into three team categories to reflect three different teamwork modes in bi-national design team. Mode one is cooperative design. In a joint team, Chinese design students collect information of Chinese people first, and then Dutch design students dominate the design ideation. Afterwards, Chinese design students give feedback and suggestion to these preliminary design ideas. Finally, Dutch design students make improvement and final decision, and Chinese design students work out the prototype. Mode two is collaborative design. In a joint team, both Chinese design students and Dutch design students 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 is chosen. Mode three is competitive design. In a joint team, both Chinese design students and Dutch design students collect data separately. Then, design students 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.

1.3 Terminology definition

1.3.1 Teamwork modes: cooperation, collaboration, competition

In this research, three different teamwork modes are investigated, which are cooperative teamwork mode, collaborative teamwork mode and competitive teamwork mode. According to the definition, cooperation means work along with others on division of tasks to get mutual benefit, collaboration means work together on common tasks to solve joint problems, and competition means work separately on same tasks to compare with each other.

1.3.2 Design teamwork: design quality, team satisfaction

In order to improve design teamwork, design quality and team satisfaction are introduced as elements to measure the aspects of design teamwork. Based on panel feedback, design quality focuses on final result, which is a measurement of design solution, to what extent is the quality of design result of the design project. Based on self-reflection diary, team satisfaction focuses on design process, which is a measurement of teamwork quality, to what extent do team members satisfy the team process.

1.3.3 Cultural difference: China and Netherlands

In the globalization of the economy and industry, it is increasingly important for western design practice and education to draw a closer view on the characteristics of Chinese design. It is known China has a very large market in the world with the development of design education, while the Netherlands has a good reputation in design. This research focuses on teamwork in the case of bi-national team of Dutch and Chinese design students.

1.3.4 Project uncertainty, 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 and to what extent the knowledge of the design brief known to the design team members. Team uncertainty is to what extent the team knows each other's strength and to what extent the design competency of the design team members from different cultures.

1.4 Thesis structure

As design research, this thesis has eight chapters in total and the structure of this thesis is organized in the following way (Table 1-1).

The first chapter is introduction. This chapter gives a brief overview of theoretical background and shows the motivation and objective of this research. The second chapter is literature study. This chapter reviews the state of the art for relevant literature studies in the relevant research fields. The third chapter is research methodology. This chapter explains the research methodology and illustrates the research approach with four iterations. This chapter also describes the case studies and course programs.

Based on research approach, chapter four to chapter seven are related to four iterations. Chapter four is about cultural difference. This chapter introduces cultural difference to

investigate the influence on design teamwork. Chapter five is about teamwork modes. This chapter introduces three teamwork modes to explore the effect on design teamwork. Chapter six is about design teamwork. This chapter analyzes how to combine different teamwork modes to improve design teamwork. Chapter seven is about teamwork approach. This chapter proposes a teamwork approach to improve design teamwork in distributed intercultural teams. The last chapter is conclusion. Based on the results of design teamwork, the reflections of this research are presented and the conclusions of this thesis are drawn in the last chapter eight.

Table 1-1. Chapters structure of thesis

chapter	content
Chapter 1	Introduction
Chapter 2	Literature Study
Chapter 3	Research Methodology
Chapter 4	Cultural Difference
Chapter 5	Teamwork Modes
Chapter 6	Design Teamwork
Chapter 7	Teamwork Approach
Chapter 8	Conclusion

Chapter 2 Literature Study

2.1 Globalization in creation and consumption

2.2 Design teamwork in international context

2.3 Distributed teamwork and virtual team

2.4 Intercultural design team

2.5 Influence of cultural difference

2.6 Intercultural communication

2.7 Literature conclusions

Chapter 2 Literature Study

This chapter reviews the state of the art in the relevant field with the structure of several aspects, including globalization and localization, distributed teamwork, and intercultural design team. Those literatures provide relevant information and knowledge about distributed teamwork and intercultural design, and set up the basis of the research field. Based on that, this research can be built up to study distributed and intercultural design teamwork.

2.1 Globalization in creation and consumption

This section discusses globalization and localization in global and local design aspects to study the product creation and consumption in the context of economic evolution and social change. When designing product and service in the global market, global perspectives and local designs need to be taken into account concurrently in the design process. Accordingly, global competition and local cooperation need to take place simultaneously in the design team. The consequence of globalization for design teamwork in cultural context contains making and using aspects. That requires designers to think globally and act locally to meet the need of users. Due to trend of globalization and localization, culture has significant impact on product and service design. The effects of cultural differences have been seen both on team climate and design usability. Therefore it is necessary to integrate culture into design to improve team satisfaction and design quality.

Globalization is the international process to integrate products and services, and interact on culture, economy and society in the worldwide context. Globalization not only involves international flows of production and transportation, but is also associated with interaction of ideation and technology (James, 2009). As a consequence of globalization, personal views and feelings, as well as behaviors cross local and national boundaries (Woodward, Skrbis and Bean, 2008). In the domain of socio-cultural consumption, a representative survey has investigated the attitudes and behaviors of personality, that indicates the opportunities and threats of community, as well as the value of global and local humanity (Calcutt, Woodward and Skrbis, 2009). With regard to the creation and consumption of global market, the effect of market globalization has been examined, including the development of market-driven values and the creation of consumer-driven lifestyles (O'Sullivan, 2003). In the mass media,

globalization has drawn attention of the public to the value of the global market (Turay and English, 2008). As regards the trend of global development, it brings people together to a global market with transnational business (Tibbitts, 2005). Therefore, international institutions attempt to understand globalization, so as to manage the complicated process on the phenomenon of globalization (Hawkins and Muecke, 2003). On one hand, the phenomenon of globalization has become ubiquitous to understand the world, but this concept goes along with its instability. On the other hand, the consequence of globalization generates uncertainty about values in various aspects, and the experience of the past becomes meaningful to understand the present (Cowen, 2004).

As globalization became a common term in business and media, it is largely visualized as a few ubiquitous global brands (McCort and Malhotra, 1993). These brands have become the symbols of globalization, such as Coca-Cola, McDonald's and Nike. Theoretically, globalization can be regarded as the process of global comprehension that leads to global consumption homogenization (De Mooij and Hofstede, 2002). In fact, globalization involves not only global consumption homogenization, but also the collaboration of globalized transnational firms.

However, the spread of the symbols of globalization does not indicate the homogenization of consumer habits or values. Instead of homogenization, globalization is the reason for the revival of localization in the world (Luna and Gupta, 2001). There are limited number of global products and global brands, and there are no global consumers leading to homogenization of consumption. With localization for different cultures, intercultural studies have been done to measure value differences and compare consumer behavior across cultures. Culture influences the values and habits of consumer, therefore, cultural values are regarded as an integrated part of the consumer, not viewed as an environmental factor (De Mooij, 2004).

People from different countries have different value orientations that cause variation in preferences of products and brands. For effective international marketing and communications people must understand these differences (Solomon et al., 2006). Therefore, analysis of the effect of culture becomes increasingly important because value differences are stable over time and become manifest with increased wealth.

Besides global consumption during global development, intercultural teamwork is also considered as important issue and introduced in international context. During the last decade, intercultural teamwork increasingly plays an important role in the context of globalization. As

the development of economy and industry, the appearance of globalization indicates the necessity and requirement of teamwork within different cultures.

2.2 Design teamwork in international context

In the context of globalization, teamwork plays an important role in industrialization (Kleinsmann et al., 2010). The context of product development has become increasingly globalized and consequently related business processes become unavoidably complex. Due to product development for different markets, it is necessary to work with people from different backgrounds (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 teamwork with each other (Molina et al., 2005). Teamwork usually comes with mutual benefits and participant learns from each other (Chung, 2009). Therefore, the research about teamwork in international design team is needed to support teamwork with different cultural backgrounds.

Teamwork is a complicated activity and difficult to establish and sustain in a team project (Kvan, 2000). Teamwork achieves success when project is accomplished in team, which cannot be accomplished in individual (Vera, West and Kvan, 1997). Therefore, design teamwork requires high effectiveness and efficiency of working together in order to achieve the design project (Craig and Zimring, 2000). Moreover, design teamwork 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.

Teamwork takes advantage of multiple skills and expertise from team members. Design teamwork requires the knowledge of multidisciplinary and the use of multiple skills (Christensenl and Yasar, 2007). In other words, it is required teamwork of people with different skills and expertise. Designers have to recognize their capacity for contributing to effective teamwork and concept generation in design process (Chung, 2009). However, designers with different backgrounds cannot guarantee a successful teamwork if their ideas, perspectives, and knowledge are not properly shared with each other (Rosenman et al., 2007).

2.3 Distributed teamwork and virtual team

As discussed earlier, globalization is not just about consumption but also about creation. It is therefore unavoidable to mention the distributed teamwork. In the globally distributed team, people can work together well as the result of respect and trust with each other. It means that human-related issues are important for distributed teamwork in the social aspect (Kotlarsky and Oshri, 2005). In the meantime, online applications are developed to support and facilitate teamwork (Vera et al., 1998). Technical equipment 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 in virtual teams. In the virtual teams, distance of team location, use of communication media and impact of time pressure are the crucial issues related to success of virtual teams. On one hand, geographically distributed team has to make use of suitable communication media for interaction of sharing and discussion. On the other hand, cross time zones distributed team has to take time differences into account for synchronous and asynchronous communication.

The virtual platforms with information and communication technologies allow designers and users to interact with each other, to discuss and share their insights and experiences, so as to build social networks and establish design communities. In the design community, it is argued that both types of relationship of cooperation and competition are relevant for innovation success to improve design quality (Hutter et al., 2011). 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 (Qian and Gross, 1999). Research has identified the advantages and disadvantages associated with creating and managing virtual teams (Bergiel, Bergiel and Balsmeier, 2008). The effectiveness and efficiency of international virtual team is dependent on successful intercultural communication rather than mastery of technology (Van Ryssen and Godar, 2000). Globally distributed teams encounter issues of member behaviors and organizational design, such as cultural difference, teamwork structure, process information and use media. Patterns of dependency and coordination were explored to facilitate and improve intense teamwork on global scale (Kumar, van Fenema & Von Glinow, 2005). Designers in distributed teams improve working environment with the influence of information and communication technology. It requires not only their current design skills but also additional skills for emerging design environment, that support designers to operate distributed projects in

distributed teams and processes (Edum-Fotwe et al., 2002). Qualitative studies describe communication and coordination related to team dynamics as typical issues to differ from distributed and collocated projects. Quantitative studies also show significant differences between distributed and collocated projects concerning team dynamics, team satisfaction and project performance (Piri, Niinimaki, 2011). Based on teamwork and taskwork in distributed virtual teams, virtual team competency was described for selection and placement of virtual team members (Hertel, Konradt & Voss, 2006). Participatory design for distributed teamwork has been applied to tackle the problems in distributed context (Loebbecke & Powell, 2009). In engineering design and manufacturing, teamwork is considered as major factor for global virtual team to promote project-oriented tasks. While communication is regard as challenge of virtual team, rely on the availability of internet media access (Oladiran et al., 2011).

Due to globalization and localization, it is natural that when discussing distributed teamwork one should also talk about distributed intercultural teams. International teamwork can help to break cultural and linguistic barriers, and also to across disciplinary and political boundaries (BISO, 2008). On the one hand as the benefits, international teamwork can give new insights beyond a view of culture to solve unexpected problems (Bainbridge, 2007). On the other hand as the obstacles, international teamwork can also face a variety of challenges and hurdles (Chan et al., 2006), especially how to facilitate teamwork and how to manage them.

Distributed teamwork may be complex and reflect different expectations of team members (Finnemore, 1993). Their work habits may vary, including workloads, division of work, vacation and deadline. The concept of agreement and disagreement may also differ in different parts of the world. Thus, working in distributed intercultural teams entails collaboration and negotiation across different cultural backgrounds, work habits, public concerns and issues (Castleman and Lemen, 1998).

Distributed teamwork, focus on the challenges across boundaries, can break the barriers and optimize mutual benefits. Therefore, team members in distributed intercultural teams should understand the boundaries and identify the value of distributed teamwork, so as to improve and facilitate the teamwork.

2.4 Intercultural design team

At the intercultural design team aspect, culture is integrated into design and intercultural competence influences design teamwork. In the global virtual teams, intercultural virtual

projects are put into practice based on intercultural teamwork. To facilitate intercultural teamwork, design patterns are introduced as a platform for improvement of project effectiveness and team efficiency. Both national and organizational cultures have influences on team performance during design process. It can be helpful for designers to get intercultural empathy to understand each other better. Cultural factor have both pros and cons to either support or obstruct design teamwork, so designers had better be aware of that and take advantage of intercultural competence.

Designers display their creativity with learned skills and experienced insights. The interaction between the designers and the environment lead to conformity and harmony (Rodil, Winschiers-Theophilus and Jensen, 2012). To create interactive systems, designers need to cooperate with developers and users in multidisciplinary team. Design patterns and languages are used to facilitate knowledge and experience sharing (Borchers, 2000). In addition, the barriers with design cultures were explored to account for the constraints on users in design (Oudshoorn, Rommes and Stienstra, 2004).

In global teamwork, it is common that team members identify and address intercultural team issues while undertaking team tasks. An intervention strategy was designed to rate attributes of communication, relationship, task management and cultural dimensions as approach to assess teamwork (Egea et al., 2010). In intercultural product development teams, team members especially pay attention to different skills, knowledge, specialties, location and cultural backgrounds. Active participation and learning in line with exercises have been introduced and developed to cope with the challenges of team product design and engineering (Yim et al., 2009). Design patterns were identified and discussed for intercultural remote teamwork in design learning. They raise cultural awareness for international design learning of interactive environments. Design patterns can be used to inform ideation and implementation of design learning in international teamwork context (Schadewitz, 2009). Design patterns were used to capture team observation for development of intercultural teamwork. They can be further evaluated in different teamwork contexts (Schadewitz & Zakaria, 2009).

2.5 Influence of cultural difference

As the globalization of 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 difference and the requirement of design teamwork.

The International Council of Societies of Industrial Design (ICSID) defined design as a 'crucial factor of cultural and economic exchange', and emphasized that design is promoting 'cultural ethics' or 'supporting cultural diversity' (ICSID, 2002). The members of the Cumulus International Association of Universities and Colleges of Art, Design and Media signed the Kyoto Design Declaration in 2008, where they committed themselves as being responsible for building sustainable societies (Cumulus, 2008). In this statement design is recognized as an approach to social, cultural, environmental and economic development for generations.

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 (Julier, 2001). 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 difference in their design, as well as enhance the cultural appeal for users (Stewart, 2005). Due to the cultural differences of designers and users, development of design teamwork depends on their norms, rules and languages (Détienne, 2006). Designers make efforts in understanding cultural differences and increasing their experiences in global product development (Xie, Song and Stringfellow, 1998). 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 (Orr, 2004). Therefore, it is worth noticing that designers are required to meet the needs of users, and culture needs are among those requirements (Nakata and Sivakumar, 1996). Designers have been aware of that cultural value and symbol is becoming more significant than physical products (Jassawalla and Sashittal, 2002). Therefore, cultural difference plays an important role in the product development process. Furthermore, cultural difference is identified in the way design concepts are developed and the links between differences in culture context (Wu, 2011). The concepts created by designers are partly based on their cultural backgrounds and social value (Snelders, Morel and Havermans, 2011). In other words, their own culture can influence their works (Press and Cooper, 2003).

The importance of culture insight has been realized and recognized by designers; however, it is usually not taken seriously in design process by companies due to some reasons (Razzaghi and Ramirez, 2005). For example, companies have to control the time and cost of product development, it is hard for designers to consider culture insight into design process. In addition, people with diverse backgrounds act as hindering factor of cultural differences and lead to misunderstanding and contradiction. However, hindering factors can act as a source of change and innovation (Nahm and Ishikawa, 2004). The hindering factors of cultural differences are limited and most of them could be conducted (Ramesh and Tiwana, 1999). 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. Teamwork in international design team plays an important role to transfer the hindering factors to the supporting factors.

Cultural differences affect the design teamwork in international teams. It is found that cultural differences have influence on design process (Razzaghi et al., 2009). Some researchers have explored cultural differences for teamwork (Hofstede et al., 1990; Smith and Malina, 1999). Distributed design teamwork in different cultures requires an understanding of cultural context in communication. Communicating with people in different cultures also requires an understanding of the cultural context. Thus, it is important for designers to draw attention to teamwork and understand the cultural differences in team design ideation, which requires designers to learn not only design skills and also intercultural communication for design teamwork. Unfortunately, cultural differences act as barrier to improve design teamwork and limited research has been found to solve design teamwork problems in the context of cultural differences. There exist problems of teamwork with people from different culture. Design teamwork has to confront cultural differences, which hinders distributed communication (Ostwald, 1995).

2.6 Intercultural communication

At international communication aspect, intercultural competence also has impact on global communication in the design teams. In order to improve intercultural teamwork for creative design task, cultural conventions are considered as collective norms of culture and language issues. In the international design teams, cultural adaptation is necessary for experiential learning to facilitate intercultural communication. As a result, intercultural relationship can be

established by means of communication strategies. In the context of intercultural relationship, international communication can get benefit from that for intercultural design teams.

In the design process of teamwork, thinking in design team is formulated into four basic operations of generation, exploration, comparison and selection, which can be mapped onto different stages of design process (Stempfle and Badke-Schaub, 2002). Some issues related to intercultural communication have been overviewed including the need for clarity, the validity of constructs, consistency of assumptions, and also cultural generic or specific goals with appropriate discussion of implications and applications. In light of these issues, several approaches to the study of intercultural competence were discussed including speaking approach, behavioral approach, attitude approach and thematizing approach (Collier, 1989). Computational applications are used to facilitate international communication between people with different cultural and language backgrounds. The translation of text message between users with different languages usually does partial translation with words not translated well. It is necessary to search for meaning in common sense knowledge, so as to understand the intention of the message well (Sugiyama et al., 2010).

People have linguistic choices to communicate their thoughts from explicit to implicit, however, the utterances chosen are often less than their actual thoughts. It means that the success in conversational interaction depends on not only speaker's utterance but also hearer's reception. During the interactive communication, people have to address the issue to choose the explicit or implicit interpretation of the utterance, depending on the contextual information of the intended interpretation. In order to find out communication problems, misunderstandings were analysed with the interpretation of the utterance. The main cases of misunderstandings are non-understanding, puzzled understanding and alternative understanding. In the case of alternative understanding, communication regards implicit as explicit or vice versa. As the cases analysed, it shows that effective communication may turn out ineffective with misunderstanding in implicit and explicit communication (Yus, 1999).

With regard to the culture of communication, there are high-context communication culture and low-context communication culture. In high-context communication, most of the information is part of the context and little information is made explicit. In low-context communication, information is carried explicit as part of the message. Thus, high-context communication can be regarded as more efficient, but inaccessible if unknown context. Low-context communication can be characterized by effective verbal messages, with high value and positive attitudes towards words (de Mooij, 2010).

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.

2.7 Literature conclusions

To sum up, the current literatures have studied several aspects related to distributed teamwork and intercultural design team. This chapter discussed the context of globalization and localization in creation and consumption. These led to the discussion of design teamwork in international context, which contained two aspects, distributed teamwork and intercultural design team. Furthermore, cultural difference and intercultural communication were discussed specifically in distributed and intercultural design teamwork. That demonstrates a well-grounded theoretical background of relevant research field. In view of literature study, this research will be built upon the field of distributed intercultural design teamwork in bi-national teams.

Chapter 3 Research Methodology

3.1 Four design research iterations

3.1.1 First exploratory iteration

3.1.2 Second creative iteration

3.1.3 Third reflective iteration

3.1.4 Fourth confirmative iteration

3.2 Overall case study approach

3.3 Case set up

3.3.1 Overall case set up

3.3.2 Case set up between groups

3.4 Course description

3.4.1 First design course program

3.4.2 Second design course program

3.4.3 Third design course program

3.4.4 Fourth design course program

3.5 Data collection with reflection

3.6 Data analysis and category

3.6.1 Data category with parameter

3.6.2 Data analysis process

3.7 Conclusions of methodology

Chapter 3 Research Methodology

In order to address the earlier identified research objectives, qualitative research methods were considered as appropriate and were therefore used. Qualitative research is a method often used in social sciences, which aims to understand human behavior in depth, and investigate why and how of decision making accordingly. Longitudinal study is a method for correlation over long period of time, which is observational study often used in sociology and psychology. The four design research iterations consist of exploration iteration, creation iteration, reflection iteration, and confirmation iteration. Case study was conducted with different research variables and objectives at each iteration. In total, four qualitative case studies were conducted in four design research iterations to investigate the team satisfaction and design quality of the distributed intercultural design teamwork.

3.1 Four design research iterations

The four design research iterations were designed with four iterative case studies in distributed intercultural design teams. Initially, the study explored how cultural differences influence design teamwork. Then, the study moved on how teamwork modes influence design teamwork. And then, the study continued how to combine different teamwork modes. Finally, the study proposed teamwork approach to facilitate design teamwork.

3.1.1 First exploratory iteration

At the stage of exploratory iteration (Figure 3-1), the research was designed to study the impact of cultural differences on the design ideation and team communication in distributed bi-national teams. The study was to identify the supporting and hindering cultural factors in distributed bi-national design teams from China and the Netherlands. In iteration 1 of exploration, a joint design course was conducted by Dutch and Chinese students to study the impact of cultural differences on design teamwork. It observed and reflected design team to explore supporting and hindering factors of cultural differences in design process.

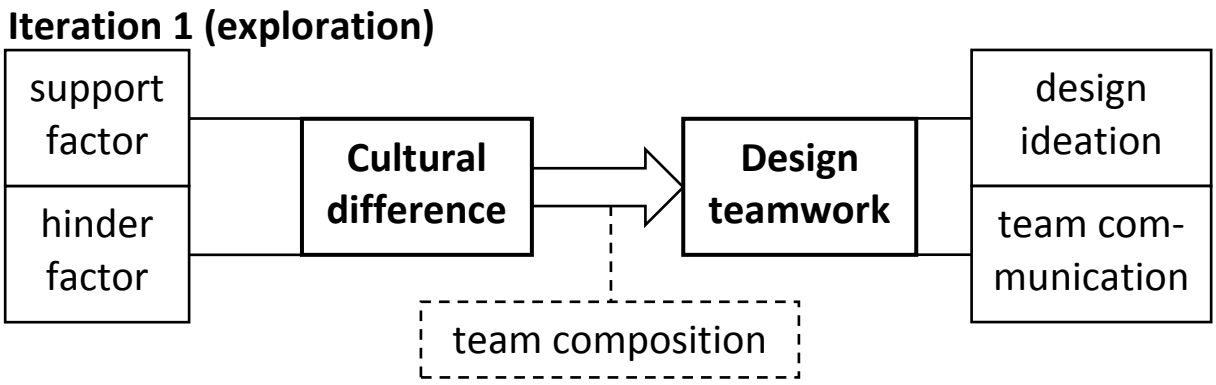

Figure 3-1. Research framework (the first exploratory iteration)

3.1.2 Second creative iteration

At the stage of creative iteration (Figure 3-2), the research was designed to study the effect of different teamwork modes (cooperation, collaboration, competition) on design teamwork. Three teamwork modes were introduced to investigate the effect on design teamwork in distributed bi-national teams. Meanwhile, design quality and team satisfaction were defined to measure the design teamwork. Given cultural differences in distributed bi-national design teams from China and the Netherlands, the research focused on how different teamwork modes affect design teamwork. In iteration 2 of creation, a revised design course was conducted by Dutch and Chinese students to investigate the effect of three different teamwork modes on design teamwork in distributed intercultural design teams.

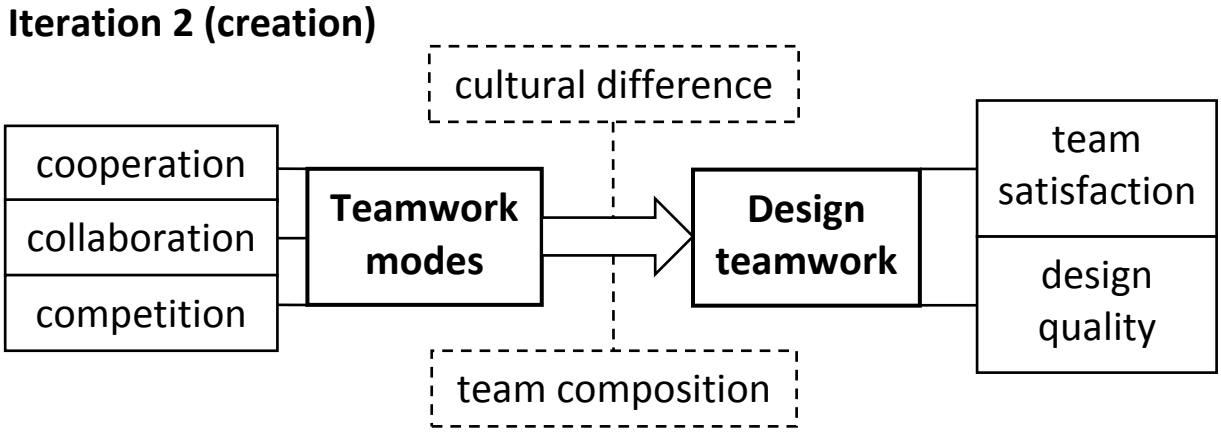

Figure 3-2. Research framework (the second creative iteration)

3.1.3 Third reflective iteration

At the stage of reflective iteration (Figure 3-3), the research investigated how to combine different teamwork modes to support designers to improve design teamwork. This research was designed to explore and identify the influence of different combination of teamwork modes on design teamwork, so as to support designers to improve design quality and team satisfaction. Comparing with different teamwork modes, the research investigated the strength and weakness of them, so as to find suitable teamwork modes for different situations in design process. In iteration 3 of reflection, an updated design course was conducted by Dutch and Chinese students to investigate different combination of teamwork modes on team satisfaction and design quality in distributed intercultural design teams.

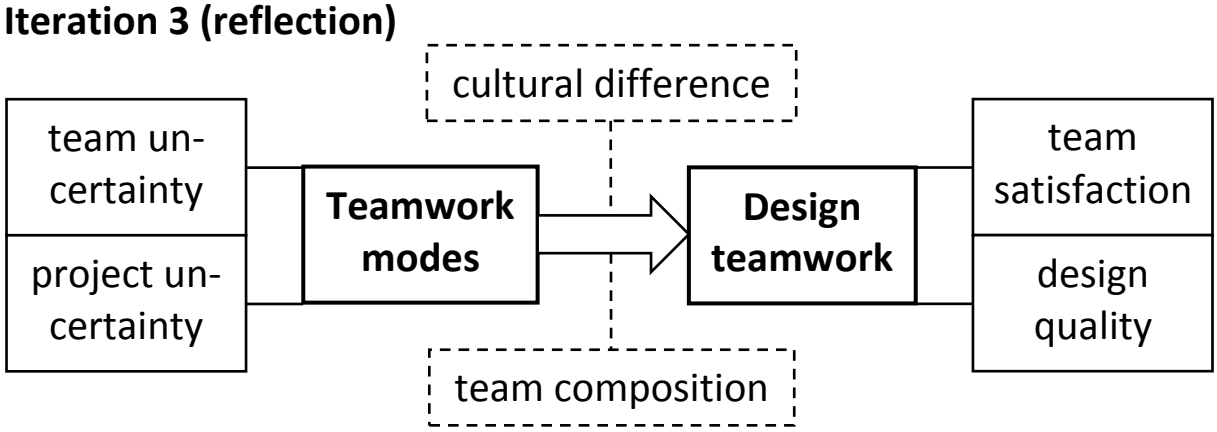

Figure 3-3. Research framework (the third reflective iteration)

3.1.4 Fourth confirmative iteration

At the stage of confirmative iteration (Figure 3-4), based on earlier insights, the research proposed a teamwork approach by combining three teamwork modes in a particular sequence. This research was designed to investigate the influence of teamwork approach to facilitate design teamwork in distributed bi-national teams. In the case study, distributed bi-national design teams were asked to employ the combined teamwork approach and its influence on design teamwork was analyzed. In iteration 4 of confirmation, a final design course was conducted by Dutch and Chinese students to investigate teamwork approach with combination of three teamwork modes to improve distributed intercultural design teamwork.

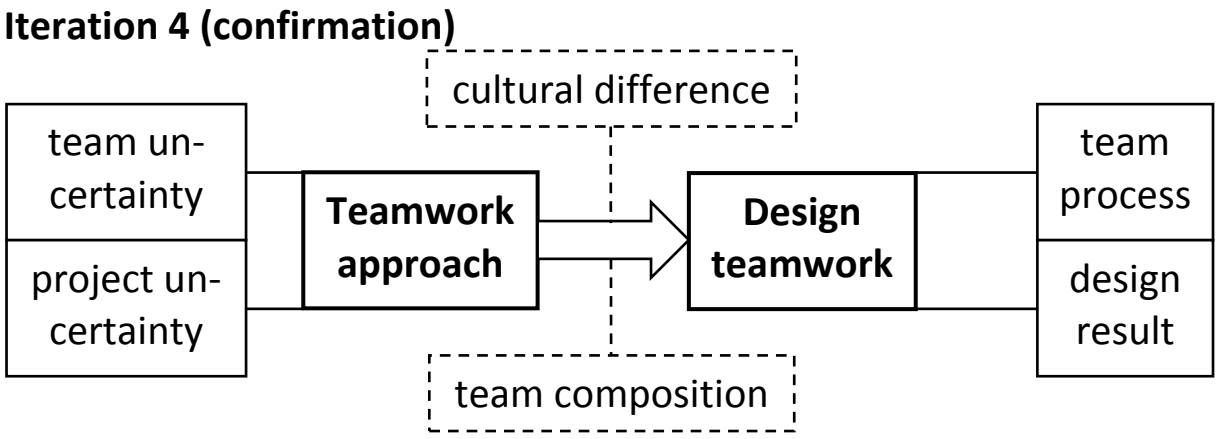

Figure 3-4. Research framework (the fourth confirmative iteration)

3.2 Overall case study approach

As discussed, this research consists of four iterations: exploration iteration, creation iteration, reflection iteration, and confirmation iteration. Case study was set up at each iteration to investigate the design teamwork in the context of distributed intercultural teams. In each case study, a joint design education course was conducted with distributed intercultural teams consisting of industrial design students from Eindhoven University of Technology in the Netherlands and Zhejiang University in China.

In the first explorative iteration, first case study aimed to explore how cultural differences affect design teamwork as support factors or hinder factors. In this case study, a joint design education course with distributed intercultural teams was conducted to explore the impact of cultural differences on design teamwork.

In the second creative iteration, second case study was defined to create three teamwork modes, that are competition, collaboration and cooperation. In this case study, the second joint design education course with distributed intercultural teams was conducted to analyze the effect of different teamwork modes on design teamwork. Each team was assigned respectively with particular teamwork mode.

In the third reflective iteration, third case study was designed to reflect the influence of different combination of teamwork modes on team satisfaction and design quality, given earlier insights obtained. In this case study, the third joint design education course with distributed intercultural teams was conducted to analyze the influence of combined teamwork modes on design teamwork. Each team was free to choose teamwork modes, based on earlier obtained insights.

In the fourth confirmative iteration, fourth case study was designed to confirm how teamwork approach affects design teamwork, a design teamwork approach consisting of different teamwork modes in a particular order was proposed. In this case study, the fourth joint design education course with distributed intercultural teams was conducted to analyze the influence of proposed teamwork approach on design teamwork.

In short, through the four research iterations in sequence, this research uses case studies with bi-national design students to investigate team process and design result in distributed team, in order to help designers improve design teamwork in intercultural context.

3.3 Case set up

3.3.1 Overall case set up

In the context of distributed intercultural design teamwork, the joint design courses with cultural and geographical difference in distant communication are increasing and becoming popular. Based on research approach and research question, design courses with four iterations were set up in the context of distributed intercultural design teams. In each iteration, a joint design course was conducted as a case study to investigate the influence on design teamwork. Therefore, the four relevant case studies were set up as multiple case studies in sequence and each simple case study has its research objective.

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

To set up the design courses in four iterations, cultural measurements and value survey were used to investigate the team composition and personal character of design students from China and Netherlands. 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.

In this intercultural research, China and Netherlands are chosen as representatives of eastern and western culture to study distributed bi-national teamwork. In the design course, design students from China and the Netherlands were regarded as main research target group. As the participants of case studies, Chinese students and Dutch students worked together according to different teamwork modes. During the team design process, it is more convenient and efficient to collect real-time and substantial data with design students, that make the analysis more valid and reliable, and lead to this research in depth. In addition, design students have early experience and original ideas for design teamwork. They will become professional designers in the future, and this research can support them to improve design teamwork accordingly.

3.3.2 Case set up between groups

This research was designed to study the distributed intercultural design teamwork with binational teams of Dutch and Chinese design students. This research was conducted between groups, different groups of students took part in the case studies with different teamwork modes in the different iterations of time. In the iterative case studies, different groups of students work in different cases, even in the same case, also work with different groups of students. Given the cultural differences in the binational teams, all the design students from both nations were divided into groups, and each group had both Dutch and Chinese design students. Two cultural measurements, team role questionnaire and value survey model, were used for team composition with team position and personal character. In the creative iteration, each group was assigned respectively with particular teamwork mode. During the process, team 1 and team 4 worked in cooperative mode, team 2 and team 5 worked in collaborative mode, team 3 and team 6 worked in competitive mode. In the reflective iteration, each group was free to choose or combine the teamwork modes. During the process, all five teams worked in different teamwork modes, for example, one team worked in competitive mode at first, then in collaborative mode, and in cooperative mode at end. In that way, design teamwork can be compared between groups with different teamwork modes.

3.4 Course description

3.4.1 First design course program

The first design course was designed to explore cultural dimension with support factors and hinder factors for team design. There were 25 design students involved in the first design course, 12 Chinese students and 13 Dutch students, who were divided into six teams, with both Chinese students and Dutch students in each team. The first design course was taken in one intensive week with five working days. During the five working days, three plenary sessions were scheduled in the morning, on the first day as kick-off meeting, on the third day as middle presentation, and on the last day as final presentation. All the design students worked in teams to present their design result and deliver their design report. The teacher gave feedback on design result and made discussion on teamwork during design process.

3.4.2 Second design course program

The second design course was designed to use three teamwork modes to investigate the influence on design teamwork. There were 30 design students recruited in the second design course, 15 Chinese students and 15 Dutch students, and there were six teams with both Chinese students and Dutch students in each team. The second design course was taken in six weeks with two working days in each week. During the six weeks, there were six plenary sessions scheduled on every Wednesday afternoon, those were kick-off meeting on the first day, middle presentation after two weeks, final presentation on the last day, and other sessions were question hours. Different design teams worked in assigned teamwork modes during design process. They delivered weekly diary and iteration diary in person, and presented design result and delivered design report in teams. The teachers and clients gave feedback on design result in presentation sessions and made discussion on teamwork in question hours.

3.4.3 Third design course program

The third design course was designed to reflect different combination of teamwork modes for design teamwork. There were 25 design students in the third design course, 18 Chinese students and 7 Dutch students, who were divided into five teams, with free use of different teamwork modes. The third design course was taken in five weeks with two working days in each week. During the five weeks, there were five plenary sessions scheduled on every Wednesday afternoon, those were kick-off meeting on the first day, middle presentation after two weeks, final presentation on the last day, and other sessions were question hours. Different design teams worked in free teamwork modes during design process. They delivered weekly diary and iteration diary in person, and presented design result and delivered design

report in teams. The teachers gave feedback on design result in presentation sessions and made discussion on teamwork in question hours.

3.4.4 Fourth design course program

The fourth design course was designed to confirm teamwork approach with combination of three teamwork modes to improve design teamwork. There were total 41 design students in the fourth design course, 32 Chinese students and 9 Dutch students, and they were divided into six teams. The fourth design course was taken in six weeks with two working days in each week. During the six weeks, there were seven plenary sessions scheduled on every Thursday afternoon, those were kick-off meeting on the first day, middle presentation after two weeks, final presentation after five weeks, oral examination on the last day, and other sessions were question hours. Different design teams worked in combined teamwork approach during design process. They delivered weekly diary and iteration diary in person, and presented design result and delivered design report in teams. The teachers gave feedback on design result in presentation sessions and made discussion on teamwork in question hours and oral examination.

3.5 Data collection with reflection

In this design research, qualitative research methods were used to study design teamwork from various aspects. In the case studies, reflection diary and panel feedback were used to record the team process and design result. Meanwhile, semi-structure interview and participant observation were also used to investigate design maintenance and achievement.

In this design research, case studies investigated design maintenance and achievement to improve design teamwork. In the case studies, 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 of these research data collections, other sources of evidence, such as participant observation, semi-structure interview, user acceptance model, were also used to study design teamwork.

During design process, 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 of team. The former directly recorded the design process and the latter indirectly improved the design result. In specifically, the reflection diary included

weekly diary and iteration diary, while the panel feedback included feedback on discussion and presentation. In the case studies, 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 had been investigated with the teamwork of design students in distributed intercultural teams.
In addition, semi-structure interview was taken to investigate the design teamwork. In the case studies, the influence of cultural difference and different teamwork modes on design quality and team satisfaction had been analyzed and found. Interview as a qualitative research method was used to field test and verified the findings from case study, that could check the findings directly in depth. Therefore, semi-structured interview was conducted every week with design students during question hours to investigate their team process and design result. From the interviews, the design research could get effective reflection with regard to the research findings.

3.6 Data analysis and category

3.6.1 Data category with parameter

In order to study design teamwork, design quality and team satisfaction were used to measure design result and team process. Based on the data from panel feedback, design quality was used to measure design result, as the definition of design quality from the literature (Juran, 1992), to what extent is the quality of design result of design project. Design quality was evaluated by data from panel feedback, including the categories of design concept, user research, presentation and design report. Design quality was measured by a number of criteria, such as visual presentation of group design and user test of design project, the first and second iteration of teamwork process, personal reflection diary, quality of the report, teamwork and communication. Based on the data from reflection diary, team satisfaction was used to measure team process, as the definition of team satisfaction from the literature (Powell, Piccoli and Ives, 2004), to what extent do team member satisfy the team process. Team satisfaction was evaluated by data from reflection diary, including the categories of activity, teamwork, communication and cultural difference (Table 3-1).
The data collection and analysis reflect on the definition to support the measurement of design quality and team satisfaction. In line with design result and team process, project uncertainty and team uncertainty were also used to measure design teamwork with different teamwork

modes in time sequence. Project uncertainty means to what extent the team understands the design challenge, and the knowledge of the design brief known to the design team members. Team uncertainty means to what extent the team knows each other's strength, and the design competency of the design team members from different cultures. The uncertainties of project and team were also evaluated by data from panel feedback and reflection diary. That studied the effect of different teamwork modes on the improvement of design teamwork during design process.

Table 3-1. Data category

data collected	data categories
reflection diary	activities, teamwork, communication, cultural difference
panel feedback	design concept, user research, presentation, design report

3.6.2 Data analysis process

Based on the data collected from the iterative case studies, the grounded theory was used for data analysis, including the data from reflection diary and panel feedback. Reflection diary was written by design students individually to record their team process. As the qualitative research diaries (Yin, 2009), the weekly diary reflected on activity, teamwork, cultural difference and communication, and the iterative diary reflected on target group, design concept, design scenario, and design result. In line with the template of reflection diary, the relevant data were grouped into four categories, activity, teamwork, communication and cultural difference. Panel feedback was given by course assigner for each team to improve their design result. The feedback for discussion was given in question hour session, and the feedback for presentation was given in presentation session. As the various aspects of panel feedback, the relevant data were grouped into four categories, design concept, user research, presentation and design report. Besides the data from reflection diary and panel feedback, participant observation and structure interview were also used for data collection and analysis. In question hour session, design students discussed their design result and team process together with course assigners. In presentation session, design students presented their teamwork and design project. Together with the presentation, design report also used for data analysis, including design challenge, design approach, iterative results, and reflection on team level and individual level.

The diary template was designed from the literature, as well as from the purpose of design course in case study. The different aspects of diary data were collected to conduct the data analysis, and these categories have been discussed in the literature to make the results valid. In the data analysis process, the qualitative research method grounded theory was used to analysis these categories more specifically. As a systematic methodology in social science, grounded theory operates in a reverse way of traditional research method to analysis the data and discovery the theory (Glaser and Strauss, 1967). At first, data collection is conducted from a variety of aspects, including reflection diary and panel feedback. Then data analysis has four steps (Table 3-2). The first step is for codes, the key points of the data are extracted and to be gathered from the text. The second step is for concepts, the codes are grouped into similar concepts to make them more workable. The third step is for categories, the categories are formed from the concepts to generate a theory. The fourth step is for theory, a theory or a reverse hypothesis explains the subject of the research.

Table 3-2. Data analysis process

step	process
code	key points from text
concept	codes group into concepts
category	concepts form categories
theory	theory or hypothesis

3.7 Conclusions of methodology

In conclusion, this research used qualitative research method and longitudinal field study to achieve the research objective. In the four design research iterations (exploratory iteration, creative iteration, reflective iteration, confirmative iteration), the iterative case studies were conducted with different variables and research objectives in distributed intercultural design teams. According to the design research approach, in line with four design courses in bi-national teams, four iterative case studies were conducted to investigate the distributed intercultural design teamwork. In the iterative case studies, the impact of cultural difference is explored in distributed intercultural teams, and then teamwork modes are introduced to investigate the effect on design teamwork, and also differently combined to improve design teamwork, and finally teamwork approach is proposed to facilitate distributed intercultural

teamwork. Through the four design research iterations, this research used four iterative case studies with bi-national teams to investigate the distributed intercultural design teamwork, in order to help designers improve design teamwork in distributed intercultural teams.

Chapter 4 Cultural Difference

4.1 Introduction

4.1.1 Research objective

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4.5 Data collection and analysis

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Chapter 4 Cultural Difference

4.1 Introduction

4.1.1 Research objective

This chapter is designed to study the impact of cultural difference on design teamwork in distributed bi-national teams. The aim of this chapter is to explore the impact of supporting and hindering cultural factors on design ideation and team communication. The correlation between cultural difference and design teamwork is regarded as main research object. A joint design course was conducted as a case study to investigate the role of cultural and national diversity on design ideation and team communication in bi-national design teams. Therefore, the case was studied by following question: how is the impact of supporting and hindering cultural factors on design ideation and team communication in distributed bi-national design teams from Netherland and China?

4.1.2 Cultural difference

The context of product development has become increasingly globalized in order to keep pace with resource availability and the demands of global markets (Davenport, 2005). Consequently related business processes become unavoidably complex. Much research has been done in the context of incorporating globalization dynamics in research and development, production, distribution and finance (Lane et al., 2005). However, limited research has been found related to collaborative design in international teams. Collaborative design is often considered as an important application of information technologies and related existing research focuses very much on the development of collaborative computer systems to support collaborative design (Kvan, 2000).

Globalization in the context of product design implies exploiting the knowledge and expertise of all parties involved in the design team, no matter how these parties are distributed geographically and organizationally. Therefore, the communication intensity needs to be high in these phases. According to Johnson (2005) design ideation represents the creative process of generating, developing, and communicating new ideas in a design process, where an idea is understood as a basic element of thought that can be visual, concrete, or abstract. Especially, given the cultural diversity today’s design teams, targets could diverge due to all kinds of

misunderstandings, thanks to deference in attitudes, values, and norms (Brouncken and Winkler, 2010). Yet, although knowledge from various cultures from all over the world is needed to come up with new innovative concepts, research about the effects of cultural behavior and values on cultural diverse teams is lacking (Schwarts, 1999). Current study focuses on this problem, and therefore, investigates the role of cultural diversity on design ideation in international design teams.

In this study, culture refers to a community shared system of values, norms, ideas, attitudes, behaviors and communication (van Oudenhoven, 2002). Culture has impact on all kinds of aspects of design. It is important to address this, because culture is closely related to design. Different views in cultures may affect the collaboration in design teams. Team diversity can support design teams by for example increasing the number of different views, ideas perceptions, etc. and can also hinder collaboration. Figure 4-1 illustrates the difference between the Dutch and the Chinese culture in terms of the dimensions proposed by Hofstede and Hofstede (2005).

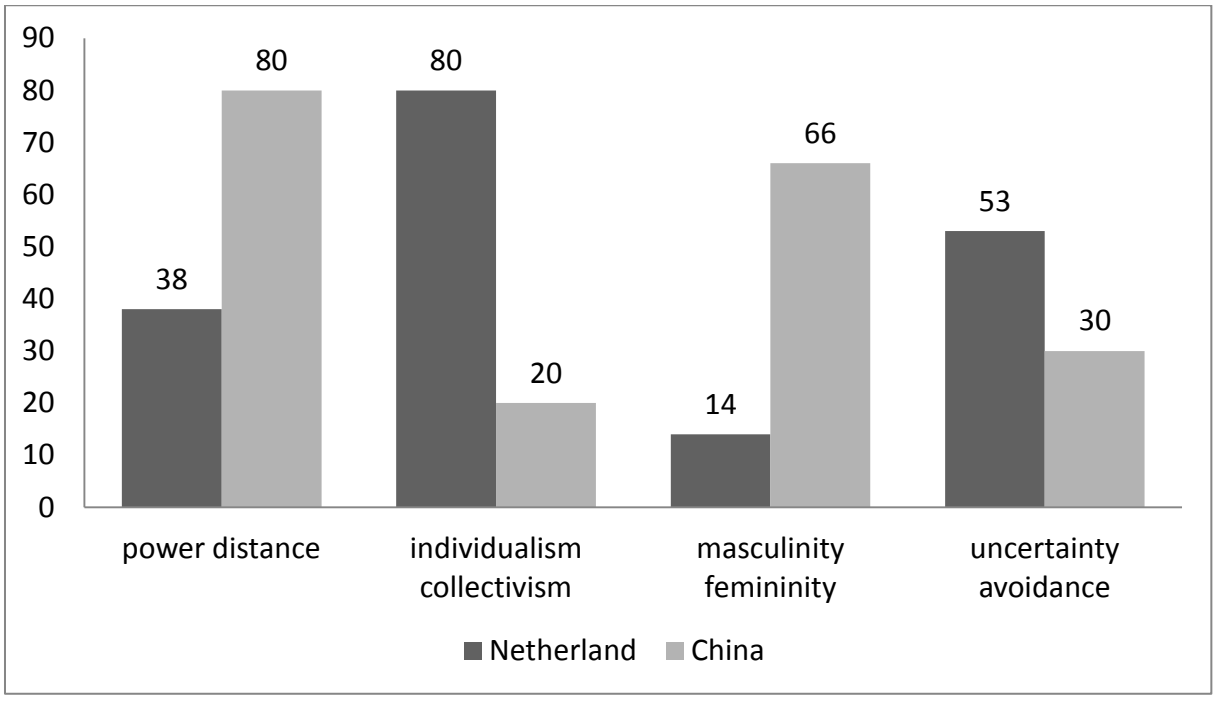

Figure 4-1. Cultural difference (Netherland and China)

According to the cultural differences between these two countries (Hofstede and Hofstede, 2005), it can be stated that these differences can act as barrier in collaborative design ideation. However, it can be argued that these factors could evolve from hindering to supporting, when

more understanding in cultural differences is reached within the design team along the design process.

4.2 Research approach

In order to achieve the research objective, a bi-national co-design course was conducted by Dutch and Chinese design students, as a case study to investigate the impact of cultural difference on co-design teamwork. The case study observed design process and interviewed design team to explore the impact of supporting and hindering cultural factors and reflect the design teamwork of design ideation and team communication. In the case study, design students considered cultural awareness for elderly communication and experienced design teamwork in distributed teams. Meanwhile, design report and reflection were used to record their design teamwork and reflect their cultural difference. During design process, video conference was used for formal sessions with presentation, while email and instant message were used as team communication media.

4.2.1 Research model

As the stage of exploratory iteration (see Figure 4-2), this chapter was designed to study the impact of cultural differences on the design ideation and team communication in distributed bi-national teams. The study was to identify the supporting and hindering cultural factors in distributed bi-national design teams from China and the Netherlands. In the exploration iteration, a joint design course was conducted by Dutch and Chinese students to study the impact of cultural differences on design teamwork. It observed and reflected design team to explore supporting and hindering factors of cultural differences in design process.

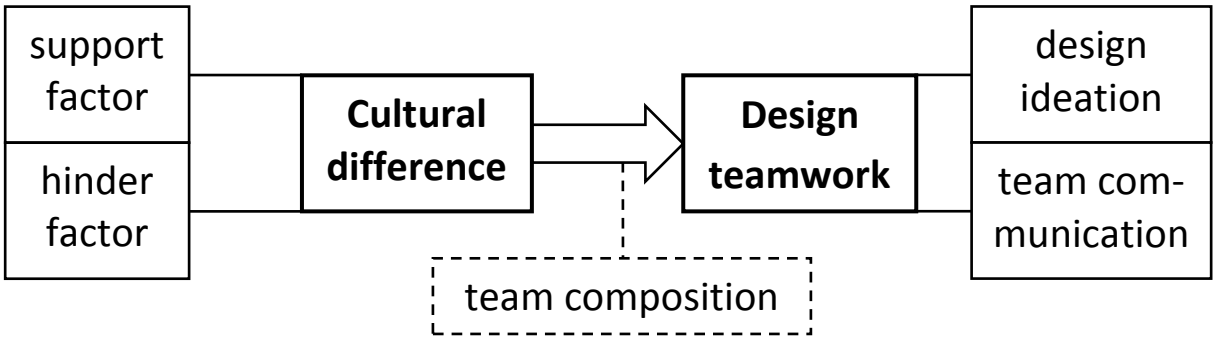

Figure 4-2. Research model (cultural difference and design teamwork)

4.2.2 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. This chapter discusses a master design course that is conducted by the Department of Industrial Design (ID) at Eindhoven University of technology (TU/e) together with the Department of Industrial Design at Zhejiang University (ZJU) in China to investigate the role of cultural and national diversity on design ideation in bi-national design teams.

In the first exploratory iteration, a joint design course is conducted as a case to study in depth the design teamwork 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 difference 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 students explores significant cultural differences in the way of concepts ideation. The presentation and report reflect their cultural differences on design process and link to their own cultural values. The observation and participation indicate that Dutch and Chinese students solved the design problems in culturally divergent ways.

4.3 Case study

4.3.1 Design course

The master design course ‘Design in International Teams’ was organized by industrial design department in Eindhoven University of Technology. The course was worked for collaboration with both Dutch team and Chinese team to design elderly communication for Dutch market and Chinese market. That was a challenge, not only to work with international teams, but also work for international market. The purpose of this design project was to create an application that enables communication between elderly and their social network. The aim of this design project was to make design students aware of and make use of different culture dimension and team collaboration. In this project, there were six intercultural teams with Dutch team members and Chinese team members. Due to the different background of two countries, it was meaningful to discuss and communicate with different culture. It was not only helpful to understand the different work habit and culture with other team members, but also understand the different requirement for target market in different countries. The master design course

took observation and participation on how different culture and background influenced team collaboration and communication. Based on the cultural difference between Dutch team and Chinese team, this chapter analyzed the two collaborative iterations in design process with cultural dimensions.

The learning objective of this design course was to understand the role of communication when designing in international teams on the same design project at two different time zones with two different cultures. The rules of this design course including professionally work in a team with designers from different backgrounds, show understanding of different cultural aspects, need to work hard and also in unusual hours, and full participation as part of the team.

4.3.2 Course set up

The master design course was used as the case to study the impact of hindering and supporting cultural factors of collaborative design ideation. Bi-national teams were studied that contain both Dutch and Chinese 'Industrial Designers'.

The master design course was conducted in one week. This design course was jointly executed by both industrial design master students from TU/e in Eindhoven and Zhejiang University in Hangzhou. The challenge here was to work with an international design team for the international market (Dutch and Chinese). During this week, they were asked to develop products for consumers in both countries. It was very important to take observations on how their different backgrounds influence design decision and communication within the team and how the requirements of consumers with different culture background differ. They were therefore asked to reflect continuously at the team level as well as at the individual level of their design process and to collect actively related user insights in these two countries based on literatures.

This master design course consisted of an iterative design project following two design iterations. The first iteration addressed only one market while the second iteration took into account the other market. It was very important that on the one hand, they understood the different working and communication culture and behavior in their team due to a different national cultural background; on the other hand, they understood the different user requirements due to a different national cultural background. The teams were encouraged to conduct small consumer research by making use of the time differences at the two locations.

In total 6 bi-national design teams participated in the master design course. The design teams worked together through one entire week on two joint design projects consecutively. To

control for extraneous factors that may influence the design ideation, only ID students from both universities participated in this course, and all teams were asked to use Skype as the only communication instrument through the whole week. Consequently, various types of data were collected, including direct observations by lecturers and documentation and reflection of the design ideation of individual team.

4.3.3 Course description

In this chapter of exploration iteration, the case study aimed to explore how cultural differences affect design teamwork as support factors or hinder factors. In this case study, a joint design education course with distributed intercultural teams was conducted to explore the impact of cultural differences on design teamwork. The design course was designed to explore cultural dimension with hinder factors and support factors for team design. The design course was taken in one intensive week with five working days. During the five working days, three plenary sessions were scheduled in the morning, on the first day as kick-off meeting, on the third day as middle presentation, and on the last day as final presentation. In the design course, there were 25 design students involved in the design course, 12 Chinese students and 13 Dutch students, who were divided into six teams, with both Chinese and Dutch in each team. That means each team comprised 2 Chinese students and 2 Dutch students, while one team comprised 3 Dutch students among others. All the design students worked in teams to present their design result and deliver their design report. The teacher gave feedback on design result and made discussion on teamwork during design process.

Table 4-1. Course program (one week with two design iterations)

working day	design program	team activity
day 1 / iteration 1 / session 1	kick-off meeting	team composition
day 2 / iteration 1	concept ideation	choose target group
day 3 / iteration 2 / session 2	middle presentation	get feedback
day 4 / iteration 2	concept finalization	further detail design
day 5 / iteration 2 / session 3	final presentation	design report

As shown in the course program in Table 4-1, the formal meetings were organized as follows. Kick off meeting was held on Monday morning to introduce and compose the team. First iteration presentation and reflection were held on Wednesday morning. Second iteration

presentation, reflection and evaluation were held on Friday morning. Tuesday afternoon and Thursday afternoon were planned for question hours via Skype. The presentation was an elevator pitch, including design problem with consumer insight, design approach and design proposal with ideas and concepts, and reflection. The report structure included introduction with background and design problem, intercultural design process and approach, results of the first iteration and second iteration, conclusion and reflection both on team level and individual level.

4.3.4 Design project

Design project was about elderly communication in aging society. As aging is a societal issue in both China and the Netherlands, more independent living of elderly in both countries and social cohesion needed. The design required to define target group and identify needs with user research, and the design should be interesting and beneficial, persuasive and subtle nonintrusive, and fit in daily life of the elderly.

The design subject was about elderly communication. The aging of the population was a well known trend. For both economical and personal reasons (van Heuvelen et al., 2000), it was preferred that these elderly live independently as long as possible. Joore (2007) determined three main need areas: safety, social cohesion and health. Social cohesion was among others about keeping contact, and lack of social cohesion could lead to social isolation and loneliness. Modern information communication technologies might be able to prevent this, by allowing richer asynchronous communication (e.g. sharing videos of experiences) and better-mediated synchronous communication (e.g. only initiate a phone call if both parties indicated that they want the contact) (Markopoulos et al., 2003). Although these modern communication technologies (the phone, e-mail, etc.) provided many ways of straightforward, one-to-one communication, developing just another communication device would not have the added value. Therefore, the purpose of this design project was to create an application that enables communication between elderly and their social network. It should motivate the elderly to use other advanced communication devices in order to stay connected with their beloved families and necessary daily contact such as doctors and care givers. Therefore, they were encouraged to aim their design to be non-intrusive, playful and easily embedded in the everyday life of the elderly.

4.4 Case results

Due to impact of cultural difference in bi-national teams, design ideation and team communication were difficult but important for co-design teamwork. Dutch and Chinese team members solved design problems in culturally divergent ways. Each team focused on different aspects of same problem and worked out different solutions. That was a challenge for design team to combine different solutions into one concept. Therefore, design teams made a plan in the beginning and had frequent meetings in the process, so as to diminish the uncertainty of distributed teams. Besides, paper based communication, such as writing document and drawing sketch, could be used to assist information sharing and facilitate team communication.

4.4.1 Design process

In this course, the general course structure and process was given, but each individual team still developed their own processes. Due to the different cultures, within each team Dutch members and Chinese members differed in their design process, yet some of steps were similar.

Orientation started after the kick off, it was observed that Chinese students took initiative to set up the connection to build relationship, while Dutch students tried to make plan for the process. One team spent time on getting to know each other at the beginning of this project and this was initiated by Chinese team members. Another team started an introduction with each other in order to understand the other culture and then decided the design process together. It was shown that Chinese team members valued the relationships and intended to set up relationships before collaboration. All teams made a plan after kick-off meeting in order to clarify the design process and team collaboration and this was initiated by Dutch team members. It was shown that Dutch team members intended to minimize or reduce the level of uncertainty by plan. Due to time difference, the plan included both collective works (such as discussion) and individual works (such as sketch). There were also many collective works done by the team members from one side (for example, making user research and interview). In that plan, both Dutch team members and Chinese team members reached an agreement on workflow. The general design process contained literature study, user research, brainstorm, concept scenario, detail design and presentation. According to the different social environment and culture, each team operated this design process in its own style.

In design iteration 1, the first iteration of idea generation, both Dutch and Chinese team members discussed and chose the target group in the first internet meeting. Then Dutch team members started work on literature study and shared the key points with each other. While Chinese team members made user interview and shared the materials and results to the other

side. According to the data from user interview and literature study, both Dutch and Chinese team members tried to create new ideas and concepts with brainstorm methodology.

In design iteration 2, the second iteration of concept development, all the team members made some progress. Dutch team members and Chinese team members improved the concepts respectively and then completed the most feasible concept as the final concept. Once the final concept was selected, all the team members worked together for presentation. Both Dutch and Chinese team members preferred to divide the work to avoid uncertainty. Dutch team members took charge of scenario, persona and specification. Chinese team members also took responsibility of sketch, model and presentation. Finally they integrate them into presentation and report.

4.4.2 Team reflection

During the course work, each design team reflected periodically on their collaboration progress and the design results. In this section, an overview of their reflections is provided.

As Chinese students and Dutch students worked in the international teams, it was a real challenge to deal with culture and language difference for this collaboration. To design communicator for elderly both in China and the Netherlands, they exerted their ability to improve this design project and collaborated with team members in both sides. In general, this international project was a challenge to both sides. It required the intercultural design and also the communication in different languages and cultures.

From the team reflection it was learned that due to the time difference, they made a plan at the beginning of the design process. They could work for nearly twenty hours in advantage, while it was not easy to communicate synchronously. That meant the two sides could not interact promptly, instead of that, they had to record the results and sent email to the other side to get some feedback with less efficiency. They also lost some subtle information in process and put more energy for explanation.

In this international design project, they also felt and learned culture differences between two sides, especially in the view of design problem. As to the same circumstance of target group, two sides were interested and focused on the different dimensions. That was also the reason why they had the variance for the target group at first and even different concepts in the design process. Sometimes it was hard to reach an agreement because of culture differences and language barriers. They had to communicate with written documents and interpretation.

With regard to the design process, they launched this project after the kick-off meeting. The Dutch team did literature study and Chinese team worked on user interview. The two sides

found the different direction for the elderly and had to reach an agreement to focus on one target group. During the design process, they did brainstorm to create and develop design concepts and sometimes the discussion took long-time for detail design. They tried their best to improve the concept to fit for the needs of the target group. Considering the lifestyle of the target group, they thought about the design solution to trigger the communication between the elderly to enhance the social cohesion.

4.4.3 Design concept

The design course was about learning to deal with cultural and location differences in design teams. In this case, design teams comprised of Chinese students and Dutch students. As to design concepts, two design backgrounds were in some aspects fundamentally different. The design project worked on challenge to design a solution that increased social cohesion between elderly or with others.

According to the design project, Chinese students and Dutch students in each team worked collaboratively to design for elderly communication to improve their social cohesion. They reached an agreement on design approach from target group to concept design. In order to find out design problem, they studied literatures and made persona about user for consumer insights. Then they made idea generation and development to create concept scenario, as a result, final concept was illustrated in Figure 4-3. Besides the value proposition of the design result, they also made reflection on collaborative teamwork.

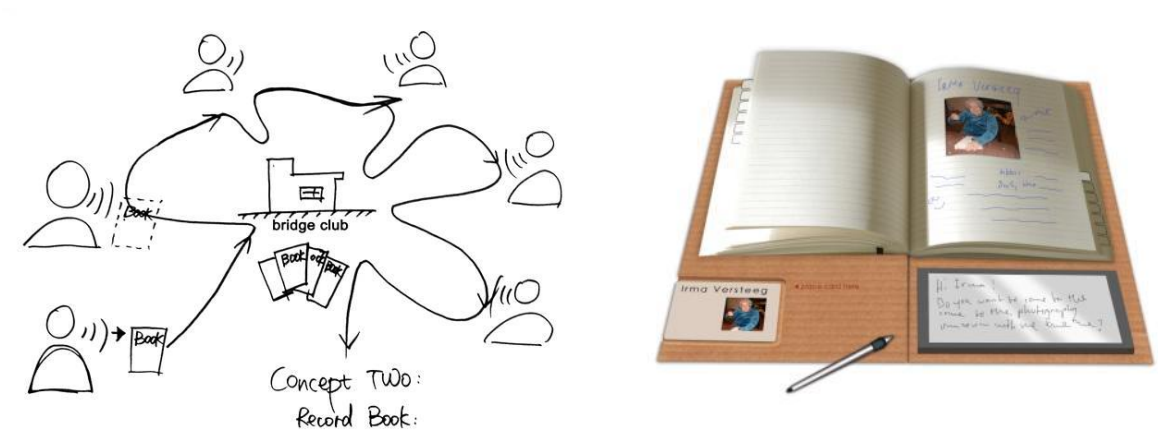

Figure 4-3. Design concept

4.5 Data collection and analysis

In the case study of explorative iteration, according to the case objective for cultural difference, research data were collected from presentation for design approach and report for team reflection. Then based on the related literature about cultural difference, the data were analysed with the categories: power distance, masculinity and femininity, individualism and collectivism, uncertainty avoidance, communication. As the process of data analysis, presentation data and report data were collected by each team separately, and then the key points are gathered from the text, and grouped into these categories, so as to generate propositions for the analysis results.

4.5.1 Case data

With the cultural dimensions, this chapter analyzed design process in bi-national teams to explore the influence on design teamwork. Based on the data collected from presentation and report for design approach and team reflection, the following statements and propositions were illustrated for validity with original data.

Power distance (PD): The way of communication for Chinese team could be characterized as indirect and implicit, while the way of communication for Dutch team was specifically direct and explicit.

"In the beginning Chinese team was very reserved in expressing their opinions, while Dutch team was very outspoken, resulting in a skew balance of power (Team 3)." "Chinese students were not telling their opinion as direct as Dutch students tended to do (Team 4)." "How Dutch actually was regarding directness, which was not particularly something bad, but was maybe not that polite towards Chinese (Team 4)."

Power distance (PD): The design activities of Dutch team lied in conceptualization and interaction, while the design activities of Chinese team focused on operational tasks with execution and realization of those tasks.

"Chinese students made the product rendering, while Dutch students had more influence on the development of concept and interaction (Team 2)." "Chinese students proved to be good at rendering and visualizing, while Dutch students benefited from their conceptualizing and presentation skills (Team 4)." "Chinese team focused on actual results and feasibility, in Dutch team the focus lied in conceptual ideas (Team 5)."

Masculinity and Femininity (M&F): Dutch team showed work in progress and preferred design process, while Chinese team showed complete work and preferred design result.

"Dutch team was constantly saving shared document, while Chinese team felt uncomfortable to show work in progress (Team 3)." "Chinese team focused more on integrating multiple

features, while Dutch team focused more on delivering good experience (Team 3).” “The way of communicating ideas was different. Dutch team showed the ongoing work, the Chinese only showed the finished part (Team 5).”

Masculinity and Femininity (M&F): Dutch team preferred the products with simplicity, while Chinese team preferred more functionality with features.

“While Dutch product needs to become some kind of simple product, Chinese product seems to require more functions for acceptance (Team 1).” “Chinese people liked products that combine functions, while Dutch people liked simple and elegant products (Team 2).” “In Chinese culture products were perceived more valuable with functions and features. While in the Netherlands products were preferred with simplicity (Team 3).” “The Dutch seek simplicity without unnecessary functionality, while the Chinese seek integration with as much functionality as possible (Team 6).”

Individualism and Collectivism (I&C): Chinese students worked more collectively and Dutch students worked more individually.

“Chinese students tended to design more towards one concept, while Dutch students tried to be more individual and differentiate from each other (Team 2).” “Chinese teams worked in collective way, while Dutch teams made their designs stand out (Team 5).”

Individualism and Collectivism (I&C): Chinese students had more technical focus and Dutch students had more conceptual focus.

“The Chinese tended to focus on technology and functions, while the Dutch tried to take account of real needs of the user (Team 2).” “For Dutch team the message was important, and for Chinese team the way they presented the message was equally important (Team 5).”

Uncertainty avoidance (UA): Dutch team took initiative with Chinese team to make a planning to avoid uncertainty of the process.

“Dutch team initiated to create a planning at the beginning of the project (Team 1).” “As usual Dutch team suggested a planning and sent to Chinese team for information (Team 4).” “All teams designed a planning that clearly showed time difference and task division between the Netherland and China (Team 6).”

Uncertainty avoidance (UA): Dutch team and Chinese team had frequent meetings to avoid uncertainty in design process.

“There were several meetings to discuss the concepts to reduce the risk of interpreting comments differently (Team 5).” “Dutch team and Chinese team had more frequent meetings to avoid uncertainty. A clearly written and updated document with design decisions and task division was made to avoid mistakes (Team 6).”

Besides the statements related to cultural dimensions, this chapter also illustrated the propositions about communication in distributed design teams. According to the original data from design teams for communication, they were specifically proposed as follows.

Communication (C): Paper based communication, such as writing document and drawing sketch, could facilitate and assist distant communication.

"It was experienced that using images in distant communication often worked better than using words (Team 1)." "In the process, putting things on paper with writing and drawing relieved some problems (Team 6)." "As a measure of process, a text document was created for design decisions and underlying reasons (Team 6)." "Language barrier and bad internet limited communication efficiency, but sketch was used to assist communication (Team 6)."

Communication (C): For linguistic problem in communication, body language was helpful and could lower the language barrier.

"Body language was actually valuable when spoken communication was obstructed (Team 6)."

"Sometimes minor pronunciation problem caused some confusion. It was different for two cultures to express and interpret, and linguistic barrier amplified this even more (Team 4)."

Communication (C): Time and place difference resulted synchronous communication problem, but time difference led to continuous development of the project.

"Time difference was seven hours and time had to be used well (Team 1)." "The project did not halt during the night, as it had been developed further by the other side (Team 5)." "As a result of time and place differences, sometimes directions taken by the other team had to be respected (Team 6)."

To sum up, based on the research data and related to the research question, the impact of cultural difference on design teamwork was studied in collaborative design ideation. Furthermore with cultural dimensions, the supporting and hindering cultural factors were identified in distributed bi-national teams from China and the Netherlands.

4.5.2 Analysis results

From the data collected, it was noticed that Chinese team members were more collective, took more interaction and even worked together, while Dutch team members worked more individually, created new ideas and promoted to others. As a result, Chinese team members tended to design towards one concept, and Dutch team members tried to make design different from each other. Cater to the different solutions for target group, team members considered several ideas, modified and combined them into concepts.

In the process of collaboration, it was found that the communication of Chinese team members could be characterized as indirect and implicit, and the communication of Dutch team members were specifically direct and explicit. Usually Chinese team members were more polite and implicit to indicate mistake or misunderstanding, while Dutch team members were more direct and explicit to express their ideas and thoughts. It was shown that Chinese team members tended to have more power distance in their communication style than Dutch team members.

As a result of the process, team members had to come up with a concept. With regard to the concept, Chinese team members preferred more function with features, whereas Dutch team members preferred the concept with simplicity. Both sides reached an agreement for the final concept after discussion and then improved and completed the concept. However, Chinese team members attempted to integrate multiple features, while Dutch team members seek necessary function for simplicity. It was shown that Chinese market required multi-function products to meet the need of consumers, and Dutch market required simple products unless the function worked well.

Because of cultural difference in design process, there were some difficulties for team collaboration. Dutch team members and Chinese team members had to interpret and understand the design process and reached an agreement on it. They also had better pay attention to the subtle different understanding of the same issue. Sometimes bad communication led to the failure of interpretation and understanding. Each team focused on the different aspects of the same design problem and worked out the different solutions. There was a challenge for international collaboration to combine different ideas and solutions into one concept. Paper based written communication, such as document and sketch image, could facilitate to combine various concepts.

Next to the cultural difference, there were also other challenges, such as time difference and language barrier. Time and place difference led to communication problems. Because of time difference, both Dutch and Chinese team had to manage the time efficiently. On the opposite, time difference also led to the continuity of the project. That meant the project could be developed for long time in one day and did not halt at night of one side. As to language barrier, sometimes minor verbal problem (such as pronunciation) caused misunderstanding and confusion in communication, but body language could lower the language barrier. Although internet connection was not enough for distant communication, shared document was used to facilitate communication. As a measure of design process, one team created a clearly written and updated document to record activities on paper, in order to clarify and

understand design decisions and underlying reasons. Sketch was also used to assist communication. Moreover images contained more information than words in the international collaboration and communication. One team experienced that using images in distant communication worked better than using words. Furthermore frequent meetings were helpful to avoid uncertainty in design process. Thus both Dutch and Chinese team had several meetings for discussion to reduce the risk of misunderstanding and mistake.

4.6 Conclusions

Through observation and reflection on the case study, with regard to team communication, Dutch team members were specifically direct and explicit, while Chinese team members could be characterized as indirect and implicit. Dutch and Chinese team members had to explain ideas generated and understand decision made, and then reached an agreement with each other. They also had better pay attention to subtle different interpretation and comprehension of same information for team communication. Based on the analysis and results of case study, it is necessary for designers to be aware of and make use of cultural difference for design ideation and team communication in distributed bi-national teams.

According to the retrospective analysis, it could draw the following conclusions. Indeed, all cultural dimensions were found as hindering factors in the first design project phase. All findings were in line with the conclusion. For example, power distance and uncertainty avoidance were found as hindering factor due to their impact on communication style. In addition, it was found in most cases that Dutch designers were very direct and explicit in communication, while Chinese designers were very indirect and implicit in communication. Dutch designers insisted to make a plan at the beginning of the process and tended to stick to it throughout the whole week, while the Chinese designers worked as the process went on and when changes occurred in the planning they tried to be clear and informative. In return, frustration and confliction were created in the teams and some teams had two different design ideation results in each design project instead of one jointly design ideation results. Especially in the case of individualism and collectivism, during the first design ideation, the Dutch design students took individually ideation, while the Chinese design students really tried to work collectively. As a result, many similar ideas were created by Chinese team members even across different teams. This result implied that collectivism was a barrier of the creative process that design ideation required. During the second design ideation, the teams had gained

good insight on the differences between individualism and collectivism and their impact on ideation. They first worked collectively to define the design goal and agree on design process. Secondly they went for individual ideation as it stimulated the creative process. After that they went back again to the collective process in order to reach consensus on the concept selection. In this way, the collaboration profited from the improved cultural insight on the bi-national design teams.

Based on these and many other results from the data analysis, it could conclude that the early culture study already provided a good conceptual foundation to describe and support collaboration in bi-national design teams. However, this study more precisely investigated the supporting and hindering factors in design ideation. The initial results indicated that collaborative design ideation was a dynamic process. If the participants were willing to learn from each other and open for the cultural differences, they could find out the optimal process eventually. Collaborative design ideation was about collaboration with jointly actions, not about cooperation with independent tasks. Globalization has led to many cases of outsourcing, which calls more for cooperation than collaboration. In the case of collaborative design ideation, the team really needs to work collaboratively but also be creative. How to support the international collaboration in design activities based on the understanding of cultural differences and the characteristics of design activities are of importance for future design research in international context.

Chapter 5 Teamwork Modes

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Chapter 5 Teamwork Modes

5.1 Introduction

5.1.1 Research objective

This chapter investigates the effect of different teamwork modes on the efficiency (team satisfaction) and effectiveness (design quality) of bi-national design teams. A case study was designed and conducted to investigate the effect of three different teamwork modes in distributed bi-national design teams. In the case study, panel feedback and reflection diary were used to measure design quality and team satisfaction. The aim of this chapter is to explore the effect of different teamwork modes (cooperation, collaboration, competition) on design teamwork (design quality, team satisfaction) in the context of distributed bi-national design teams. Therefore, the research question is: how different teamwork modes affect design teamwork in distributed bi-national design teams of Dutch and Chinese?

5.1.2 Teamwork modes

In this thesis, three different teamwork modes are investigated, which are competition mode, collaboration mode and cooperation mode. 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 on common tasks to solve joint problems and find solutions. As to the definition of cooperate, cooperation means work along with others on division of tasks to get mutual benefit. From the definition of compete, competition means work separately on same tasks to compare with each other (Hutter et al., 2011). It is also found cooperation is an older concept than collaboration. Cooperation is characterized by more informal or less formal relationship and understanding of compatible mission. It requires a flexible attitude without a commonly defined structure or effort, thus communication could be asynchronous and less frequent and information is shared partly. Collaboration is characterized by more durable and pervasive relationship and a full commitment to a common mission. It requires project plan and division of work is considered, thus communication should be synchronous and more frequent and information is shared further (Mattessich and Monsey, 1992).

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.

5.2 Research approach

5.2.1 Research model

At the stage of creative iteration (see Figure 5-1), this chapter was designed to explore the effect of different teamwork modes (cooperation, collaboration, competition) on design teamwork. Three teamwork modes were introduced to investigate the effect on design teamwork in distributed bi-national teams. Meanwhile, design quality and team satisfaction were defined to measure the design teamwork. Given cultural differences in distributed bi-national design teams from China and the Netherlands, the research focused on how different teamwork modes affect design teamwork. In the creation iteration, a revised design course was conducted by Dutch and Chinese students to investigate the effect of three different teamwork modes on design teamwork in distributed intercultural design teams.

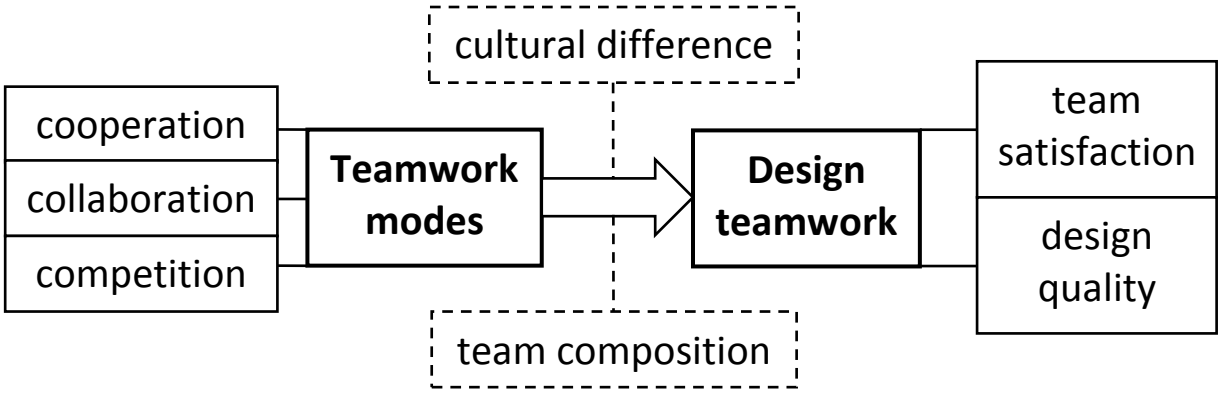

Figure 5-1. Research model (teamwork modes and design teamwork)

As the research design framework (as shown in Figure 5-1), the effect of different teamwork modes on design teamwork is considered as the main research object. In this research,

teamwork modes (cooperation, collaboration, competition) are introduced to investigate the effect on design teamwork in distributed bi-national teams. Meanwhile, design quality and team satisfaction are considered as the main elements to measure the design teamwork.

5.2.2 Research design

In the second creative iteration, a revised case study is conducted to investigate the effect 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 strength and weakness of design teamwork modes, it is useful to investigate the effect 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 with value survey model and team role questionnaire were used to ensure a balanced team composition with personal character and team position of the designers. Two cultural measurements were used for team composition. Value survey module was used to measure designers personal cultural character. Team role questionnaire was used to identify their suitable team positions. With the two cultural measurements, very different Dutch and Chinese were teamed up over distance.

Iterative design process was used to each team. Information distribution and interaction was different for distant communication. Different communication tools were used next to the predefined tools by the teams to support their communication. Co-creation was used to explore design opportunities and solutions to support their teamwork in distance. In addition, the design solutions were evaluated and reflected together with the panel.

The panel consists of the lecturers and the clients. The lecturers are researchers from Eindhoven University of Technology, with expertise in social cultural collaboration. The clients are designers from Philips research Asia Shanghai, working in multinational company.

5.3 Case study

5.3.1 Design course

CHAPTER 5

The design of intelligent systems, products and related services is currently a process that takes place, in most cases, in a network of partner companies scattered around the globe. This puts considerable strains on the people creating these systems. Communicating with people in different cultures requires an understanding of the cultural context of communication. In this course students actively work with colleague students at another university in a different culture at a long distance. The idea is to jointly create a system or product with meaningful results for the partner company. For this course the partner university is Zhejiang University in Hangzhou, China. Therefore this course is designed to, on the one hand, give students a real life experience of working in bi-national design teams; on the other hand, help getting better understanding on how collaborative design works in bi-national design teams.

The course was conducted in five continuous weeks. This course was jointly executed by both industrial design students from Eindhoven University of Technology in Eindhoven and Zhejiang University in Hangzhou. The challenge was to work with an international design team for Chinese market. During this week, they were asked to develop products for consumers. For this research, it was very important to make observations on how their different backgrounds influence design decision and communication within the team and how the requirements of consumers with different culture background differ. They were therefore asked to reflect continuously at the team level as well as at the individual level of their design process and to collect actively related user insights based on literatures and interviews to the users. This course consisted of an iterative design project following two design iterations. It was very important that they understood the different working and communication culture and behavior in their team due to a different national cultural background. The teams were encouraged to conduct consumer research by making use of the time differences. For the project the students used Skype as the primary communication equipment. Since the project involved teamwork at different time zones, the students at both locations (the Netherlands and China) had to be prepared to work at unusual hours to accommodate with the time differences.

The learning objectives of this course are to understand the role of communication between partners located in the different countries, cultures and time zone in a joint international design project. More specifically that are learn to collaborate with other cultures, learn to design for other cultures in global and local, learn to systematically reflect on design and design process; while the researchers collects data on how different teamwork modes affect design teamwork in distributed bi-national teams.

5.3.2 Course set up

In this chapter of creation iteration, the case study was defined to create three teamwork modes, that are competition, collaboration and cooperation. In this case study, the joint design education course with distributed intercultural teams was conducted to analyze the effect of different teamwork modes on design teamwork. Each team was assigned respectively with particular teamwork mode. The design course was designed to use three teamwork modes to investigate the influence on design teamwork. As shown in the course program in Table 5-1, the design course was taken in six weeks with two working days in each week. During the six weeks, there were six plenary sessions scheduled on every Wednesday afternoon, those were kick-off meeting on the first day, middle presentation after two weeks, final presentation on the last day, and other sessions were question hours. Different design teams worked in assigned teamwork modes during design process. They delivered weekly diary and iteration diary in person, and presented design result and delivered design report in teams. The teachers and clients gave feedback on design result in presentation sessions and made discussion on teamwork in question hours.

Table 5-1. Course program (six weeks with two design iterations)

working time	design program	team activity	deliverable
session 1 - week 1 / iteration 1	kick-off meeting	team composition, smooth team communication	weekly diary
session 2 - week 2 / iteration 1	question hours, first iteration reflection	concept ideation, target group, ideas,	iteration diary, weekly diary
session 3 - week 3 / iteration 1	middle presentation on first iteration	choose concept	weekly diary
session 4 - week 4 / iteration 2	question hours, second iteration	further design, further ideation	weekly diary
session 5 - week 5 / iteration 2	question hours, second iteration reflection	concept finalization, selecting concept, building prototype	iteration diary, weekly diary
session 6 - week 6 / iteration 2	final presentation on second iteration	design result	design report, weekly diary

5.3.3 Course description and process

In the design course (as shown in Figure 5-2), there were 15 Dutch students and 15 Chinese students. All of the 30 design students were divided into 6 teams, and each team had both Dutch and Chinese students. That means three teams comprised 2 Dutch students and 3 Chinese students, while other three teams comprised 2 Chinese students and 3 Dutch students. 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. The joint design course was a considerable complex course for design students. It required not only to work together with distributed bi-national design teams, but also to design for the target group in different cultural context. In addition to cultural differences, three teamwork modes (cooperation, collaboration, competition) were introduced to guide the distributed bi-national teamwork and allocated to all the teams. 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.

Figure 5-2. Design course in bi-national teams (the second design course)

This design course took six weeks, including two iterations. At the beginning of design course, all the designers were divided into teams, and each team contained both Dutch and Chinese designers. The first week was for kick-off and preparing for teamwork. Each design team was designated a teamwork mode. Afterwards, they chose a specific target group and considered the problems and design opportunities for the target group. They started the first iteration in the second week. Each design team worked in their own teamwork mode, and created the initial solutions of problems. They created several possible ideas and solutions.

The mid-term presentation was given in the third week. All the design teams presented their design concepts, and got feedback and suggestions from each other. The second iteration was conducted in the fourth week and fifth week. Each team still worked in their own teamwork mode. They improved their design concept and design details in the fourth week. In the fifth week, they made usability evaluation of final design for target market. They made final decision and reached an agreement on design solution. In the last week, all the teams wrote design report and made prototype, and then presented their final design concepts. In the end, the evaluation was taken place, including comments from lecturers and feedback from the panel.

5.3.4 Teamwork modes in program

In the joint design course, Dutch and Chinese design students were divided into three team categories to reflect three different teamwork modes in bi-national design team (as shown in Table 5-2).

Table 5-2. Teamwork modes in program

competition	Chinese members	Dutch members
step 1	data collection (user & market)	data collection (user & market)
step 2	data analysis (product opportunity)	data analysis (product opportunity)
step 3	conceptual design (idea generation)	conceptual design (idea generation)
step 4	design selection(present & discuss)	
step 5	final design (presentation) & prototype	
step 6	evaluation (client & designer)	

With the competition mode in a joint team, either Chinese or Dutch design students collected data separately, and then design students from each nation made an idea generation independently. Next, they presented and discussed to choose the better idea or to mix them into a final design idea, and improved it together as the final solution.

collaboration	Chinese members	Dutch members
step 1	data collection (user & market)	
step 2	data analysis (product opportunity)	
step 3	conceptual design (design ideation)	

step 4	detail design (feedback & development)
step 5	final design (presentation) & prototype
step 6	evaluation (client & designer)

With the collaboration mode in a joint team, both Chinese and Dutch design students collected data in a collaborative way, and then made a collaborative ideation for target market. After discussion, they improved the design solution and chosen the final case.

cooperation	Chinese members	Dutch members
step 1	data collection (user & market)	
step 2		data analysis (product opportunity)
step 3		conceptual design (design ideation)
step 4	feedback (suggestion)	
step 5	Prototype	final design (presentation)
step 6	evaluation (client & designer)	

With the cooperation mode in a joint team, Chinese design students collected information from target market, and Dutch design students further focused on the design ideation. Afterwards, Chinese design students gave feedback and suggestions to these preliminary design ideas. Finally, Dutch design students made improvement and final decision, and Chinese design students work out the prototype.

5.3.5 Design case

The design case is to design a display to facilitate the after-stroke recovery period and motivate elderly recovering from a stroke to move. The design case “how to move people to move” aims to motivate stroke patients to exercise more often and to support their after-stroke recovery at home. This design case was collaboration with Philips, after reading the background information from Philips, the students understood that the after-stroke recovery period is a difficult but crucial time for patients to recover. As stated, the point for home rehabilitation is to help patients understand the rehabilitation exercises, to monitor whether they have done it right and to encourage them to continue in spite of lack of obvious progress in short period of time. The goal is to design an interactive display that motivates Chinese stroke patients to exercise more and to recover better from a stroke at home. The specific

requirements are as follows. The display must be specifically designed for the home-period after the first three months of recovery. The display can be a tablet personal computer available through the university, but can also be other existing device or system of feedback for patients, e.g. mobile phone, television, etc. The display must have a feedback system that persuades the users to stay active. The end result can be a movie, a storyboard or model that shows the design solution and that enables the users in their task. The design must make use of the background info from Philips regarding exercises and medical knowledge.

5.4 Data collection and analysis

In the case study of creative iteration, according to the case objective for teamwork modes, research data were collected from reflection diary for team satisfaction and panel feedback for design quality. Then based on the related literature about teamwork modes, the data from reflection diary were analysed with the categories: activities, teamwork, culture, communication. As the process of data analysis, diary data were collected by design students individually, and then the key points are gathered from the text, and grouped into these categories, so as to find the analysis results to improve team satisfaction for team process.

5.4.1 Data collection

In the case study, data were collected during the design process, which contain panel feedback and reflection diary. The feedback was given by the clients as well as the lecturers during the two iterations, which was used to measure design quality. The reflection diary was written by the students, which was used to measure team satisfaction. Every week, the design students wrote diary to document and reflect on their teamwork. They also wrote diary to reflect on their design.

The reflection diary was written from various aspects, e.g. activities, teamwork, culture, communication. The data about activities referred to team activities, including purpose and process of the activities, outcomes and problems in the activities. The data about teamwork referred to how to work with team members, including supporting factors and hindering factors in teamwork. The data about culture referred to cultural differences and how to deal with them. The data about communication referred to how to communicate in team and how teamwork modes affect communication. Reflection was also made on panel feedback. The

related data referred to the team reflection on the feedback on design concept and user research of each team.

5.4.2 Data analysis

Based on the data from case study, the grounded theory method was used for data analysis of each team. Grounded theory method is a research methodology in social sciences, which operates in a reverse way to find the results and conclusions. After the case study data was collected from the panel feedback and the reflection diary, all the data were aggregated for each individual team. From the original text of feedback and diary, the key points were marked and gathered with codes separately. Then the codes were grouped into relevant concepts with similar content. According to these concepts, categories were formed from similar concepts. Based on these categories, the results could be found and would draw the conclusions. In this way, design quality and team satisfaction reflected data could be identified and analyzed. In the next sub-section, panel feedback data and reflection diary data are described.

5.5 Case data

5.5.1 Panel feedback data

As mentioned earlier, the teaching panel includes the researchers from TU/e and the clients from Philips. They provided their feedback at the two iterations on different design activities and related results. In general, they found that the students followed the pre-assigned design process with clear user demands in mind before generating concepts and linked with a lot of culture aspects with demands. Personas need be anonymous and personal information should not appear on the material. User test and feedback on generated concept is missing in most of teams. It is necessary to seek information from medical side, as a healthcare project not only consumer type concept. The underlying reason for delivering successful post-stroke rehabilitation is explored and different motivations including society and family association are proposed. More ideas could be generated with comparison and analysis between each other. It seems that the propositions did not separate short-term instant feedback and long-term motivation factors.

In the first iteration, specifically for team 1, the panel thought that the exploration process was intact, but the concept description was difficult to understand. Some ideas were delivered

from brainstorm, but the conclusion was not clear. More evidences to backup statement were needed. For team 2, the panel found that the concept exploration was good with user profile, and the key points were quite good as well. The interaction model made sense, but needed to be more specific. For team 3, the panel considered that the user demands were abstracted quite well and it was useful to generate ideas. But the ideas could be considered deeper and the concept could be clearer on user interaction. For team 4, the panel liked the clear and promising ideas, but more detailed concept was expected. For team 5, the panel found that the indication of task ownership was interesting and good for teamwork. The conclusion was valid with user profile and analysis. Some ideas were generated based on cultural differences. The concept was specific and feasible, but more thoughts could be given to the design of interaction and motivation. For team 6, the panel considered the concept as most detailed concept with clear user interaction and motivation. Besides this, it could also be done to teach and educate the user how to use it. The panel suggested the team to consider the difference between this concept and existing device.

In the second iteration, for team 1, their teamwork mode was cooperative. Based on their teamwork mode, they needed to divide the tasks accordingly. However, they soon realized that simply throwing the work across the ocean would not lead to the successful results. They did at the beginning make good appointment about how to work together; took much initiative to contact the team members and motivated them to stay contact and work together. Especially their remark during the first iteration presentation about how to motivate the other team members to work with them in the project is very useful for all other teams. Overall they were very motivated and open to the cultural differences, they worked hard with the team members during the course weeks, and they were able to deliver a potentially fruitful concept. For team 2, their teamwork mode was collaborative. They realised that they needed to work extensively with the partners despite the language difference, design skill difference and time difference. They showed their strong sympathy for the cultural differences, they put themselves in the shoes of the partners and understood how hard they need to work in order to be able to work with them in this project. They tolerated the time difference, took a lot of initiatives to contact them, also outside the course time. They considered that the nicest teamwork experience was the positive remarks from the partners with respect to their positive attitude. They commented that because of their driven attitude and energy showed in this course, they were motivated to work along with the speed and direction despite much time inconvenience for their side. They also found out one online tool that helps to understand each other’s design better. Overall they got the essence of teamwork in different cultural context.

For team 3, their teamwork mode was competitive. Based on their teamwork mode, they needed to compete with each other in this project. However, sooner they realized that pure competition would not make the teamwork effectively. They adjusted their process and started to collaborate with each other afterwards. In the last part, based on the insight on each other's capability, they made the final results with the cooperative mode. Their team appeared to be very active and motivated during the project. Overall they got the essence of teamwork in different cultural context. For team 4, their teamwork mode was cooperative. They realised that they needed to agree on design process and activities and separate each other's tasks. They were indeed aware of the cultural differences in communication, such as the explicit and implicit communication used often by Dutch and Chinese people. However it was still not yet clear to them how to deal with this situation. Therefore they addressed some awareness issues. When they were not satisfied with the work done by the other people, they should tell them directly or keep silent, the optimal way to get the message across without offending the other party despite all the difficulties to communicate in distance and in different cultures. These uncertainties kind of hindered their initial process. After the question hours, with the suggestions given to them, they were more open to share their thoughts in a positive way. Also by exploring different communication media, the quality of the communication got improved. The second phase of the course went much smoother. Both Chinese and Dutch students showed considerable efforts and motivation to work with other teams. The efforts also paid back in results. Overall they learned the lesson by really experiencing and doing it themselves. For team 5, their teamwork mode was collaborative. Based on their teamwork mode, they needed to discuss all issues in a collective way. They did not realize till their first presentation that the collaboration within the Dutch team was not going on well. They were not able to have collective discussion within the Dutch team members. Mismatch in activity planning and priorities setting and motivation caused unnecessary delay. They were invited to have a separate discussion and discussed openly what could cause this delay and how they planned to overcome it. It could be mentioned that one of their challenges could be to improve their reflection on their design process. The second phase of the course went much smoother. Their motivation directly stimulated Chinese student participation. Their learning made them realized that collaboration needs to start from themselves first and the key was to motivate. Overall with this lesson and the experience they got the essence of collaboration, also in the Dutch-Chinese context.

5.5.2 Team reflection data

This sub-section will describe the reflection diary made by each team. Team 1 was working in cooperative design mode. In the beginning, they made friendship with each other and exchanged personal information. For the design project, they divided tasks in cooperative way. Chinese students made a user interview and Dutch students conducted literature review. After that, they conducted a brainstorm session to create some ideas. For the teamwork, they mentioned that they suffered from communication issues as results of time difference, technology incapability and cultural difference, such as shyness of Chinese of not speaking directly and bad internet connection. Then they made appointments early and planned the deadline to facilitate the communication. During the later stages of the process they were able to work better with their team members: as they knew each other for longer time, the teamwork improved. In general, the course provided them the bases to be able to work with other cultures better. During the design process, they made user research on the elderly and got inspiration from brain challenge game. They combined two concepts and designed a device to motivate the patients to do exercises and get feedback for recovery. The final game looked good; it had mental stimulation and a fun factor. In the end, they presented their design process step by step, from data collection, idea generation to design concept and final solution. Thus, the design process was sufficiently designed. Two Dutch teammates took charge of final presentation. For the design concept, they made a scenario and prototype with the traditional Chinese background. They made various drawings that explained the design concept. However, the drawings could have been a bit more professional, although they looked very clear and precise. In conclusion, although they had some trouble in the beginning, they did well for cooperation design. They made use of time difference to optimize the work completed in one day. They were aware of cultural differences, and they were able to learn from each other. In addition they were able to make a realistic game design. The client made some remark, especially aspects such as why this game was chosen, how it can be guaranteed that a game will be helpful in long recovery process. The team realized that this should be covered to finalize the concept into a successful commercial application.

Team 2 was working in collaborative design mode. In the beginning, they got to know each other via Skype meeting. For the design project, they did research on stroke and after-stroke recovery for the elderly, and made nice user profile. Besides Skype meeting in video and audio communication, they made a brainstorm in written and visual communication for idea generation. Despite of the absence of one Chinese teammate, they discussed details and made decisions together. It took them a lot of time to combine the research conducted and they made decisions collaboratively together. They commented that they had also communication

issues, as other teams did, such as hard to explain and difficult to understand each other, and low sound quality of the microphone. They enjoyed the fact that one Dutch teammate with Chinese background took the role of a mediator, not only for language translation, but also to bridge the cultural difference. During the design process, they came up with an initial design concept based on user research and design opportunity. They designed an interface in 2D and 3D versions and conducted user test to simplify the structure and beautify the background. For the teamwork, it required more communication and more time to work together. Due to the limitation of meeting time, they had to work in cooperative way sometimes to make it more efficient. When some uncertain change led to negative influence, they kept the information updated with extra communication. The quality of the end design solution looked convincing: they designed a nice product with many details and professionally looking graphics. Their starting point for the solution space, the biggest problem for the elderly was impressive, sounded like a very convincing strategy. The information of their research was very well integrated in their design. They really used both parts of the team to refine their design solution in user tests. The initial concept development process could have been a bit more explored. In the scenario they presented, it seemed that not all the parts of the user scenario were covered in their analysis. Because of that, their solution appeared based on the first good idea that came up: improvement iterations seemed to be lacking. For this reason they were advised to explore concepts a bit more next time, before they made the final synthesis. Their end presentation looked very structured and clear. In the end, they designed a platform with a reward system to strengthen the bond in the family and stay connected with society. With the demo video, users could understand how to do exercises to unlock the rewards of information of personal interests, which was quite good for rehabilitation. As raised by the client, the challenge remained to which types of feedback they explored in this platform. Using only text feedback on the screen might not work for stroke patients as they might be easily distracted or have trouble to read after the stroke. They might want to explore more different ways of interacting with the user using video or haptic feedback.

Team 3 was working in competitive design mode. In the beginning, they read through information documents and had a Skype meeting to get to know each other. The Dutch teammates took the initiative to contact the Chinese teammates. In parallel the Chinese teammates made an interview of stroke patients and abstracted user demands quite well. They chose the target group according to user research and interview results. Then they generated several ideas based on consumer insights. In the second iteration their ideas were joined together. In their presentation and reflection they evaluated the competition mode as well as

the design project. During the project one Dutch teammate went abroad and could not attend the meeting, and because of this the whole team lost their balance for competition. Therefore, they decided to combine open collaboration with competition as their teamwork method. During the design process, they spent more time in facilitating communication than working on design project. Due to the time difference, the Chinese team had to meet in the evening, while it was morning or afternoon for Dutch team. They were glad to talk about anything, even irrelevant to this project; as a result, the relaxing working atmosphere made them comfortable. The Chinese teammates had a decent level of English, which was good for smooth communication. Considering the competition mode, they did not share too much information, which led to lack of information and negative communication. As they had to choose or combine design concepts into one final solution, they kept basic contact with positive response. Their design solutions looked smart. After the first iteration, the target group and starting point were clear. They looked into what kind of movement was necessary, and took games that corresponded with those movements. The idea of using existing games to join the elderly and children made sense because of that aspect. They also made proper use of the existing products, as stated in the design brief. The presentation and the movie were very funny and overall clear. It was very nice to see that the Chinese teammates were presenting and doing a good job. It seemed that there was a balance in that. In the end, they made games to motivate the patients to move their bodies and played with family members, which helped the patients to insist on doing physical therapy with proper guidance and good feedback. The client liked that they explored the use of social interaction with family members for the stroke patients. They thought social support would work in this case.

Team 4 was working in cooperative design mode. During the first course meeting they got to know each other by names and roles. Then they made mind maps and preliminary brainstorm for the design project. They also made a plan for the design process and appointments for tasks and deadline. For the teamwork, they used Skype meeting, talked via Skype, and sent emails to each other. However, they suffered from communication problems. They failed to make contact sometimes and didn’t get reaction from each other. As a result of language issue, sometimes they only got the general ideas, but didn’t understand each other in details. Due to cultural difference, they had different meaning of confirming by saying yes, which led to misunderstanding sometimes. To solve communication problem, they tried their best to make smooth conversation and confirmed by email with meeting summary. Besides this, they had funny conversations with jokes and laughter. During the design process, the whole team discussed the research results and explored the possible design directions. Chinese teammates

made research and explanation, which provided more in-depth knowledge about the user. They made a sound market analysis which improved the overall quality of the design concept. Dutch teammates analysed the research data from Chinese teammates. The final design was based on a discussion, where the Chinese teammates convinced the Dutch teammates to use the family as the main motivational tool for the elderly. In the end, they presented their final design with a story, interaction and movement example. They also made a demonstration to show the interface of their design. They showed insightful drawings of the different movements, but the drawings of their scenario could have been more professional; the black and white drawings looked as if they were put together at the last moment. In conclusion, the language issue and cultural difference influenced their cooperation and communication and also design quality, but they were aware of these and made the effort to improve and got the final design. They made a big step in overcoming the social barriers.

Team 5 was working in collaborative design mode. In the beginning, every teammate gave an introduction and tried to get a good relationship with each other. For the design project, they made a plan and agreed on how to process the design project and divided tasks so as to improve efficiency. Time difference played a hindering role, which required them to work at unusual time like early in the morning or late in the evening. During the design process, they had to work together via Skype accordingly to accomplish teamwork, such as a brainstorm and presentations, but time was still a scarce resource and they had difficulties in doing everything together. Therefore it was important to have efficient and effective communication. However, they suffered from some communication issues. The Dutch teammates replied email a little bit late, and the Chinese teammates were a bit reserved and shy during Skype meetings. Gradually, they had one Dutch and one Chinese spokesman, who told and explained everything to the other side. Besides the cultural difference, the Dutch teammates also had trouble working with their own Dutch side, which was unexpected. In general, the project team could make more effective use of cultural relativity and probing techniques. For example, time was spent to achieve a positive team climate. For the design concept, they made research on Chinese values and hobbies, and considered existing methods. They went back to the theories behind motivation, as one of the only teams. They found that rewarding was better than punishment to motivate the patient. The Dutch teammates thought simplicity was more important than a lot of functions, while the Chinese teammates considered as much functions as possible. With these cultural differences, some intriguing ideas were generated, such as virtual social rankings and doing common games. Though the calendar system was impressive and useful for the patients and it was specific and technically

feasible, the client challenged them to explore the use of calendar and focused on how they could design such a calendar that did the motivation trick to the patients as a normal calendar with a textual reminding might not work for these stroke patients. The design could have been worked out a bit more. In the end, they combined the interface between Dutch design and Chinese design, which was simpler for Chinese elderly and kept most of functions logically. They came up with some convincing ideas that blended into one design. The Dutch teammates took charge of the final presentation. The report showed that they had learned a lot, both in culture and in communication.

Team 6 was working in competitive design mode. In the beginning, they established communication and were interested to know each other. For the design project, they read the documents to understand the project and collected data separately. They collected data by questionnaire survey and interviews. For the teamwork, they worked in competitive design mode, but they suffered from some communication difficulties caused by language barriers and technological problems. This enhanced their cultural awareness. During the design process, they analysed the data and made a brainstorm to get concepts. Due to time differences and distance, sometimes they didn't get response back timely after sending an email. Both Dutch and Chinese teammates were used to working in the daytime and sending emails in the evening, which led to missing information sometimes. As to communication, they were aware that it was necessary to make their opinions clear and avoid misunderstanding. Therefore they moved competition to collaboration so as to merge ideas into final concept ultimately. For that reason, they were able to reflect on their own process and improve it based on their reflection. In the end, they presented the final concept, which allowed patients to do with gestures, collaboration and competition in interaction. For design concept, they presented the most detailed concept with a specific way to interact with the user and motivate them over a longer time span. They should consider that how to teach the patients to do the exercise correctly, and what was the difference between the medical device for rehabilitation and a game box. In the first presentation, it was not always clear if they had the backup information for the design decisions they made. In the report they showed that they did quite some research, so it was improved compared with earlier presentation. They had a good impression of Chinese society and the problems of the elderly with a stroke. In the end, their product looked very convincing, realistic and well thought because of the different scenarios they tried out. Overall, they became aware of dynamics of designing for other cultures. The client liked their final concept and thought it was very Chinese and very Dutch. Especially the interaction they had designed caught their attention.

5.6 Analysis results

According to the reflection diaries, the data were grouped into categories: activities, teamwork, communication, cultural differences. According to the panel feedback, the data were grouped into categories: design concept, user research, presentation, report.

Team 1 and Team 4 were working in cooperative design mode. During the first iteration, their design concept was difficult to understand and more evidences were needed to backup statement. During the second iteration, they combined two concepts and designed a device, and also made scenario and prototype for design concept. Team 2 and Team 5 were working in collaborative design mode. During the first iteration, their design concept was good with user profile. During the second iteration, they designed interface and made user test, and then designed a platform with the demo video. Team 3 and Team 6 were working in competitive design mode. During the first iteration, they made an interview and abstracted user demands. Their design concept could be deeper and clearer. During the second iteration, they made games to motivate and help the users with proper guidance and good feedback.

5.6.1 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 (as shown in Table 5-3), including design quality and team satisfaction. Based on team reflection data, the following results are stated with the original data.

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.

"For the design project, they divided tasks in cooperative way. Chinese students made user interview and Dutch students conducted literature review. (Team 1)" "For the teamwork, they suffered from communication issues as results of time difference, technology incapability and cultural difference. (Team 1)" "They made appointments early and planned the deadline to facilitate the communication. (Team 1)" "As they knew each other for longer time, they were able to work better with their team members, the teamwork improved. (Team 1)" "The design process was sufficiently designed, from data collection, idea generation to design concept and

final solution. (Team 1)" "For the cooperation design, they made use of time difference to optimize the work completed in one day. (Team 1)" "For the design project, they made a plan for the design process and appointments for tasks division and deadline. (Team 4)" "As a result of language issue, sometimes they only got the general ideas, but didn't understand each other in details. (Team 4)" "Due to cultural difference, they had different meaning of confirming by saying yes, which led to misunderstanding sometimes. (Team 4)" "To solve communication problem, they tried their best to make smooth conversation and confirmed by email with meeting summary. (Team 4)" "During the design process, Chinese teammates made user research and explanation, Dutch teammates analysed the research data from Chinese teammates. (Team 4)" "The language issue and cultural difference influenced their cooperation and communication, but they were aware of these and made the effort to improve it. (Team 4)"

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.

"Besides online meeting in video and audio communication, they made a brainstorm in written and visual communication for idea generation. (Team 2)" "For the teamwork, it took them a lot of time to discuss details and make decisions collaboratively together. (Team 2)" "They also had communication issues, such as hard to explain and difficult to understand each other, and low sound quality. (Team 2)" "For the teamwork, it required more communication and more time to work together. (Team 2)" "Due to the limitation of meeting time, they had to work in cooperative way sometimes to make it more efficient. (Team 2)" "The information of their research was well integrated in their design, and the quality of the end design solution looked convincing. (Team 2)" "In the beginning, every teammate gave an introduction and tried to get good relationship with each other. (Team 5)" "Time difference played a hindering role, which required them to work at unusual time, like early morning or late evening. (Team 5)" "During the design process, they had to work together via Internet to accomplish teamwork, but time was scarce resources that they had difficulties to do everything together. (Team 5)" "Gradually, they had one Dutch and one Chinese spokesman, who told and explained everything to the other side. (Team 5)" "The project team could make more effective use of cultural relativity and probing techniques, and spent more time to

achieve positive team climate. (Team 5)" "For the design concept, they came up with some convincing ideas that blended into one design. (Team 5)"

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 parallel they generated several ideas based on consumer insights, and then their ideas were joined together in the second iteration. (Team 3)" "In their presentation and reflection, they evaluated the competition mode as well as the design project. (Team 3)" "Because the whole team lost their balance for competition, they decided to combine open collaboration with competition as their teamwork method. (Team 3)" "During the design process, they spent more time in facilitating communication than working on design project. (Team 3)" "They were glad to talk about anything, as a result, the relaxing working atmosphere made them comfortable. (Team 3)" "For the competition mode, they did not share too much information, which led to lack of information and negative communication. (Team 3)" "As they had to choose or combine design concepts into one final solution, they kept basic contact with positive response. (Team 3)" "For the design project, they read the documents to understand the project and collected data separately by questionnaire survey and interviews. (Team 6)" "For the teamwork, they worked in competition mode, but suffered from communication difficulties caused by language barriers and technological problems. (Team 6)" "During the design process, they moved competition to collaboration so as to merge ideas into final concept ultimately. (Team 6)" "They were able to reflect on their own process and improve it based on their reflection. (Team 6)" "In the end, their product looked very convincing, realistic and well thought because of the different solutions they tried out. (Team 6)"

Table 5-3. The effect of different teamwork modes on design teamwork

teamwork modes	Attribute	design quality	team satisfaction
cooperative mode	divide the work, work continuously and efficiently	take advantage of skills	explanation and understanding
collaborative mode	work together, share information and	acceptable design solution by both	team communication

	discuss ideas	teams	
competitive mode	work in parallel, work separately	different solutions for same task	know each other better

5.6.2 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 and weakness. Compared with different teamwork modes, the research investigates the strength and weakness of them (as shown in Table 5-4), 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.

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.

"Based on their teamwork mode, they needed to divide the tasks accordingly. (Team 1)" "They soon realized that simply throwing the work across the ocean would not lead to the successful results. (Team 1)" "They made good appointment about how to work together, took much initiative to contact the team members and motivated them to stay contact and work together. (Team 1)" "They needed to agree on design process and activities, and separate each other's tasks. (Team 4)" "When they were not satisfied with the work done by the other people, they should tell them directly or keep silent, (Team 4)" "the optimal way to get the message across without offending the other party, despite all the difficulties to communicate in distance and in different cultures. (Team 4)"

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.

"They needed to work extensively with the partners, despite the language difference, design skill difference and time difference. (Team 2)" "They tolerated the time difference, took a lot of initiatives to contact them, also outside the course time. (Team 2)" "They were motivated to work along with the speed and direction, despite much time inconvenience for their side. (Team 2)" "Based on their teamwork mode, they needed to discuss all issues in a collective way. (Team 5)" "Mismatch in activity planning and priorities setting and motivation caused

unnecessary delay. (Team 5)" "Their learning made them realized that collaboration needs to start from themselves first and the key was to motivate. (Team 5)"

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.

"Based on their teamwork mode, they needed to compete with each other in this project. (Team 3)" "Sooner they realized that pure competition would not make the teamwork effectively. (Team 3)" "They adjusted their process and started to collaborate with each other afterwards. (Team 3)" "Based on the insight on each other's capability, they made the final results with the cooperative mode. (Team 3)"

Table 5-4. The strength and weakness of different teamwork modes

teamwork modes	strength	Weakness
cooperative mode	work continuously, clear tasks	wait for the other
collaborative mode	timely feedback, adjust design direction	require much time to work together
competitive mode	independent idea generation, outstanding design solution	repetitive work, difficulty of choosing or combining

5.7 Conclusions

This chapter has explored the effect of different teamwork modes on design teamwork in distributed bi-national design teams. In order to support cross cultural design teamwork, this study uses design course with Dutch and Chinese students as case to investigate how different teamwork modes affect design teamwork. This study has investigated the effectiveness and efficiency of three teamwork modes, and the strength and weakness of them are measured by design quality and team satisfaction.

As shown in results, three different teamwork modes have different attribute and different reflection on design quality and team satisfaction. In different teamwork modes, work requirement and team communication are also different accordingly. Therefore, it is worthy that team members take advantage of the strength of teamwork modes and get away of the weakness of them for different design cases.

CHAPTER 5

The findings of this study have important implications for practice. The implication of these findings is to support designers to improve design teamwork in distributed bi-national design teams. 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. This research is a step towards design guidelines of future distributed teamwork to support designers to improve design teamwork in distributed bi-national teams.

Chapter 6 Design Teamwork

6.1 Introduction

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Chapter 6 Design Teamwork

6.1 Introduction

6.1.1 Research objective

This chapter derives strategies for better design teamwork of design quality and team satisfaction in distributed bi-national design teams. Based on earlier insights of different teamwork modes in distributed bi-national teams, a case study was designed to explore the use of free combination of different teamwork modes. In the case study, different combination of teamwork modes were analyzed to investigate the dynamics of design teamwork. The aim of this chapter is to investigate the influence of different combination of teamwork modes (competition, collaboration, cooperation) on design teamwork (design quality, team satisfaction) in the context of international design teams. Therefore, the research question is: how to combine different teamwork modes for design teamwork in distributed intercultural teams of Dutch and Chinese?

6.1.2 Project uncertainty and 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 project 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). Team activities are supported by distributed communication based on internet. 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.

Base on earlier insights of previous chapter, two additional factors are identified: project uncertainty and team uncertainty. Project uncertainty is to what extent the team understands the design challenge and to what extent the knowledge of the design brief known to the design team members. Team uncertainty is to what extent the team knows each other's strength and to what extent the design competency of the design team members from different cultures. In order to find applicable teamwork approach for different situations, this research compares the advantage and disadvantage of them.

6.2 Methodology and approach

6.2.1 Research model

At the stage of reflective iteration (Figure 6-1), this chapter investigated how to combine different teamwork modes to support designers to improve design teamwork. This chapter was designed to explore and identify the influence of different combination of teamwork modes on design teamwork, so as to support designers to improve design quality and team satisfaction. Comparing with different teamwork modes, the research investigated the strength and weakness of them, so as to find suitable teamwork modes for different situations in design process. In the reflection iteration, an updated design course was conducted by Dutch and Chinese students to investigate different combination of teamwork modes on team satisfaction and design quality in distributed intercultural design teams.

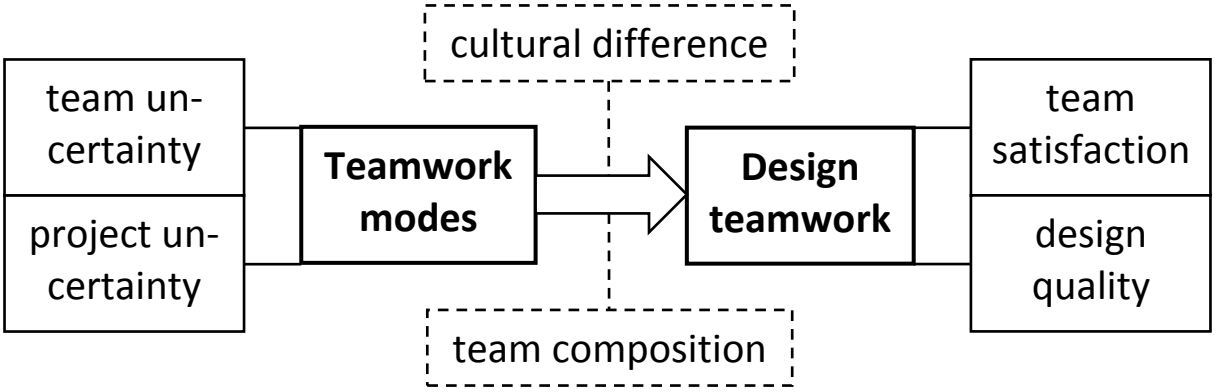

Figure 6-1. Research model (teamwork modes and design teamwork)

As the research design framework (Figure 6-1), 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, different combination of teamwork modes are introduced to investigate the influence on design teamwork in international teams. Given cultural differences in international design team from China and Netherlands, the research focuses on how different combination of 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.

6.2.2 Research design

In the third reflective iteration, an updated design course is conducted to reflect on different combination of teamwork modes in distributed intercultural design teams. In this revised case study, different combination of teamwork modes are studied to reflect the influence on design teamwork of team satisfaction and design quality. Design students from China and Netherlands work with different combination of teamwork modes during design process to study the effectiveness and efficiency of distributed intercultural design teamwork. During the joint design process, Chinese and Dutch students make weekly diaries to record their design activities for team satisfaction and design quality.

In the preparation phase, cultural measurements with value survey and team role were used to ensure a balanced team cultural composition and team position of the designers. They were

free to choose the teamwork modes or even combine them given the insights of the effects of different teamwork modes on design quality and team satisfaction. The results will provide useful input to formulate teamwork strategy for distributed bi-national teams.

6.3 Case study

6.3.1 Design course

In this research project, a joint design course is conducted to investigate the influence of different combination of teamwork modes in bi-national design teams. A case study approach is chosen to study in depth the design teamwork 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 combination of 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 value survey is used to measure personal cultural character. Team role questionnaire is used to identify their suitable team position. In the process of design course, self-reflection diary is 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 teamwork is evaluated by measuring team satisfaction and design quality. All the designers make self-reflection diary for team satisfaction and use panel meeting feedback for design quality.

6.3.2 Course set up

In this chapter of reflection iteration, the case study was designed to reflect the influence of different combination of teamwork modes on team satisfaction and design quality, given earlier insights obtained. In this case study, the joint design education course with distributed

intercultural teams was conducted to analyze the influence of combined teamwork modes on design teamwork. Each team was free to choose teamwork modes, based on earlier obtained insights. The design course was designed to reflect different combination of teamwork modes for design teamwork. As shown in the course program in Table 6-1, the design course was taken in five weeks with two working days in each week. During the five weeks, there were five plenary sessions scheduled on every Wednesday afternoon, those were kick-off meeting on the first day, middle presentation after two weeks, final presentation on the last day, and other sessions were question hours. Different design teams worked in free teamwork modes during design process. They delivered weekly diary and iteration diary in person, and presented design result and delivered design report in teams. The teachers gave feedback on design result in presentation sessions and made discussion on teamwork in question hours.

Table 6-1. Course program (five weeks with two design iterations)

working time	design program	team activity	deliverable
session 1 - week 1 / iteration 1	kick-off meeting	team composition, smooth team communication,	weekly diary
session 2 - week 2 / iteration 1	question hours, first iteration	concept ideation, target group, idea generation,	iteration diary, weekly diary
session 3 - week 3 / iteration 1	middle presentation on first iteration	choose concept, further ideation, selecting concept,	weekly diary
session 4 - week 4 / iteration 2	question hours, second iteration	concept finalization, writing report, building prototype,	iteration diary, weekly diary
session 5 - week 1 / iteration 2	final presentation on second iteration	design result	design report, weekly diary

6.3.3 Course description

In the design course (Figure 6-2), 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. 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.

Figure 6-2. Design course in bi-national teams (the third design course)

This design course took five weeks, including two iterations. At the beginning of design course, all the designers were divided into teams, and each team contained both Dutch and Chinese designers. The first week was for kick-off and preparing for teamwork, the assignors gave presentations about theory, design challenge and design process. Each design team was free to choose to work with a specific or a combination of teamwork modes based on earlier insights. Afterwards, they chose a specific target group and considered the problems and product opportunities for the target group. In the second week they started the first iteration. Each design team worked in their own teamwork mode, and considered the solution of problems and design features and created possible ideas and original solutions. The third week was mid-term presentation. All the design teams presented their conceptual design, and got feedbacks and suggestions from each other. The second iteration was executed in the fourth week. Each team still worked in their own teamwork mode. They improved their design concept and design details, and made usability evaluation of final design for target market. In the last week, they made final decision and reached an agreement on design solution. They wrote design report and made prototype. In the end, all the teams presented their final design, and got evaluation from assignors.

6.3.4 Design brief

The design case is design for ageing, including active and healthy ageing and smart and social ageing. The elderly population has increased over the past decades. Often ageing is regarded as a large socio-economic threat because of costs for care pensions, etc. However, they challenge to engage this differently. Ageing requires innovative approaches presenting opportunities for new businesses and designs as well as concerted action by caregivers, families, and organisations at all levels. They want to develop solutions for elderly that are confronted with the ageing problem. By confronting them with a multicultural setting they expect a very diverse solution space. They provide two cases: active ageing and social ageing. As the description of active and healthy ageing, this challenge aims to stimulate elderly to participate both socially and physically in sports, communities, societies, in order to achieve an active lifestyle. The target group is Dutch or Chinese elderly, still healthy, age from 60 to 70 or 55 to 65. And the possible directions and solution concepts are: friends exercise with them, new meaning of life, maintaining existing contact, better job is earlier retirement, be aware of the status. As the description of smart and social ageing, this challenge aims to encourage elderly to engage each other in games, reading, discussions, etc. in order to stimulate smart and social aging lifestyle. The target group is Dutch or Chinese elderly, sometimes socially isolated and change of social network and friends, age from 70 to 85 or 65 to 75. And the possible directions and solution concepts are: family subtle regular contact intergenerational, how to overcome mental problems, in china elderly people dancing together, need to make new contacts, older when own family has died. The requirements and opportunities are: the display must have a feedback system that persuades the users to stay active, healthy, and social. So, their task will be to design a product that either enables elderly to stay healthy, or to stay socially involved. They will do this in two contexts: both in China and in the Netherlands, so in the end they will have two designs. The end result does not need to be a physical product, it can also be a service or system. They can explain their end ‘product’ in a movie, a storyboard or model that shows their design solution and shows that they enable the users in their task.

6.4 Data collection and analysis

In the case study of reflective iteration, according to the case objective for design teamwork, research data were collected from reflection diary for maintenance and panel feedback for achievement. Then based on the related literature about design teamwork, the data from panel feedback were analysed with the categories: design process, cultural awareness, teamwork

process. As the process of data analysis, feedback data were collected by assigners to each team, and then the key points are gathered from the text, and grouped into these categories, so as to find the analysis results to improve design quality for design results.

6.4.1 Data collection sources

This case study mainly investigates design maintenance and achievement to improve design teamwork (Figure 6-3). 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.

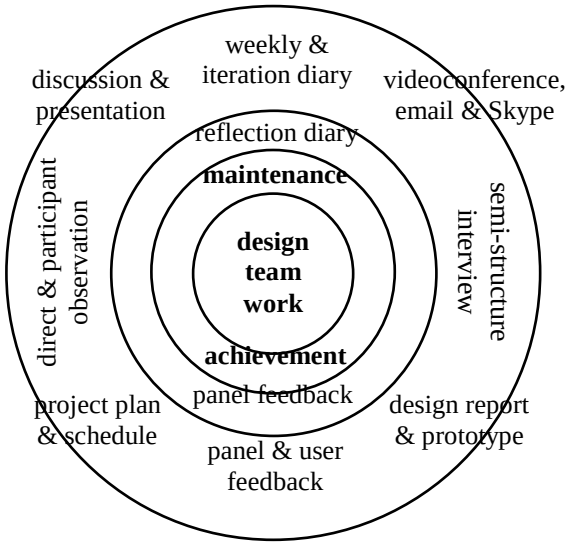

Figure 6-3. Data collection sources

6.4.2 Data analysis

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.

6.5 Case data

6.5.1 Panel feedback data

During this course they were challenged to work in a multi-cultural setting. Also they were given the opportunity to work with people that have different educational backgrounds. This became especially clear in the way they approached the assignment and the way they addressed problem. Whereas the students with design background tended to start framing and reframing the problems in terms of opportunities, others commonly started with defining requirements and finding solutions to these requirements. Sometimes this was counter-productive, but most of the time it was inspiring to see in many cases this difference could lead to new insights. Overall, they learned a lot from this teamwork.

For team 1, in general it was clear in their team that they made a good scenario and that they explored quite a lot. They started with a strong vision that was founded on the use of traditions. In terms of validation they expected a bit more user tests. Their analysis showed a strong background about societal challenges. Their design process was nicely structured. Overall they showed quite some awareness about their design process. It was very clear from their work that the Dutch team started from a concept focus, and the Chinese team from an available technology. The Chinese had a hand-on mentality of first try-out, while the Dutch first reaction was to start asking questions. How to overcome time differences was one of the biggest intercultural learning points. In the end, they did make a design for the other context. They used each other in a designer-client relationship. The final designs were refined, but there were still some doubts about the context validation. For the Dutch team, the small Chinese family means that the elderly need more friends, or it means that they want more contact with the family. This was not backed up with tests. The Chinese solution with the stability pen could have a bit more validation as well. A last step could have been some research with end users.

For team 2, it was clear that they made a good exploration of the solution space and the opportunities that were connected to that. Still some more confrontation with the user could be nice. Not only to inspire and adapt their design, but also to find new opportunities. In addition they made a quite strong analysis of the background of the design brief. Still, it was not very clear what the vision behind the concept was, what societal change do they portray. However, overall they showed a nice learning process and quite some awareness about their design process. There were a lot of communication and timing problems in their team, but they did manage to come up with two very specific designs, based on the same theme. The final design for Dutch elderly looked very technical with quite some features. It would also be the right design for non-technical elderly. And the Chinese design looked very non-technical. It would be nice if they could test their final design with their target group. The workshop

connected to the product looked smart. In the final presentation, it seems that not enough time was spent on the project due to difficulties in distance and timing the meetings. The background pictures looked very attractive, why not used them for the final.

For team 3, overall they were quite positive about their design process. Still, the structure was quite straightforward and sequential. A more iterative approach with early small user tests to get inspired would be nice. Still they saw lots of good points. Especially their vision behind the concept was well established. In terms of making they showed nice visuals of their final concept. Their final concept aimed to establish communication among people through a pen. Although it was based on other existing products, the form was quite good. The questionnaires they used worked: the tea mat had an interesting start because it was designed for a specific context. The pen took the context into consideration to some extent, Dutch elderly are usually able to write, and in the end they made the product simpler and thus more suitable for Dutch elderly, but both the designs could be a bit more refined. They did get the feeling that they were not able to communicate about their designs together on a deeper level, this was because of the trouble with Skype and the unbalanced set-up of their team.

For team 4, overall they showed a well structured design process. They iterated twice and made use of the advantages of the different backgrounds of the people in their team. They made a quite good analysis of the context of both products. Some more validation by confrontation with the user might be better. Due to time limits of this course this was of course more difficult. Yet, they interviewed quite some people and they analyzed the data very well. Also the scenario video they made showed a quite nice result. Also in terms of making and concretizing they showed very nice visualizations of their concepts. Overall, they showed quite some awareness about design process. Although from the reflections that there were really nice, in depth and substantial discussions about different lifestyles, not only about the elderly but also about their own lifestyle, they missed the cross-cultural aspect in their designs. The Dutch team made a design for the Dutch culture, the Chinese team for the Chinese culture. However, because they wrote so well about their discussions, they did learn valid intercultural lessons from working together. Both the designs had a depth level that really appreciated. The movie and final presentation were great, and they put a lot of effort in the course.

For team 5, the vision behind their concept was quite clear, the use of principles to stimulate the relationship between young and the elderly. Also they made a quite good analysis of the background of calligraphy to use in their design. Their visualization of these concepts was also quite good, but they had the feeling that the concepts had some loose ends. Especially if

they wanted to implement the design in a real life setting they might encounter difficulties. For example, the scenarios and services that support the maintenance of the product in the long term. Also some more exploring and validating in the context to implement the design might be better. Yet, overall it was a nice learning process and they were able to apply the lessons of this course in other projects. It was really appreciated that their team looked beyond the stereotypes and beyond the product itself, and connected the two worlds of the elderly together, while still keeping track of the differences in behavior of the elderly in the Netherlands and in China. The design made sense, and it could actually work in both contexts. The conclusion made sense as well. Instead of adapting completely to the context, they could play with the difference in background to make even more exciting design. However, Dutch elderly would need some more background information on the value and poeticness of calligraphy. The conclusions of their report were very well written and they got the essence of the course.

6.5.2 Team reflection data

Team 1 was made up of four members, including two Dutch students and two Chinese students. In their team, Chinese students designed for Dutch elderly and Dutch students designed for Chinese elderly. They collected information of target group and gave feedback to each other in collaborative way. They worked on ideas generation and design concepts in competitive way. It was also good to make use of each other for design ideation and improvement in the context. Dutch team members designed to stimulate social interaction between strangers. This was based on the information from Chinese team members. Chinese team members designed to tackle social isolation problem with disease. During the teamwork process, they set up the designer and client relationship with each other. It was good for them to explore the target and get feedback in the context.

Team 2 was made up of four members, including one Dutch student and three Chinese students. Their team contained two parts, Chinese students designed for Dutch elderly and Dutch students designed for Chinese elderly. For the teamwork, they arranged the meeting beforehand and used both Skype and QQ for communication. It was inconvenient for distant communication due to internet issue and time difference. They got the awareness and understood the situation, and then made the effort to facilitate the communication. They worked on the design case in collaborative way. They spent the time together to discuss their design concept. It was good way to generate and present their ideas to each other and also get feedback from each other in the context.

Team 3 was made up of five members, including one Dutch student and four Chinese students. For the teamwork, it was important to have different members in the team. Each member was essential for the team, which kept the balance of teamwork. In addition, communication was effective in their team. They worked on collaborative way and competitive way. In the first iteration, their team started the steps with a brainstorm about target group and went deeper to find possible solution. Their team chose elderly communication as the target and generated the concept of social network system. They had time to think about it and got the design concept together. In the second iteration, they worked in competition mode and their team was divided into two parts. Dutch students designed for Chinese elderly and Chinese students designed for Dutch elderly. In this way, they were aware of and understood each other better. In order to improve the design concept, much more information and data were collected in the context. During the teamwork process, they designed separately and exchanged information, and then gave feedback to each other.

Team 4 was made up of five members, including one Dutch student and four Chinese students. During the teamwork process, they arranged meeting to discuss the concept together. They made sketch, prototype and scenario separately and gave feedbacks to each other. Besides, they communicated about different cultural background, which enriched their experience on working in intercultural design team. They appreciated the teamwork during the process since they worked together and overcame the troubles to facilitate the teamwork. In the first week, they worked in cooperation mode. They discussed the direction and made a brainstorm about concepts. They designed questionnaires together and divided work to collect data. After that, they generated the concepts separately and gave feedbacks to each other. In the second week, they worked in competition mode. They developed the concept with elderly people and also came up with new concept for communication between generations. In the third week, they worked in collaboration mode. They further developed the concept together and discussed the details. In the fourth week, they worked in cooperation mode. They communicated about target group and validation in the context. They did analysis, prototype and scenario separately.

Team 5 was made up of five members, including one Dutch student and four Chinese students. Before the course, it was nice for them to set up contact with team members to get to know each other. Both Dutch and Chinese team members collected background information about the elderly separately. As a result, they could analyze the target group and thought about ideas in the first meeting. They first generated ideas and then led to the direction with social aspects of becoming older. In addition, they also found some cultural differences in target group.

They found the design opportunity based on their findings. During the teamwork process, they had some problems about meeting set-up. They tried to solve the problem and facilitate the communication via Skype. They chose a concept and thought further about it. They improved the concept and gave a new meaning to communication in the question hours. In the competition mode, it was supposed each team to do background research, but only one team did it. The research gave them more information about the concept. The discussion and explanation made the concept clearer. The inspirational picture of target group was used for communication and inspiration. They discussed the remarks and comments from question hours and developed the original concept further. In general, their teamwork and communication was going well, which resulted in their team as the best communication.

6.6 Analysis results

In this chapter, it is found that different combination of teamwork modes affect design quality and team satisfaction in international teams. In previous chapter, 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.

6.6.1 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 6-2). 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.

"They collected information of target group and gave feedback to each other in collaborative way. (Team 1)" "They worked on ideas generation and design concepts in competitive way.

(Team 1)" "During the teamwork process, they set up the designer and client relationship with each other. (Team 1)" "Their team contained two parts, Chinese students designed for Dutch elderly and Dutch students designed for Chinese elderly. (Team 2)" "It was inconvenient for distant communication due to internet issue and time difference. (Team 2)" "They worked on the design case in collaborative way, and spent time together to discuss their design concept. (Team 2)" "In the first iteration, they worked on collaborative way and competitive way. (Team 3)" "They had time to think about it and got the design concept together. (Team 3)" "In the second iteration, they worked in competition mode and their team was divided into two parts. (Team 3)" "During the teamwork process, they designed separately and exchanged information, and then gave feedback to each other. (Team 3)" "In the first week, they worked in cooperation mode. They designed questionnaires together and divided work to collect data. (Team 4)" "In the second week, they worked in competition mode. They generated the concepts separately and gave feedbacks to each other. (Team 4)" "In the third week, they worked in collaboration mode. They further developed the concept together and discussed the details. (Team 4)" "In the fourth week, they worked in cooperation mode. They made sketch, prototype and scenario separately. (Team 4)" "Both Dutch and Chinese team members collected background information about the elderly separately. (Team 5)" "During the teamwork process, they had some problems about meeting set-up, but tried to solve the problem and facilitate the communication via internet. (Team 5)" "In the competition mode, their team did background research, which gave them more information about the concept. (Team 5)"

Table 6-2. Different teamwork modes 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

6.6.2 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 6-3). 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.

"Their design process was nicely structured, and they showed quite some awareness about their design process. (Team 1)" "From their work, the Dutch team started from a concept focus and the Chinese team from an available technology. (Team 1)" "They used each other in a designer-client relationship, in the end they did make a design for the other context. (Team 1)" "They made a quite strong analysis of the background of the design brief. (Team 2)" "They showed a nice learning process and quite some awareness about their design process. (Team 2)" "It seems that not enough time was spent on the project due to difficulties in distance and timing the meetings. (Team 2)" "They were quite positive about their design process, and the structure was quite straightforward and sequential. (Team 3)" "They were not able to communicate about their designs together on a deeper level with internet in their team. (Team 3)" "They showed a well structured design process and iterated twice. (Team 4)" "They took advantage of the different backgrounds in their team. (Team 4)" "They wrote well about their discussions that they did learn valid intercultural lessons from working together. (Team 4)" "It was a nice learning process, they were able to apply the lessons of this course in other projects. (Team 5)" "The design made sense and it could actually work in both contexts in the Netherlands and in China. (Team 5)"

Table 6-3. 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

6.7 Conclusions

This chapter has explored the influence of different combination of teamwork modes on design teamwork in distributed bi-national design teams. In order to support designers to improve design teamwork, design course with Dutch and Chinese students is used as case study to investigate how to combine different teamwork modes. In the design course, they choose their own teamwork modes or even combine different teamwork modes. Thus, different combination of teamwork modes are analyzed to investigate the dynamics of design

teamwork. By measuring design quality and team satisfaction, the study has investigated the strength and weakness of different teamwork modes, so as to find suitable teamwork modes for different design cases.

As shown in results, different combination of teamwork modes affect design quality and team satisfaction in distributed bi-national design teams. This study shows different teamwork modes fit design cases with different project uncertainty and team uncertainty. That also means different teamwork modes are used in time sequence for different situations of uncertainty. Therefore, it is important for designers to be aware of cultural differences and make use of teamwork modes in design process.

The findings of this study have important implications for practice. The implication of these findings is to support designers to improve design teamwork in distributed bi-national design teams. This research illustrates the influence on design teamwork in the context of cultural differences and facilitates the implement of future distributed design teamwork.

Chapter 7 Teamwork Approach

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Chapter 7 Teamwork Approach

7.1 Introduction

7.1.1 Research objective

Based on earlier insights, design teamwork has been taken into account as a key process with different culture in international design teams. This chapter proposes teamwork approach by combining three teamwork modes in particular sequence to investigate the influence on design teamwork in bi-national design teams of Netherlands and China. The aim of this chapter is to investigate the influence of teamwork approach and facilitate design teamwork in the context of distributed intercultural teams. Therefore, it was attempt to study the influence of combined teamwork approach on design teamwork with cultural differences.

7.1.2 Teamwork approach

In this chapter, it proposes teamwork approach by combining three teamwork modes in particular sequence, the combined teamwork approach refers to competition, collaboration and cooperation. More specifically, competition means work separately for same tasks; collaboration means work together for common tasks; cooperation means work apart for divided tasks. In this research, teamwork approach is implemented to analyze the effect on design teamwork of process and result. An earlier case study was conducted to investigate the effect of three different teamwork modes in distributed intercultural design teams. In this case study of design course, Dutch and Chinese student designers are assigned to work in combined teamwork approach, so as to examine the effectiveness and efficiency of intercultural design teamwork.

Base on earlier insights of previous chapter, different combination of teamwork modes have been investigated for design quality and team satisfaction. In this chapter, teamwork approach by combining three teamwork modes are applied in sequence during the design course. In the beginning of design course, competition is used to get to know each other. In the middle of design course, collaboration is used to facilitate the design project. In the end of design course, cooperation is used to accomplish the design teamwork.

7.2 Methodological approach

7.2.1 Research model

At the stage of confirmative iteration (Figure 7-1), based on earlier case study insights, this chapter proposed a teamwork approach by combining three teamwork modes in a particular sequence. This chapter was designed to investigate the influence of teamwork approach to facilitate design teamwork in distributed bi-national teams. In the case study, distributed bi-national design teams were asked to employ the combined teamwork approach and its influence on design teamwork was analyzed. In the confirmation iteration, a final design course was conducted by Dutch and Chinese students to investigate teamwork approach with combination of three teamwork modes to improve distributed intercultural design teamwork.

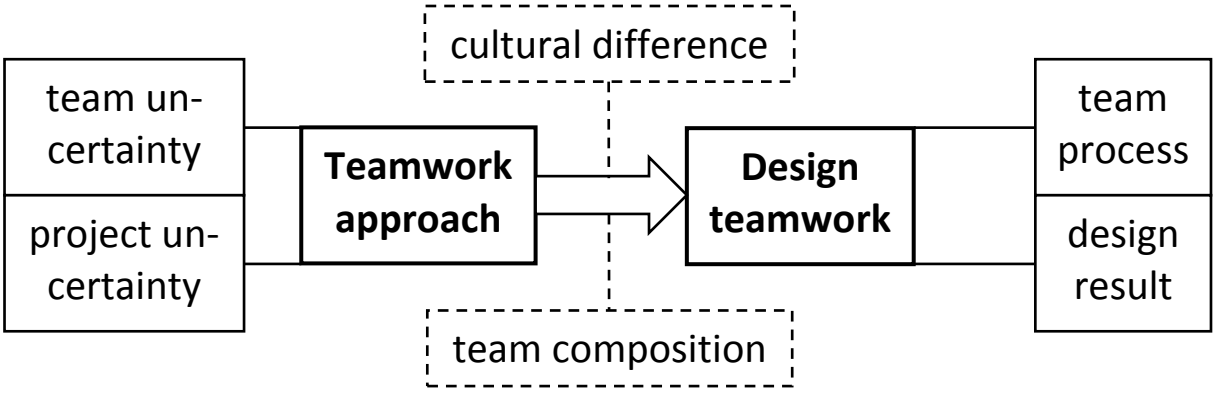


Figure 7-1. Research model (teamwork approach and design teamwork)

As shown in research framework (Figure 7-1), the effect of teamwork approach on design teamwork is considered as the main research object. In this chapter, teamwork approach by combining three teamwork modes in particular sequence is proposed to investigate the influence on design teamwork in bi-national design teams. Meanwhile, project uncertainty and team uncertainty are used to measure design teamwork. Furthermore, distributed and intercultural teams are considered in the context of bi-national design teams.

7.2.2 Research design

In the fourth confirmative iteration, a final case study is conducted to confirm teamwork approach with combination of three teamwork modes. Based on the research findings from previous iterations, teamwork approach with combination of three teamwork modes is introduced as design solution method for distributed intercultural design teamwork. Given the project case and team composition, this design course studies teamwork approach to support

designers to improve distributed intercultural design teamwork. In the design course, refection diaries and panel feedback are recorded to study team satisfaction and design quality. That confirms teamwork approach with combination of three teamwork modes can improve design teamwork in distributed intercultural design teams.

7.3 Case study

7.3.1 Design course

The design for health course took the ageing context of China as the design context. The learning activities were case studies on elderly health and wellbeing related to Crisp Gray but Mobile project.

This course introduced the newly developed method of Experiential Design Landscapes (EDL): a method where an infrastructure is created that, on one hand, stimulates the creation of new, disruptive, propositions in a semi-open environment where these new propositions are used as agents to facilitate new and emerging behavior and that, in parallel, enables the detailed analysis of the emerging data patterns as a source of inspiration for the design of future services and products. This method was used especially in the context of health care. The students learned to apply this method in the context of designing for health through improving social and physical mobility of elderly people in the neighborhood of Hangzhou. They took initiative to define their own health care service carriers including both social care and medical care examples through which evidences and inspirations for future disruptive innovation can be created. During the course, they also worked with Dutch design students to co-design future solutions and learn from useful health care lessons from other cultural perspective.

This course has both a strong societal economical dimension as well as an academic research dimension. The societal economic dimension concentrates on the systems and products created with their impact on society; the academic research dimension concentrates on the underlying scientific principles. These learning objectives can be found in the field of design, engineering, social sciences and law: How to create an EDL that is both flexible for the creation of new concepts and realistic acceptable for end users? How to deal with the legal implications (liability, privacy, data protection, intellectual property rights) of these, highly unpredictable, datasets and how can these implications be regulated in such a way that the different interests at stake are adequately balanced? How to handle unforeseen positive and negative emerging patterns in the field? How to work in intercultural design teams?

The key challenge for this assignment, is two-fold: how to learn to use a methodology that enables designers to, on one side, introduce disruptive concepts into a near-real world environment and, on the other hand, how to interpret the data as it emerges over longer periods of time into meaningful design information while maintaining legal and ethical integrity for the open audience.

7.3.2 Course approach

The course consisted of lectures and weekly assignments, connected to a design case. Chinese students worked in teams of four or five worked also on the weekly assignments initially to define the design for health design brief. Dutch students jointed the Chinese students later to co-design. The lectures were delivered through videoconferences and face-to-face when some of the lecturers came to China. These lectures were delivered interactively in which the students and lectures could ask and answer about the lectures were answered; also, in these meetings the teams presented the results of the weekly assignment and feedback was provided orally, and sometimes in writing as well through email. Question hours were arranged on regular basis and also on the request of the students. This flexibility was created to maximize the learning effects. Chinese students organized an exhibition to demonstrate their learning process and results and invited the involved elderly people to visit the Exhibition.

Deliverables were: video about mobility from students perspective, video about mobility from elderly perspective, probing the elderly mobility behavior using outdoor GPS, dairy and interview, presentations about videos and design brief, co-design diary and reflection, co-design report and final presentation, summarizing the results and approach of the different teams and reflection on learning experience and results on individual level.

The course involved seven lectures of two hours. It was assumed that students would spend approximately eight hours per week on reading literature and doing the weekly assignment. Lectures were partly organized through video conferences, face-to-face workshops, co-design workshops, for a total of two hours per week. In addition, participants read literature and did small assignments for a total of about eight hours per week. The assignments were built around a design case. Students were expected to team up to prepare and execute their weekly exercises in groups of five students.

7.3.3 Course set up

In this chapter of confirmation iteration, the case study was designed to confirm how teamwork approach affects design teamwork, a design teamwork approach consisting of

different teamwork modes in a particular order was proposed. In this case study, the joint design education course with distributed intercultural teams was conducted to analyze the influence of proposed teamwork approach on design teamwork. The design course was designed to confirm teamwork approach with combination of three teamwork modes to improve design teamwork. As shown in the course program in Table 7-1, the design course was taken in six weeks with two working days in each week. During the six weeks, there were seven plenary sessions scheduled on every Thursday afternoon, those were kick-off meeting on the first day, middle presentation after two weeks, final presentation after five weeks, oral examination on the last day, and other sessions were question hours. In the design course, there were 41 design students in the design course, 32 Chinese students and 9 Dutch students, and they were divided into six teams with both Chinese and Dutch in each team. Different design teams worked in combined teamwork approach during design process. They delivered weekly diary and iteration diary in person, and presented design result and delivered design report in teams. The teachers gave feedback on design result in presentation sessions and made discussion on teamwork in question hours and oral examination.

Table 7-1. Course program (six weeks with two design iterations)

working time	design program	team activity	deliverable
session 1 - week 1 / iteration 1	kick-off meeting	team composition, target group	weekly diary
session 2 - week 2 / iteration 1	question hours, first iteration	concept ideation, design opportunities	iteration diary, weekly diary
session 3 - week 3 / iteration 1	middle presentation on first iteration	choose concept, idea generation	weekly diary
session 4 - week 4 / iteration 2	question hours, second iteration	further design, further ideation	weekly diary
session 5 - week 5 / iteration 2	question hours, second iteration	concept finalization, building prototype, writing report	iteration diary, weekly diary
session 6 - week 6 / iteration 2	final presentation on second iteration	design result, final report	design report, weekly diary
session 7	oral examination	evaluation, reflection and feedback	peer-review

7.3.4 Course description

The design case is to design for elderly with aging problem, to facilitate elderly independent living and motivate them to stay active, healthy and social. This design course takes six weeks, including two iterations (Figure 7-2). As the proposed teamwork approach, three design teamwork modes (competition, collaboration, cooperation) are allocated to all the teams in particular sequence, namely competition design for first weeks, and then collaboration design for following weeks, and cooperation design for last weeks. Before the design course, all the designers are divided into teams, and each team contains both Dutch and Chinese designers. It is considered the diversity and balance of cultural differences in each team, which are assured by grouping student designers based on their cultural measurements beforehand.

Figure 7-2. Design course in international teams (the fourth design course)

This design course took six weeks, including two iterations. At the beginning of design course, all the designers were divided into teams, and each team contained both Dutch and Chinese designers. The first week was for kick-off and preparing for design teamwork, the assignors gave presentations about theory, design challenge and design process. Each design team worked in competition design to collect information. Afterwards, they chose a specific target group and considered the problems and product opportunities for the target group. The second week was in the first iteration. Each design team worked in collaboration design to consider the solution of problems and design features. They created several possible ideas and original solutions. The third week was the middle presentation. All the design teams presented their conceptual design, and got feedback and suggestion with each other. The second iteration contained the fourth week and fifth week. In the fourth week, each team still worked in

collaboration design. They improved their design concept and design details, and then made usability evaluation of final design for target market. In the fifth week, each design team worked in cooperation design to complete the design case. They made final decision and reached an agreement on design solution. They wrote design report and made prototype. The last week was the final presentation. All the teams presented their final design, and got evaluation from assignors. After the design course, they had final examination with reflection and feedback.

7.3.5 Design context

As in other countries all over the world, China faces an ageing population with increasing life expectancy and elderly support ratios. The health and social consequences of an ageing population have been well recognized by the government. With the birth control policy of one child per family since 1978 in China, the extended family structure of 4:2:1 has become the norm (two sets of grandparents, two parents and one child). There is an increasing emphasis on personal success and happiness, which may conflict with the responsibility of living and caring for elderly members of the family. There are concerns that respect for the latter is diminishing and they are increasingly being regarded as consumers of resource within the family and in society as a whole. Next to the social implications, the health implications cannot be ignored. Especially in the field of medical care, much can be done to develop medical training, establish medical facilities and research into medical and health care. As in other countries, theoretically much more can be achieved by efforts targeted at disease prevention and maintenance of function by lifestyle modification, promoting a positive image of ageing, and re-engineering service delivery methods. However, politics and finance are major factors influencing the well-being of ageing populations, and the latter is seldom the major driving force behind the shaping of political platforms and financial strategies.

The ideal solution is to develop comprehensive service systems covering various aspects including medical, preventive, convalescent, physical, psychological and environmental aspects. However, given the dynamics, the complexity and the high degree of structural uncertainty in the health care context of the aging population in China, the outcomes of the best possible solutions are by no means easily predictable. For the health care industry it is therefore very difficult to introduce these disruptive innovations without a solid basis of evidence. More evidence related to various modes of care, for example community health care networks, in addition to medical clinics and hospitals need to be collected.

7.4 Data collection and analysis

In the case study of confirmative iteration, according to the case objective for teamwork approach, research data were collected from reflection diary for team process and panel feedback for design result. Then based on the related literature about teamwork approach, the data from reflection diary were analysed with the categories: activities, teamwork, communication, cultural difference, and the data from panel feedback were analysed with the categories: design concept, user research, presentation, design report. As the process of data analysis, diary data and feedback data were collected by design students and assigners, and then the key points are gathered from the text, and grouped into these categories, so as to find the analysis results to improve team satisfaction and design quality for design teamwork.

7.4.1 Data collection

In the case study, data are collected during the design process (Table 7-2), which contain reflection diary and panel feedback. The reflection diary is written by designers for every week and two iterations. The panel feedback is given by assigner for the whole design process. Accordingly, videoconferencing was used for the formal sessions with presentation, and Email and Skype were used as the team communication media. In the beginning, some cultural measurements are used for team composition. Cultural value survey is used to measure personal character of designers. Team role questionnaire is used to identify their suitable team position. In the process, self-reflection diary is used to study in depth the change process of design teamwork. 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. Moreover, project plan and weekly diary are made in each team so as to record the specifics in design process. In the end, design teamwork is evaluated, containing team process and design result. Finally, user acceptance model is also used to test design result.

Table 7-2. Data collection

phase	data collection
overall process	reflection diary, panel feedback, videoconferencing, Email and Skype
begin phase	cultural measurement: cultural value survey, team role questionnaire
process phase	self-reflection diary, participant observation,

	semi-structure interview, project plan and weekly diary
end phase	team process and design result, user acceptance model

7.4.2 Data analysis

Based on the data from case study, the grounded theory method was used for data analysis of each team. According to the reflection diary, the data were grouped into categories: activities, teamwork, communication, cultural differences. According to the panel feedback, the data were grouped into categories: design concept, user research, presentation, report. Grounded theory method (GT) has four stages. At codes stage, key points and codes from text are gathered. At concepts stage, codes are grouped into concepts. At categories stage, categories from concepts are used to generate theory. At theory stage, theory or hypothesis is generated with explanation.

Meanwhile, Maturity Index on Reliability (MIR) model was used to investigate the process output and the quality of information flow. MIR was used here to measure the capability that each team reacted to comments and took improved actions in their design process. Maturity Index on Reliability (MIR) model has five levels. Level 0 is uncontrol without loop, there is no evidence or feedback. Level 1 is measuring, there are evidence and feedback but problem is unknown. Level 2 is communication with loop, problem is known but cause is unknown. Level 3 is analysis and control, cause is known and problem is solved but not prevented. Level 4 is adaptation and learning with all loop, root-cause is known and problem is prevented.

7.5 Case data

7.5.1 Panel feedback data

It was a considerable busy assignment for them and their team members. They had witnessed and experienced not only how a distributed bi-national design team works together with design students, but also how to design for a target group in a different cultural context. During this course they were challenged to work in a multi-cultural setting. They had the opportunity to work with people that have different educational backgrounds. This became especially clear in the way they approached the assignment and the way they addressed problem. Whereas the students with design background tended to start framing and reframing the problems in terms of opportunities, others commonly started with defining requirements

and finding solutions to these requirements. Sometimes this was counter-productive, but most of the time it was inspiring to see that in many cases this difference could lead to new insights. Overall, they learned a lot from this teamwork and design process.

7.5.2 Team reflection data

Team 1 was comprised of 7 team members, including 5 Chinese and 2 Dutch. All their team members participated co-design process to contribute on the teamwork. They realized the cultural awareness during the process and tried to facilitate the distributed communication. As for design result perspective, they created preliminary design concepts and improved the concept with the comments in question hours. They focused on elderly mobility in China to fulfill their life quality. In the first iteration, they collected date and made persona for target user. They also had a brainstorm to explore the business model. In the second iteration, they tried to integrate the concepts and designed for details to solve the problem. As for team process perspective, they confronted communication problem in the beginning due to cultural differences and distributed locations. They experienced the cultural differences and learned to work in bi-national teams. As for the deliverables, their report documented their design concepts and teamwork process. They also used diaries to record their activities.

Team 2 was comprised of 7 team members, including 6 Chinese and 1 Dutch. They got the cultural awareness during the process and improved their distributed communication. They also learned from each others to work with another culture. As for design result perspective, they developed the final solution according to user research and feedback. They explored design concepts in the first iteration, and then chose the final concept in the second iteration. It was worthy that they made video and storyboard to illustrate their idea. They designed a system rather than a product to solve the problem for elderly mobility. As for team process perspective, they suffered communication problem in the beginning. Then they tried different tools for voice and text communication. Most of their team members joined the process together and made their contribution to the teamwork. As for the deliverables, their report recorded their teamwork process and learning activities. It was good that Dutch member gave more reflection for their work. Their diaries also reflected on their teamwork and design.

Team 3 was comprised of 7 team members, including 5 Chinese and 2 Dutch. They were active to contact each other and took initiative for the relationship. They tried various communication tools to improve teamwork and made use of their advantages. As for design result perspective, they had a brainstorm to generate new ideas. They probed user experience for concept and prototype. They also made storyboard and video to visualize their design

concept. It was a challenge to design with and for another culture. They designed for elderly social mobility to improve their social life. They also made videos to demonstrate their concept dynamically. As for team process perspective, they introduced and got to know each other in the beginning. During the process, they suffered the internet connection problem that spent their extra time. However, they made use of various tools to facilitate distributed communication. They also made agenda before and minutes after to improve the meeting. They also suffered the language issue for interpretation, but they tried to practice and explain to each other clearly. That improved finally. Moreover, distributed locations and time difference also influenced their teamwork process. As for the deliverables, their report reflected their teamwork and design well. Most of team members joined co-design actively, but some members still did not perform properly.

Team 4 was comprised of 7 team members, including 6 Chinese and 1 Dutch. Their team improved their teamwork during the design process and generated the proper design concept finally. They were aware of cultural difference and intercultural communication. As for design result perspective, their team did the user research to find the elder time in daily life. Their team did not create many concepts to explore the design opportunity in the beginning. In the second iteration, their team really improved the design result and updated the video. Finally, they generated the solution to improve the social mobility for the elderly. As for team process perspective, they learned from each others about cultural difference. They had to understand cultural awareness and made contribution to the teamwork. Their team suffered some communication problem in the beginning. When they realized the cultural awareness, they made the plan and scheduled their meeting with both Dutch and Chinese students. They made effort to facilitate the distributed communication and tried to explain the ideas clearly. As for the deliverables, most of their team members participated co-design actively, but there were still some members should have more time involved. They divided the tasks and controlled the time better in the final presentation, so the final presentation demonstrated their design concept well. Their report also reflected their teamwork to show the improvement of design concept during the process.

Team 5 was comprised of 6 team members, including 5 Chinese and 1 Dutch. They had relatively less members than other teams, but most of their team members participated actively. They learned to design in social and cultural context and worked together with another culture. As for design result perspective, they had a brainstorm to explore the idea generation. They created three concepts in the first iteration and chose the mature idea as the final concept. They realized that cultural differences acted as both advantage and

disadvantage. As for team process perspective, they experienced the bi-national teamwork in the cultural context. They got to know each other through distributed communication in the beginning. But they also confronted communication problems due to cultural difference and distributed locations. It would be better to value the relationship other than their work. As for the deliverables, their report had the structure of their work with teamwork process and design results. Besides, their diaries also recorded their teamwork.

Team 6 was comprised of 7 team members, including 5 Chinese and 2 Dutch. Their teamwork was going well because of active members to facilitate communication. They had the cultural awareness and improved the time management during the process. Finally, they got the joint design concept and presented them to other students. As for design result perspective, Dutch and Chinese members had a brainstorm separately and then exchanged the ideas. They explored the design opportunity and focused on game experiences. Then they researched user experiences and body movement to improve their design concept. In the second iteration, they voted for the best idea to make the decision and worked out the final concept. As for team process perspective, they realized that it was better to get to know each other before working on the project. Their team took initiative to introduce themselves and facilitate communication in the context of cultural awareness. In the second iteration, they spent more time to work together not only for the project but also for the relationship. They learned from each others during the design process. There were many discussions to improve the idea. Due to the cultural difference and distributed communication, they confronted the challenge that Dutch and Chinese members need express and interpret the idea in the right way. As for the deliverables, their diaries reflected their teamwork process well. In the last week, their team divided the tasks properly and also in the final presentation. Their report also recorded their design process and individual reflection. They had meetings at unusual time because time difference. The teamwork was uncommon because of cultural difference. It was really hard to design for another culture.

7.6 Analysis results

7.6.1 Research results

The joint design course was a considerable complex course for student designers. It required not only to work together with distributed bi-national design teams, but also to design for target group in different cultural context. In addition to cultural differences, teamwork approach was proposed to guide the distributed bi-national teamwork. Consequently, the

participants had to take into account the project information from design brief and combination of teamwork approach. For the project, they had to work with another culture and also work for another culture.

Based on the data and analysis from case study, the following results regarding teamwork approach can be found. First of all, competition design is applicable to team with high uncertainty to lower it. Subsequently, collaboration design is applicable to project with high uncertainty to lower it. Last but not least, cooperation design is applicable to both team and project with low uncertainty in design course. In the sequence of competition and collaboration and cooperation, they made progress and improved the design in the end. Compared first iteration with second iteration, it was obvious to show that design teamwork was improved with combined teamwork approach.

As shown in research results (Figure 7-3), with regard to time sequence, the results show that team and project with different uncertainties need teamwork approach with three different teamwork modes during design process. In the initial stage with high uncertainty of project and team, competitive design could be used to decrease uncertainty of team. In the middle stage with high uncertainty of project and low uncertainty of team, collaborative design could be used to decline uncertainty of project. In the final stage with low uncertainty of project and team, cooperative design could be used efficiently and effectively during the process.

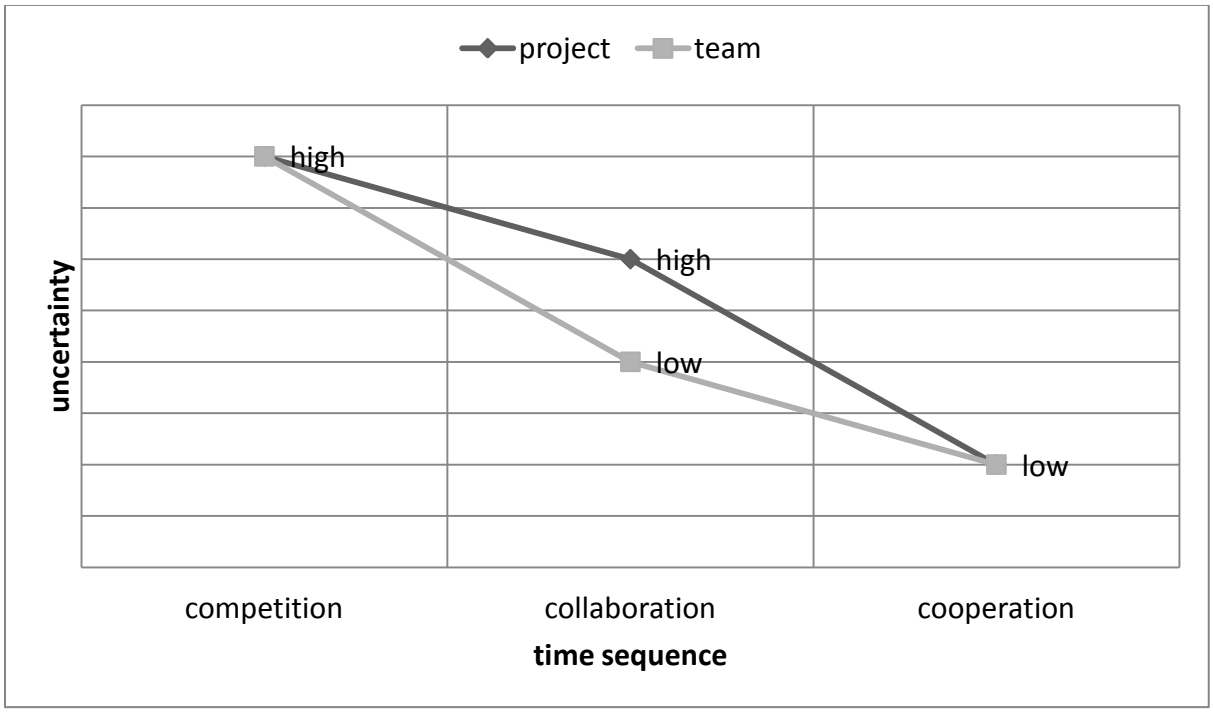


Figure 7-3. Research results

During the design course, design interaction between the student designers was investigated for the nature of design process and design outcomes, in order to clarify the influence of cultural differences on design. In the beginning with high uncertainty of project and team, the student designers had different cultural backgrounds and design skills for design teamwork, as well as the uncertainty of requirement and expectation of design project. They desired to work in competitive design, so as to know the strength of each other. In the middle with high uncertainty of project and low uncertainty of team, the student designers were eager to work in collaborative design, so as to make the project details clear with mutual understanding. In the final with low uncertainty of project and team, the student designers were able to work in cooperative design, in the way of work division and design interaction. In these three stages in sequence, teamwork approach with three different teamwork modes have different influence on team process and design result.

7.6.2 Reflection on case study

During the joint design course, reflection diary is made in each team so as to record the specifics in design process and give feedback. It is helpful to improve the course design and integrate research into design education. This course gives opportunity to both Dutch and Chinese student designers for cross cultural design teamwork, and it is also field study of cross cultural research for designers. In the framework of cross cultural research, Dutch student designers and Chinese student designers work together in teamwork approach with three different teamwork modes to investigate the possibility and efficiency of cross cultural design.

According to cultural differences in bi-national design team, teamwork approach affects design result and team process. The purpose of cross cultural research is to motivate and improve the design teamwork for designers from different cultures and countries. For the teamwork approach with three different teamwork modes, they take the different way of design teamwork, and also meet the different problems in communication. Cooperative design team can work continuously and the task of each side is clear, but one side has to wait for the other to finish the previous step. Collaborative design team can take timely feedback and adjust the design direction, but it requires much time to work together with discussion. Competitive design team can keep independent idea generation and lead to outstanding design solution, but it leads to some work overlap and difficulty of choosing or combining design concepts. During the course, cultural differences and personal character also affect the execution of teamwork approach. For example, one team in collaborative design is also

encouraged with each other in competitive way, which leads to more interaction in design process. While one team in competitive design also share the data in collaborative way, which gives the team members abundant design material.

7.6.3 Reflection on diary

In the joint design course, reflection diary is used to record the specifics in design teamwork process. The diary is designed to investigate the design teamwork, culture insight, and design process. In the context of cross culture, designers are supposed to have the awareness and understanding of the cultural differences.

The reflection diary is written by both Dutch and Chinese student designers in each team. In this joint design course, teamwork approach with three different teamwork modes are used to study the team process and design result in joint design team. According to their teamwork approach, the student designers use weekly diary to record their design activities and communication.

In the beginning, both Dutch and Chinese student designers set up connection and get to know each other. On the other hand, they read the design brief and understand the design requirement. Due to the time difference, some teams make a plan to divide the tasks and make an appointment for internet meeting. The advantage of time difference is that the bi-national team can work for the whole day in turn; while the disadvantage is that it is hard to communicate synchronously and get feedback from the other side immediately. As a result of time difference, Chinese student designers collect data for target group of Chinese market, and Dutch student designers study the literature to find potential design opportunities. Due to the cultural differences and language barrier, they have to take more time for explanation and make group meeting inefficient. The quality of internet connection also affects the efficiency of discussion. For some teams, it is not easy to understand each other when the signal is weak and voice is low. However, some teams establish smooth communication and interact in design teamwork, when both Dutch and Chinese student designers take awareness of cultural differences and have patience to hear from the other side.

7.6.4 Reflection by students

At the end of the course, all students were asked to reflect upon the course that they participated and the lessons that they learned that contribute to their growth as future designers. Their reflections were available in the final report. They found this course really useful and an eye opening. They appreciated the learning approach and the feedback they

received. They found it very important to really design with the target group than from their own perspective alone. The course was considered very interesting and they were very glad with the progress made. They appreciated very much the intercultural design experiences. Students recognized the difference between their background and competency in contrast with their fellow Dutch design students. They learned to deal with them in the complex design context.

"All their team members participated co-design process to contribute on the teamwork. (Team 1)" "They realized the cultural awareness during the process and tried to facilitate the distributed communication. (Team 1)" "They confronted communication problem in the beginning due to cultural differences and distributed locations. (Team 1)" "They got the cultural awareness during the process and improved their distributed communication. (Team 2)" "They suffered communication problem in the beginning, and then tried different tools for voice and text communication. (Team 2)" "Most of their team members joined the process together and made their contribution to the teamwork. (Team 2)" "They were active to contact each other and took initiative for the relationship. (Team 3)" "During the process, they suffered the internet connection problem that spent their extra time. (Team 3)" "They suffered the language issue for interpretation, but tried to practice and explain to each other clearly. (Team 3)" "They had to understand cultural awareness and made contribution to the teamwork. (Team 4)" "They made effort to facilitate the distributed communication and tried to explain the ideas clearly. (Team 4)" "They divided the tasks and controlled the time better in the final presentation. (Team 4)" "They realized that cultural differences acted as both advantage and disadvantage. (Team 5)" "They confronted communication problems due to cultural difference and distributed locations. (Team 5)" "It would be better to value the relationship other than their work. (Team 5)" "They had the cultural awareness and improved the time management during the process. (Team 6)" "Dutch and Chinese members had a brainstorm separately and then exchanged the ideas. (Team 6)" "In the second iteration, they voted for the best idea to make the decision and worked out the final concept. (Team 6)" "They realized that it was better to get to know each other before working on the project. (Team 6)" "They spent more time to work together not only for the project but also for the relationship. (Team 6)" "In the last week, their team divided the tasks properly and also in the final presentation. (Team 6)"

7.6.5 Evaluation of results

Overall, the performance of the students was highly satisfactory. The videos made were very communicative. From the first person perspective to the second person perspective, they learned that designers need to design for and with the society. The presentations given during the course were initially less structured and students were less confident about their language. When the course progressed, obvious improvement was made. They demonstrated that they were quick learners and they were able to actively act upon the feedback they received and incorporate the feedback in next presentations. Both the intermediary and final presentations provided evidence of the good commitment of the students. Their progress in mastering English was very evident. The reports written together with the Dutch students were well structured with good graphical layout and deserve applause. During the first iteration of the co-design phase, Chinese students experienced a lot of difficulties with regard to time differences, language, different education background and communication style and etc. They learned from these difficulties and acted upon them accordingly and obtained very in-depth intercultural teamwork insight when designing with a different culture. The final oral exam indicated that the students achieved the main learning goals. The prescribed grading system (10% peer review and 90% based on videos, presentations, oral exams and individual performance) was used to reflect the performance of the students. Despite the differences in team performance, all teams demonstrated sufficient growth made during this course.

Overall, they were definitely satisfied with the results, and they were confident that the students achieved the main learning goals. Finally, they would like to express that it was an interesting experience in several respects. Education wise: this was a new teaching experience for them as they managed to give an interactive learning in distant. They combined the use of videoconferences for interactive lectures and face-to-face meetings. They were also teaching a very interesting and hard working group with a mixture of different cultures and education backgrounds. A good student assistant was one of the secrets of the smooth and successful teaching process. Research wise: they learned that well-established market research methods couldn’t be directly applied to a new culture and unknown target group. If they want to further develop EDL approach in the Chinese context, they need to adjust the research methods. They learned that one of the most important aspects in designing for and with different cultures was to have a deep understanding of the cultural differences and to have the right teamwork process that supported the communication between the cultures.

7.7 Conclusions

This study has proposed teamwork approach by combining three teamwork modes in particular sequence and investigated the influence of teamwork approach on design teamwork in distributed intercultural design teams. In order to facilitate design teamwork, Dutch and Chinese students use design course as case study. This study has measured design result and team process to investigate design teamwork. This study shows that teamwork approach with three different teamwork modes are used in time sequence for team and project with different uncertainties.

This study has investigated the importance of teamwork approach with three different teamwork modes and the sequence of their usage. Consequently, the following conclusions can be drawn from this study. In this research, it could state that teamwork approach affects design teamwork of design result and team process in bi-national design teams. Besides teamwork approach, this study has also shown that cultural differences also have impact on design teamwork of process and result for bi-national teamwork. In order to motivate and improve design teamwork, the results of this study indicate that it is important for designers to be aware of cultural differences and make use of teamwork approach. Therefore, the results of this study have a number of important implications for future practice.

As the research progress, 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.

Chapter 8 Conclusion

8.1 Conclusions on research question, framework, approach

8.1.1 Conclusions on research questions

8.1.2 Conclusions on research framework

8.1.3 Conclusions on research approach

8.2 Conclusions on design research, culture and communication

8.2.1 Conclusions on design research

8.2.2 Conclusions on international culture

8.2.3 Conclusions on design team communication

8.3 Implication to intercultural design studies

8.4 Implication to international design teams

8.5 Implication for industrial practitioner

8.6 Implication for future research

8.7 Conclusions on distributed intercultural teams

Chapter 8 Conclusion

This chapter concludes the whole design research, based on the results of case studies discussed in previous chapters. This chapter summarizes the design research for distributed intercultural design teamwork. In line with four design courses in bi-national teams, four iterative case studies are conducted to investigate the distributed intercultural design teamwork. As the research framework, this chapter answers the research questions by two parts and draws the conclusions for design theory and design practice. On the one hand of design theory, this research has the implication to intercultural design studies. On the other hand of design practice, this research also has the implication for international design teams. From this research but beyond, the questions about distributed intercultural design teamwork is worthy of future research. Based on the results of design teamwork, the reflections of this research are presented and the conclusions of this thesis are drawn in this chapter.

8.1 Conclusions on research question, framework, approach

8.1.1 Conclusions on research questions

This research investigated design teamwork to answer the research questions through the iterative case studies in distributed intercultural design teams. In the context of cultural difference in international design teams, this research answered the questions by two parts, how different teamwork modes affect design quality and team satisfaction, and how to support designers to improve design teamwork.

The first half part of research questions is answered for design theory. Based on the results of data analysis from case studies, this research has shown that different teamwork modes have effect on design teamwork of design quality and team satisfaction. In the competitive teamwork modes, designers work separately on same tasks to compare with each other. As a result, design quality is improved through competition and team satisfaction is based on team competition. In the collaborative teamwork modes, designers work together on joint tasks to solve common problems. As a result, design quality is more acceptable through collaboration and team satisfaction is based on work discussion. In the cooperative teamwork modes, designers work long with others on division of tasks to get mutual benefit. As a result, design quality is based on connection of tasks and team satisfaction is more efficient.

The second half part of research questions is answered for design practice. Besides the effect of teamwork modes on design teamwork, the results of this research also support designers to improve design teamwork in distributed intercultural design teams. In order to improve the effectiveness and efficiency of design teamwork, designers make use of different teamwork modes for teams and projects with different uncertainty. For design teams with high uncertainty, designers work in competitive mode to decrease team uncertainty. For design project with high uncertainty, designers work in collaborative mode to diminish project uncertainty. For design teams and design projects with low uncertainty, designers work in cooperative mode for effectiveness and efficiency.

8.1.2 Conclusions on research framework

As the research framework (Figure 8-1), the correlation of teamwork modes and design teamwork is considered as main research object. In this research, different teamwork modes (competition, collaboration, cooperation) are used as independent variable to investigate the effect on design teamwork as dependent variable in distributed intercultural bi-national teams. More specifically, project uncertainty and team uncertainty are considered as main factors to study the effect on design teamwork. In order to study the design teamwork, team satisfaction and design quality are considered as main elements to measure the aspects of design teamwork. Team satisfaction reflects on the team uncertainty, which is a measurement of team process at individual level. Design quality reflects on project uncertainty, which is a measurement of design result at team level. Moreover, cultural differences and bi-national teams are considered as extraneous factors with the cultural measurements for team composition. Given cultural differences in distributed intercultural bi-national design teams from China and the Netherlands, this research investigates the use of different teamwork modes for team process and design result, so as to facilitate the design teamwork in distributed intercultural teams.

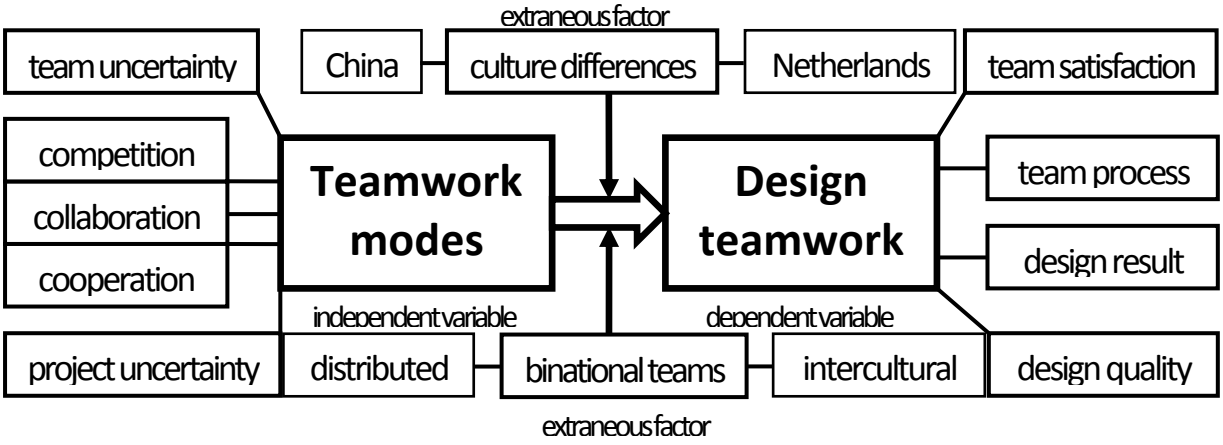


Figure 8-1. Research framework (effect of teamwork modes on design teamwork in distributed intercultural teams)

8.1.3 Conclusions on research approach

As to conclusion on research approach, qualitative research method and longitudinal field study were used to investigate the distributed intercultural design teamwork. As the research approach, the design research was divided into four iterations: exploration iteration, creation iteration, reflection iteration, confirmation iteration. As the four design research iterations, four relevant case studies were conducted in distributed intercultural design teams. In the iterative case studies, the impact of cultural difference was explored in distributed intercultural teams, and then teamwork modes were introduced to investigate the effect on design teamwork, and also differently combined to improve design teamwork, and finally teamwork approach was proposed to facilitate distributed intercultural teamwork. In each case study, design students from China and the Netherlands worked together over distance with different teamwork modes. As the research target group, design students make original ideas and take team activities during design process. It is more convenient to collect raw data with design students to get the analysis more effective and efficient. They have early experience and will become professional designers in the future. In this way, this research has investigated the impact of cultural difference and effect of teamwork modes on design teamwork, so as to help designers to improve and facilitate distributed intercultural design teamwork.

8.2 Conclusions on design research, culture and communication

In the conclusion, this research has contribution to the development of product creation process. As the tendency of product creation and business process, all the phases, including concept design, development, engineering, production and use, have transferred to global distributed. Consequently, designers have to work in the distributed intercultural teams, and the design teamwork has challenge at two aspects of geographical distributed and cultural difference. Therefore, designers have to be aware of cultural difference and make use of communication tools within different teamwork modes.

8.2.1 Conclusions on design research

As to conclusion on design research, the conclusion of the research contains design theory for intercultural design studies and design practice for international design teams. In the distributed intercultural design teams, designers should be aware of cultural difference and can make use of teamwork modes to improve design teamwork. During the teamwork process, cultural difference can transform from hinder factor to support factor by knowing each other better. The proposed teamwork approach by combining three teamwork modes is functional for distributed intercultural design teams, in the sequence of competitive mode to decrease team uncertainty, collaborative mode to diminish project uncertainty, and cooperative mode for efficiency and effectiveness. Meanwhile, the cycle of competitive mode and collaborative mode should be used in the earlier design phase repeatedly to improve design teamwork.

As for conclusion on industrial implication, the development of product creation process to global-for-global stage, all the phases of concept design, development, engineering, production and use are distributed worldwide within intercultural teams. As the teamwork approach for distributed intercultural teams, different design projects with different uncertainties can use different teamwork modes. More specifically, design team with high uncertainty can use competitive teamwork mode, design project with high uncertainty can use collaborative teamwork mode, but design team and project with low uncertainty can use cooperative teamwork mode. Therefore, designers as team members have to work in the context of cultural difference and to work in suitable teamwork modes with each other, so as to facilitate team satisfaction and improve design quality for distributed intercultural design teamwork.

8.2.2 Conclusions on international culture

In the distributed intercultural teams, team composition is in the context of cultural difference. On the one hand, cultural measurements are used to compose the team for the balance of each

team. On the other hand, cultural differences compose the team for the diversity in each team. More specifically, all the Dutch and Chinese design students are divided into teams on average and different Dutch and Chinese are team up cross culture and over distance.

This research is designed in the context of cultural difference, with the case it has studied national cultural difference of China and the Netherlands. Based on the comparison of cultural dimensions, power distance, uncertainty avoidance, individualism and collectivism, masculinity and femininity, are supposed to evaluate the impact of cultural difference on design teamwork, so as to find the support and hinder cultural factors in distributed intercultural teams.

As this research is set upon the cultural dimensions and the conclusion is therefore based on the cultural difference as well. The cultural difference has impact on design teamwork as support or hinder factor, and if designers are aware of cultural difference, the factors evolve from hinder to support during the process. In the distributed intercultural teams, cultural difference is given as the context and designers have to make use of that to improve design teamwork.

This research has drawn the conclusion about design teamwork in the context of distributed intercultural teams, in line with product creation process of international global-for-global tendency. In the international context, designers have to deal with the uncertainty of project and team, which make the teamwork more important but difficult. In order to improve international design teamwork, designers can work within suitable teamwork modes in the context of cultural difference and distributed communication.

8.2.3 Conclusions on design team communication

During the team communication in international design teams, ten relevant factors are indicated to investigate their influence on design teamwork (see table 8-1). These factors are generated by designers in distributed intercultural teams, and they have explained the details of each aspect. The factors include interaction, interpretation, relationship, atmosphere, tools, information, language, design process, culture and distance. They are divided into two groups, implicit and explicit. Based on the discussion about team communication in the design workshop, interaction, interpretation, relationship, atmosphere, culture are considered as implicit factors, and tools, information, language, design process, distance are considered as explicit factors, among others, culture and distance are as given factors. More specifically for each factor, designers have discussed the specific aspects of each factor for the influence of team communication on design teamwork. These ten factors are not only communication

problems in distributed intercultural design teams, but also design challenges for distributed intercultural design teamwork. With the implicit factors and explicit factors of communication issues and design challenges, designers can facilitate team communication and improve design teamwork in distributed intercultural teams.

Table 8-1. Communication issues and design challenges

Implicit factors	
interaction	time and frequency, synchronous / asynchronous, action and reaction, proactive and reflective, offline and online, discussion and presentation
interpretation	content convey, agreement / disagreement, different meanings, explain and understand, templates
relationship	team roles, expertise and skill, strength and weakness, common grounds, introduction / profile, friendship, education and background, interest and hobby
atmosphere	context / environment, group tension, inside and outside
culture	difference and similarity, cultural context and background, culture insight, personal character
Explicit factors	
tool	social media, technology: technical equipments, written and visual, internet connection, video and audio, sound quality
information	project info, personal info, meta info, distribute and share, update, missing, back-up
language	language difference, language barrier, translation, decent English, body language
design process	process oriented, unaware of progress, different processes
distance	physical contact, distant communication, time difference, modalities and senses

In the distributed intercultural design teams, team communication is important but difficulty for design teamwork, and team composition with cultural difference also has impact on distributed intercultural design teamwork. In order to improve distributed intercultural design teamwork, it is necessary for designers to be aware of cultural difference and make use of communication tools for all the design teamwork modes. As a result, different aspects of

communication issues in distributed intercultural design teams are stated and discussed as design challenges for distributed intercultural design teamwork. Based on the discussion and related results of the case study, this research shows the importance and relative difficulty of distributed team communication and intercultural teamwork, in order to help designers facilitate team communication and improve design teamwork in distributed intercultural teams.

8.3 Implication to intercultural design studies

This design research was conducted in the context of bi-national teams from Netherlands and China to investigate cultural differences between western and eastern countries. In the context of cultural differences from case studies, the results of this research contribute to design theory for intercultural design studies. Based on the results from data analysis, it could conclude that intercultural design study provided a good conceptual foundation to describe and support design teamwork in international design teams. This study more precisely investigated the supporting and hindering factors of cultural differences in Dutch and Chinese design teams. The results indicated that design teamwork was a dynamic process. Design teamwork was not only about cooperation with separate tasks, but also about collaboration with jointly actions. Designers had better learn from each other and open for the cultural differences to find out the optimal process eventually.

This study has explored the effect of different teamwork modes on design teamwork in distributed international design teams. In order to support cross cultural design teamwork, this study use design course with Dutch and Chinese students as case to investigate how different teamwork modes affect design teamwork. This study has investigated the effectiveness and efficiency of three teamwork modes, and the strength and weakness of them are measured by design quality and team satisfaction. This study also has explored the influence of different combination of teamwork modes on design teamwork in distributed international design teams. In order to support designers to improve design teamwork, design course with Dutch and Chinese students is used as case study to investigate how to combine different teamwork modes. In the design course, they choose their own teamwork modes or even combine different teamwork modes. Thus, different combination of teamwork modes are analyzed to investigate the dynamics of design teamwork. By measuring design quality and team satisfaction, the study has investigated the strength and weakness of different teamwork

modes, so as to find suitable teamwork modes for different design cases. This is about the study in the third reflective iteration for design teamwork. Based on the results of the second creative iteration, this study has investigated the combination of different teamwork modes to analyse the dynamics of design teamwork with uncertainty of project and team, so as to find suitable teamwork modes for distributed intercultural design teamwork.

As a result, this study has proposed teamwork approach by combining three teamwork modes in particular sequence and investigated the influence of teamwork approach on design teamwork in distributed intercultural design teams. In order to facilitate design teamwork, Dutch and Chinese students use design course as case study. This study has measured design result and team process to investigate design teamwork. This study shows that teamwork approach with three different teamwork modes are used in time sequence for team and project with different uncertainties. Therefore, the results of this study have implications for intercultural design studies. This is about the study in the fourth confirmative iteration for teamwork approach. Based on the results of the third reflective iteration, this study has proposed teamwork approach by combining three teamwork modes in particular sequence to investigate the influence of teamwork approach in time sequence with uncertainty of project and team, so as to support designers to improve distributed intercultural design teamwork.

8.4 Implication to international design teams

Besides design theory for intercultural design studies, the results of this research also contribute to design practice for international design teams. This design research was conducted in the context of bi-national teams to investigated design teamwork for improvement in international design teams. In the international design teams, design teamwork has been considered as significant issue and crucial factor. In the case of design teamwork, the team needs to work jointly for innovation. Globalization has led to many cases of international teamwork, which calls both cooperation and collaboration. The improvement of international teamwork is based on the understanding of cultural differences, and the characteristics of design teamwork are important for future design research in international design teams.

As shown in results of this study, three different teamwork modes have different attribute and different reflection on design quality and team satisfaction. In different teamwork modes, work requirement and team communication are also different accordingly. Therefore, it is

worthy that team members take advantage of the strength of teamwork modes and get away of the weakness of them for different design cases. Besides shown in results, different combination of teamwork modes affect design quality and team satisfaction in distributed intercultural design teams. This study shows different teamwork modes fit design cases with different project uncertainty and team uncertainty. That also means different teamwork modes are used in time sequence for different situations of uncertainty. Therefore, it is important for team members to make use of suitable combination of teamwork modes in design process.

In general, this study has investigated the importance of teamwork approach with three different teamwork modes and the sequence of their usage. In this research, it could state that teamwork approach affects design teamwork of design result and team process in international design teams. Besides teamwork approach, this study has also shown that cultural differences also have impact on design teamwork of process and result for international teamwork. In order to motivate and improve design teamwork, the results of this study indicate that it is important for designers to be aware of cultural differences and make use of teamwork approach in international teams. Therefore, the results of this study have implications for practice in international design teams.

8.5 Implication for industrial practitioner

As the hypothesis and conclusions of this research, the implication to international design teams has been addressed to support designers to improve distributed intercultural design teamwork. This design research has contributed to practical implication for industrial designer and manager. Given the cultural differences in binational teams for the distributed intercultural design teamwork, on one hand, they have to be aware of cultural differences to transform hinder factor to support factor by knowing the team and project better, on the other hand, they can make use of the proposed teamwork approach by combining three teamwork modes in particular sequence of competitive mode to decrease team uncertainty at first, then collaborative mode to diminish project uncertainty, and cooperative mode for efficiency and effectiveness at end.

In line with the global-for-global stage of product creation process, all the phases of concept design, development, engineering, production and use are distributed worldwide within intercultural teams. Therefore, this research is in the context of cultural differences in binational teams, and the three teamwork modes are introduced in distributed intercultural

design teams. That means in this research the effect of different teamwork modes on design quality and team satisfaction are investigated in the context of distributed intercultural design teams. In order to support designers to improve design teamwork in distributed intercultural teams, industrial designers and managers can make use of different teamwork modes in particular sequence for teams and projects with different uncertainty. More specifically, design team members work in competitive mode at first to know each other's strength and the design competency of the design team members from different cultures, then work in collaborative mode to understand the design challenge and the knowledge of the design brief known to the design team members, and work in cooperative mode at end to complete the design teamwork in effective and efficient way.

8.6 Implication for future research

From this research, the questions by two parts have been answered, both design theory for intercultural design studies and design practice for international design teams. Beyond this research, the questions about distributed intercultural design teamwork are also worthy of future research. From the historical perspective, product creation and consumption has transformed from local to global, and related business model and process has also changed accordingly. In the future perspective, product creation and business process will vary continuously, and designers with different cultural backgrounds have to work in distributed teams for different markets and consumers. That means design teamwork plays an important role for future development and designers take teamwork modes into account in accord with future tendency. That requires designers work in distributed intercultural teams, not only be aware of cultural difference but also make use of different teamwork modes. This is the implication for future research about production creation and business process in distributed intercultural design teams. As to the implication for designers, on one hand, cultural differences have to be aware during the design teamwork, on the other hand, teamwork modes can be used to improve distributed intercultural design teamwork.

The results of this study have important implications for design theory and design practice. The implications of these results are to support designers to improve design teamwork in distributed intercultural design teams. As the research progress, it is expected further design exploration of cultural differences and establishes the strong links between culture and design. This research is a step towards design guidelines of future distributed teamwork to support

designers to improve design teamwork in distributed intercultural teams. This research illustrates the influence on design teamwork in the context of cultural differences and facilitates the implement of future distributed design teamwork. This research takes the initiative for further study of design teamwork in other countries and cultures.

8.7 Conclusions on distributed intercultural teams

In the context of international teamwork, design teamwork in distributed intercultural teams has to be taken into account to facilitate design teamwork worldwide. The research is designed to investigate the impact of design teamwork over distance and cross culture in distributed intercultural teams. Different design teamwork modes are used to investigate the impact of design teamwork and facilitate teamwork effectiveness and efficiency. In this design research through four iterative case studies, the importance and difficulty of distributed intercultural design teamwork has been investigated, and accordingly, the influence and usage of teamwork modes has also been illustrated. In the context of cultural difference and distributed team, different teamwork modes can be used for different design teams and design projects to improve the effectiveness and efficiency of design teamwork. Based on the research objective and research questions, the effect of different teamwork modes on design quality and team satisfaction has been investigated and the way of support designers to improve design teamwork has been explored.

As the tendency of global industry and economy, design teamwork is making changes from locally centralized to globally distributed, in line with mass customization and design globalization. In the context of global trend for product development, industrial structure and economic growth have transformed from simplicity to complexity. Accordingly, the demands from consumers and the supplies of production are increasingly global distributed, and that leads to the experience of intercultural impact on both consumers and designers. Therefore, the way of design teamwork should be transformed accordingly for implementation, that requires designers to make use of different teamwork modes in distributed intercultural teams. In the case of international design teamwork, designers should work in suitable teamwork approach to facilitate distributed intercultural design teamwork.

In conclusion, this dissertation has investigated the design teamwork in distributed intercultural bi-national teams, and made use of teamwork modes in different ways for distributed intercultural teamwork. Based on the results of case studies, this research indicated

the importance of design teamwork in distributed intercultural teams and interpreted the approach for distributed intercultural teamwork. Based on the results of iterative case studies, this design research has devoted to the field of intercultural design studies in international design teams, and has contributed to distributed intercultural design teamwork. To conclude this design research, it has studied the product creation and business process from historical perspective, and contributes to distributed intercultural design teamwork for future perspective.

Appendix

Appendix 1 Course Book

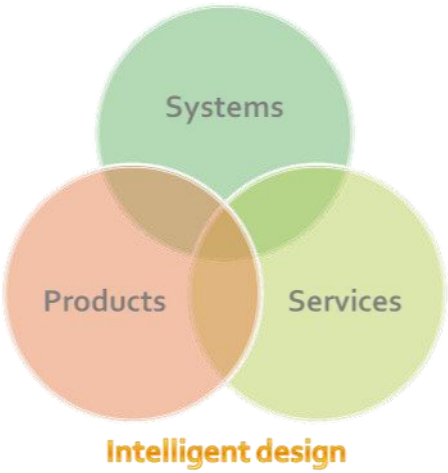
Appendix 2 Self-reflection Diary

Appendix 3 Panel Feedback Form

Design in International Teams
Course Book

1. Introduction

The design of intelligent systems, products and related services is currently a process that takes place, in most cases, in a network of partner companies scattered around the globe. This puts considerable strains on the people creating these systems. Communicating with people in different cultures requires an understanding of the cultural context of communication. In this assignment students actively work with colleague students at another university in a different culture at a longer distance. The idea is to jointly create a system or product with meaningful results for the partner company. For this semester the partner university is Zhejiang University in China.



China's economy is one of the largest in the world. As the large trading nation, its influence on the world economy continues to grow. One of prominent phenomena of globalization is "Made in China". However, this country is trying to move from "Made in China" to "Designed in China". In the globalization economy, it is increasingly important for westerner design practitioners and education to draw a closer view on the characteristics of Chinese design education. Therefore this course is designed to, on the one hand, give students a real life experience of working in bi-national design teams; on the other hand, help getting better understanding on how design teamwork in bi-national design teams works.

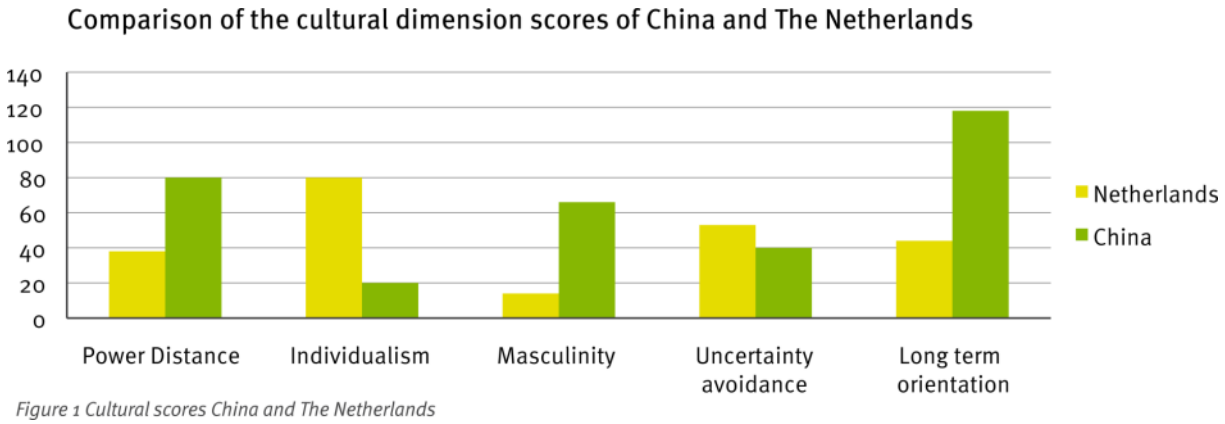


Figure 1 Cultural scores China and The Netherlands

The course is conducted for five continuous weeks. This course is jointly executed by both industrial design students from Eindhoven University of Technology in Eindhoven and Zhejiang University in Hangzhou. The challenge here is to work with an international design team. During this week, they are asked to develop products for consumers. It is very important to take observations on how their different backgrounds influence design decision and communication within the team and how the requirements of consumers with different culture background differ. They are therefore asked to reflect continuously at the team level as well as at the individual level of their design process and to collect actively related user insights based on literatures.

This course consists of an iterative design project following two design iterations. It is very important that they understand the different working and communication culture and behaviour in their team due to a different national cultural background. The teams are encouraged to conduct consumer research by making use of the time differences. Since the project involves teamwork at different time zones, the students at both locations (the Netherlands and China) have to be prepared to work at unusual hours to accommodate with the time differences.

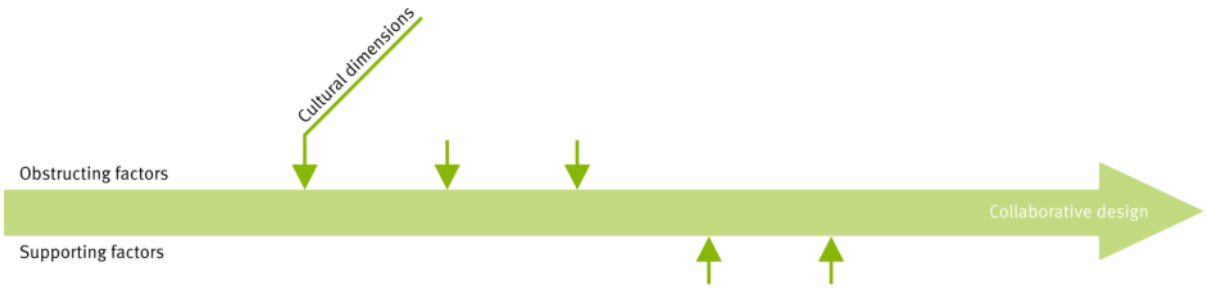


Figure 2 Conceptual framework

2. Learning objectives

Understanding the role of communication between partners located in the different country/cultures/time zone in a joint international design project.

- Learn to collaborate with other cultures
- Learn to design for other cultures (global/local)
- Learn to systematically reflect on your design and design process

3. Design Case

How to move people to move
User experience design for after-stroke recovery period

Design for Ageing

- Active and healthy ageing
- Smart and social ageing

Design for Health
Case studies on elderly health and wellbeing related to gray but mobile project

4. Design process

The timetable of assignment is scheduled every week one day in the afternoon of Netherlands time and in the evening of China time for five continuous weeks.

The formal sessions are organized as follows.

1. Session: kick off, introduction and team composition
2. Session: first iteration reflection, question hours
3. Session: first presentation and panel feedback
4. Session: second iteration reflection, question hours
5. Session: second iteration reflection, question hours
6. Session: final presentation and report evaluation

Kick off meeting

There are three presentations at the beginning of this course, and every presentation takes half an hour.

1. Kick off and theory context
2. Design challenge and design case
3. Design process and course program

Course sessions

This design course takes five weeks, including two iterations. At the beginning of design course, all the designers are divided into teams, and each team contains both Dutch and Chinese designers. Meanwhile, the diversity and balance of cultural differences in each team are assured by grouping students based on their team role measures and cultural measures beforehand.

The detailed learning activities are listed below.

	activities	description	deliverables
s1	kick off	The assignors give presentations about theory, design challenge and design process.	team composition
wk 1	first iteration	Each team works in collaboration modes. They choose a specific target group, and consider the problems and product opportunities.	smooth team communication
s2	question hours	Each team discusses their questions or ideas.	weekly diary
wk 2	first iteration	Each team works in competition modes. They consider the design solution and features, and create possible ideas and original solutions.	target group, idea generation
s3	first presentation	All the teams present their conceptual design, and get feedback suggestion with each other.	first presentation, iterative diary
wk 3	second iteration	Each team works in collaboration modes. They improve design concept and details, and make usability evaluation of final design.	further ideation, selecting concept
s4	question hours	Each team discusses their questions or ideas.	weekly diary
wk 4	second iteration	Each team works in cooperation modes. They make final decision and reach an agreement	final decision, design solution

		on design solution.	
s5	question hours	Each team discusses their questions or ideas.	weekly diary
wk 5	second iteration	Each team works in cooperation modes. They write design report and make prototype.	writing report, building prototype,
s6	final presentation	All the teams present their final design, and get evaluation from assignors.	final presentation, iterative diary

Presentation

The presentation is a 10 minutes elevator pitch. It should explain clearly the consumer insight, design problem, design approach, resulted value proposition, ideas and concepts. If feasible, concept scenarios and low fidelity prototypes should be made to illustrate selected ideas and concepts.

Report

The final report should follow the structure

1. Introduction: background of the course, design problem, report structure (1 page)
2. Intercultural design process and approach (1 page)
3. Results (2-4 pages): a. First iteration b. Second iteration
4. Conclusion and reflection both on team level and individual level (2-4 pages)

The report should be written in English with no more than 10 pages.

Deliverables

- Team Role Self-Perception Inventory (Team composition)
- Values Survey Module (Cultural measurement)
- Self-reflection diary (Team satisfaction)
- Technology Acceptance Model (User acceptance)
- Presentation (two design iterations)
- Prototype (low fidelity)
- Design report (design challenge - target group - design solution)

All deliverables including presentations and reports should be submitted to Dropbox.

5. Course program

In this joint design course, Dutch and Chinese students reflect three different teamwork modes in bi-national design team.

Teamwork modes

Competition design mode: In a joint team, Chinese designers and Dutch designers collect information of target group separately. Then designers from each nation in the design team make an idea generation independently. Afterwards they present and discuss to choose the better idea or to mix them into final design idea, and improve it together as the final solution.

competition	Chinese members	Dutch members
step 1	data collection (user & market)	data collection (user & market)

step 2	data analysis (product opportunity)	data analysis (product opportunity)
step 3	conceptual design (idea generation)	conceptual design (idea generation)
step 4	design selection(present & discuss)	
step 5	final design (presentation) & prototype	
step 6	evaluation (client & designer)	

Collaboration design mode: In a joint team, Chinese designers and Dutch designers collect information of target group in a collaborative way, and then make a collaborative ideation for target market. After discussion, the design solution is improved and the final design is chosen.

collaboration	Chinese members	Dutch members
step 1	data collection (user & market)	
step 2	data analysis (product opportunity)	
step 3	conceptual design (design ideation)	
step 4	detail design (feedback & development)	
step 5	final design (presentation) & prototype	
step 6	evaluation (client & designer)	

Cooperation design mode: In a joint team, Chinese designers collect information of target group, and then Dutch designers dominate the design ideation. Afterwards, Chinese designers give feedback and suggestion to these preliminary design ideas. Finally, Dutch designers make design improvement and final decision, and Chinese designers work out the prototype.

cooperation	Chinese members	Dutch members
step 1	data collection (user & market)	
step 2		data analysis (product opportunity)
step 3		conceptual design (design ideation)
step 4	feedback (suggestion)	
step 5	Prototype	final design (presentation)
step 6	evaluation (client & designer)	

6. Team composition

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 personal cultural character. Team role questionnaire is used to identify their suitable team position.

Team composition

- Team Role questionnaire: Self-Perception Inventory (SPI)

Cultural measurement

- International Questionnaire: Values Survey Module (VSM)

7. Design teamwork

At the end of design course, design teamwork is evaluated measured, containing team satisfaction and design quality. All the designers make self-reflection of team satisfaction. Panel meeting feedback is used for design quality.

Team satisfaction

- Self-reflection diary (activities, teamwork, culture, communication)

Design quality

- Panel meeting feedback form (design concept, user research, presentation, report)

User acceptance

- Technology Acceptance Model (TAM)

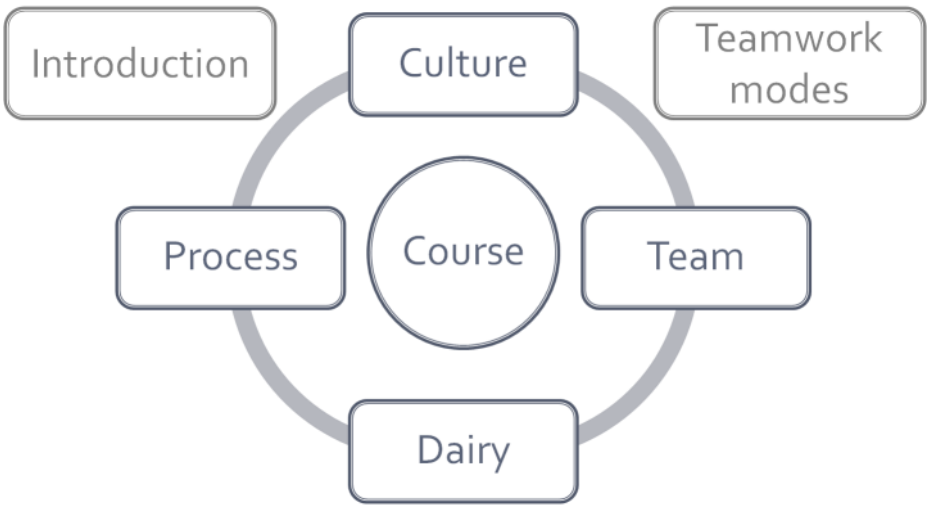
8. Reference and literature

Hofstede, Geert and Hofstede, Gert-Jan. Cultures and Organizations: Software of the Mind. New York: McGraw-Hill U.S.A., 2004.

De Mooij, Marieke. Consumer Behavior and Culture: Consequences for Global Marketing and Advertising. SAGE Publications Ltd, 2003.

9. Contact

Videoconferencing is used for the formal sessions.
Skype is used as the team communication media.



Design in International Teams
Self-reflection Diary

Introduction

Designers have to reflect on their team work, therefore the diary can help you to reflect on your design. Do not share your diary with others, your information will be part of the assignment.

In this design course, diaries are used to investigate how different teamwork modes affect teamwork quality and design result in the context of the cultural differences in bi-national design teams. You will be asked to record: reactions and feelings; specific behaviors; team interactions; activities and events on a daily basis.

Procedure

During the design course, please spend one hour every week to describe your major activities that week in relation to the design course. The activities may include: an internet conversation; writing a document; attending a meeting; discussion with team members; creating ideas, etc. The nature and number of the activities will largely depend on your team role. When describing these activities, please try to answer as fully as possible. The completed record will be considered confidential. At the end of the design course, we collect the diaries and have a general discussion of experiences.

Teamwork mode: competition design

In this teamwork mode, team members have to compete during the design process. In a joint team, Chinese designers and Dutch designers collect information of target group separately. Then designers from each nation in the design team make an idea generation independently. Afterwards they present and discuss to choose the better idea or to mix them into final design idea, and improve it together as the final solution.

competition	Chinese members	Dutch members
step 1	data collection (user & market)	data collection (user & market)
step 2	data analysis (product opportunity)	data analysis (product opportunity)
step 3	conceptual design (idea generation)	conceptual design (idea generation)
step 4	design selection(present & discuss)	
step 5	final design (presentation) & prototype	
step 6	evaluation (client & designer)	

Teamwork mode: collaboration design

In this teamwork mode, team members have to collaborate during the design process. In a joint team, Chinese designers and Dutch designers collect information of target group in a

collaborative way, and then make a collaborative ideation for target market. After discussion, the design solution is improved and the final design is chosen.

collaboration	Chinese members	Dutch members
step 1	data collection (user & market)	
step 2	data analysis (product opportunity)	
step 3	conceptual design (design ideation)	
step 4	detail design (feedback & development)	
step 5	final design (presentation) & prototype	
step 6	evaluation (client & designer)	

Teamwork mode: cooperation design

In this teamwork mode, team members have to cooperate during the design process. In a joint team, Chinese designers collect information of target group, and then Dutch designers dominate the design ideation. Afterwards, Chinese designers give feedback and suggestion to these preliminary design ideas. Finally, Dutch designers make design improvement and final decision, and Chinese designers work out the prototype.

cooperation	Chinese members	Dutch members
step 1	data collection (user & market)	
step 2		data analysis (product opportunity)
step 3		conceptual design (design ideation)
step 4	feedback (suggestion)	
step 5	prototype	final design (presentation)
step 6	evaluation (client & designer)	

Diary (weekly)

Date / Time		Place	
Event/ Activity		Participants	

1. What were your activities in this week?

2. What was your team role in these activities?

3. What was the purpose of these activities in the design process?

4. Please describe the process of these activities in detail.

5. ACTIVITIES

5.1 What were outcomes of these activities?

5.2 What problems were solved in these activities?

5.3 Were there new activities revealed?

5.4 Were there some activities completed, postponed or cancelled?

6. TEAMWORK

6.1 How did you work with Dutch/Chinese team members this week?

6.2 What were the hindering factors in your teamwork with Dutch/Chinese team members?

6.3 What were the supporting factors in your teamwork with Dutch/Chinese team members?

7. CULTURAL DIFFERENCE

7.1 What cultural differences did you feel in these activities?

7.2 How did you deal with the cultural difference in your team?

8. COMMUNICATION

8.1 How did you communicate in your team this week?

8.2 How teamwork mode affected your communication?

Diary (first iteration)

1. **TIME DIFFERENCE**

   1.1 How did you deal with time difference in your design project?

   1.2 What were the problems related to time difference in the execution of your task?

2. **TARGET GROUP**

   2.1 What was your target group in this design project?

   2.2 Why did you choose this target group?

3. **DESIGN CONCEPT**

   3.1 What was your design concept in this design project?

   (Please attach the sketch with descriptive text)

   3.2 How did you get this design concept?

3.3 What was your contribution to that?

4. FIRST ITERATION

4.1 What were the main activities in 1st iteration?

4.2 Please describe 1st iteration with your opinion in your design team.

5. TEAM WORK

What is your reflection on teamwork?

Diary (second iteration)

1. **DESIGN PROCESS**

1.1 What kind of design process steps did you choose in the execution of your task?

1.2 How did they change in approach during your project?

1.3 Why did they change?

2. **DESIGN SCENARIO**

2.1 What was the design scenario in your team?

(Please attach the sketch with descriptive text)

2.2 What was your contribution to that?

3. SECOND ITERATION

3.1 What were the main activities in 2nd iteration?

3.2 Please describe 2nd iteration with your opinion in your design team.

4. TEAM WORK

What is your reflection on teamwork?

5. DESIGN RESULT

What is your conclusion about design result?

Design in International Teams

Panel Feedback Form

1. Student information

Information to identify the student on the feedback form.

Student family name:
Student initials:
Student number:
Group:

2. Overall comment

In this text box you give your overall impression of the student in this module. You can give a summary of his/her overall performance, understanding of and contributions to the module material and his/her (professional) attitude.

3. Quality of deliverables

In this text box you give feedback on the quality of the module deliverables. Chose for each deliverable one statement (good, average or low) remove the other two.

Deliverable	Quality
Design project	
Visual presentation of group design	***Good*/*Average*/*Low***
User test	***Good*/*Average*/*Low***
Collaboration process	
1st iteration	***Good*/*Average*/*Low***
2nd iteration	***Good*/*Average*/*Low***
Diary (personal reflection)	***Good*/*Average*/*Low***
Quality of the Report	***Good*/*Average*/*Low***
Teamwork and Communication	***Good*/*Average*/*Low***

4. Competency development

In this text box, indicate the level in which the student has developed him/herself in this competency area. For the five relevant competency areas, please select the appropriate level (yes, substantially, yes, to some extent or no, although expected) by deleting the other two statements. For a description of the relevant competency areas, please refer to the Appendix A of this document.

Learning activity and development per competency area	
Type of learning activity	Assignment
Ideas and concepts	***Yes, substantially*/*Yes, to some extent*/*No, although expected***
Integrating technology	N.A.
User focus and perspective	***Yes, substantially*/*Yes, to some extent*/*No, although expected***
Social-cultural awareness	***Yes, substantially*/*Yes, to some extent*/*No, although expected***
Designing business processes	N.A.
Form and senses	N.A.
Teamwork and communication	***Yes, substantially*/*Yes, to some extent*/*No, although expected***
Design and research process	***Yes, substantially*/*Yes, to some extent*/*No, although expected***
Self-directed and continuous learning	***Yes, substantially*/*Yes, to some extent*/*No, although expected***
Descriptive and mathematical modeling	N.A.

5. Activities of the design process

This part describes in which activities of the design process the student has done.

Activities of the design process	
Envisioning/transforming society	***Yes, substantially/Yes, to some extent/No, although expected***
Exploring/validating in context	N.A.
Making: synthesis/concretizing	***Yes, substantially/Yes, to some extent/No, although expected***
Thinking: analyzing/abstracting	N.A.

6. Attitude

In this text box, describe and give feedback on the student's attitude.

7. Advice

In this text box you can give the student some advice (content related, attitude, communication or other relevant tips)

(ID education, Eindhoven University of Technology)

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Curriculum Vitae

Jinfan Man was born on 11-12-1983 in Hangzhou China. After finishing Industrial Design in 2006 at Zhejiang University in Hangzhou China, he studied Design Art at Zhejiang University in Hangzhou China. From 2009 he started a PhD project at Eindhoven University of Technology in Eindhoven Netherland of which the results are presented in this dissertation.

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