Cross-Cultural Design of a Groupware Application for Global Virtual Team

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Abstract. The need for supportive and reliable collaborative application is critical; it is also the need for many organizational supports. This paper reports about on-going research on how culture influence should be applied as a requirement when designing a synchronous groupware application as an intercultural collaboration tools aimed for global virtual team which consist of multicultural users. It will try to analyze how culture influences the way users prefer to interact using a groupware. Individuals are conditioned by their culture, therefore in this study we propose to extend Technology Acceptance Model so that we can understand the mechanism by which cultural differences could explain user's behavior toward the acceptance to a groupware application as a remote collaboration tool for global virtual team.

Keywords: Cross-cultural design, groupware, HCI, globalization, global virtual team.

1 Introduction

Computing nowadays has become a global discipline. Many industries are now dealing with the issue of globalization. Globalization extends computing, information, and communication technologies across an increasing number of cultural boundaries, generating a corresponding need for cross-cultural partnerships and due to globalization, global virtual teams are commonplace and the number of virtual teams keeps growing. Global virtual teams with members from different cultures are an emerging trend, although it raises a number of issues variously relating to technology, tasks and people working in their different locations. This raises the issue of cross cultural problems, especially communication conflicts caused by cultural diversity.

Information and communication technology (ICT) plays an important role in supporting international/intercultural collaboration. A tool that can accommodate collaboration and coordination without any barrier to cultural matters is urgently needed and useful. Groupware is a technology explicitly designed to support the work of groups. The importance of understanding culture and the key role it plays in the software industry has substantially increased over the last twenty years [1]. The groupware application and socialization tools that are currently available in the

market are not sufficient to meet the needs of a number of the above human elements necessary to facilitate users' engagement and development of intercultural competence. In order for the new groupware system to be able adopted by globalized industries around the world, the design and interface of the groupware should be able to be used by all cultures across the world. A great attention should be given for the cultural element in creating products and interfaces that are culture "fit" to its users. This research combines many aspects of different study fields, such as computer supported cooperative work (CSCW), intercultural communication and human-computer interaction (HCI). In designing a groupware application where cultural elements will be used, this research paper will propose to extend the Technology Acceptance Model (TAM) so that we can understand the mechanism by which cultural differences could explain user's behavior toward the acceptance of a groupware as a remote collaboration tool for global virtual team.

2   Research Objective

Research exploring issues related to cross-cultural and user-interface design had quickly spread, where earlier research had shown an increase of scholarly interest on cultural factors affecting Human Computer Interaction [2]. However, there is not much research done on how culture influences user's preference and behavior on groupware application. Most groupware that are available for the society to use does not consider any social aspect in the interface design of the application, such as very few research performed the investigation of the differences in cross-cultural understanding of interface design especially for a groupware application. The different backgrounds of people from different culture may cause them to have different expectations and attitudes towards the usage of the tools and functionalities of an application. The different expectations affect the way they learn to use and understand technology. This research contributes knowledge on how to identify user's need to support collaborative activities among culturally and geographically dispersed global virtual team.

The main research question dealt within this paper is: How can a groupware designed in order to be acceptable for multicultural users from the Human Computer Interaction perspectives? The aim of this research is to develop strategies for groupware developers and designers for greater effectiveness in a global setting, an enhanced sensitivity to cultural differences and a respect for future colleagues and team members across the world. It is expected that the result of this research can stimulate innovative collaborations aimed at improving new groupware applications.

At University Duisburg-Essen Germany, a synchronous groupware named PASSENGER has been developed at the Institute of Computer Engineering throughout the last years. This client-server based groupware application enables student teams to communicate and cooperate via internet, even if the members are located at distributed sites [3]. The system has not applied any social aspect which allow multicultural user to collaborate conveniently using the available tools therefore a new system approach is under development namely PASSENGER 2. It will rely on *user-defined* specification to present optimal environment and configuration during its operation. This research suggests solution on how to support cultural differences in the interface design and tools that support for collaboration among culturally diverse users.

3   Research Framework and Hypotheses

The component of cultural influence on specific design preference has been incorporated in the TAM and serves as an extension to TAM for measuring the acceptance of groupware application. The research model explains the system usage of groupware application for globalised industries. It consists cultural influence on specific design preference, perceived usefulness, perceived ease of use, attitude, intention to use and system usage (see Fig. 2).
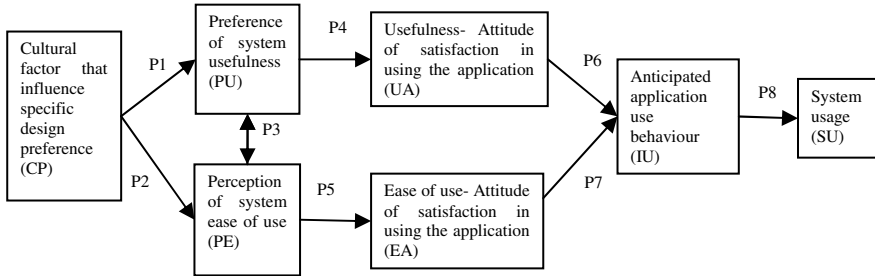

Fig. 1. Research Model

Previous studies have shown that there are various external factors that indirectly influence the acceptance of technology through perceived usefulness and perceived ease of use [4], [5]. In this study, it is expected that cultural preference to be one such external factor affecting the acceptance of groupware application in globalised industries usage, with the hypotheses made as follow:

a.   Culturally Specific Design Preference (CP)

This represents what users want the system to look like and what functionality should be included. User's preference in interface design can be expected to be influenced by culture. The term culturally specific design preference was adopted from the previous research conducted by Evers (1997) [2]. As a result, the following hypotheses are proposed:

P1 : Cultural specific design preference influence user's perception on system usefulness while using groupware application
P2 : Cultural specific design preference influence user's perception about system ease of use while using groupware application

b.   User's perception about system usefulness (PU)

Previous studies on TAM demonstrated strong empirical support for a positive relationship between perceived ease of use and perceived usefulness [4], [5], [2]. The perceived usefulness for a groupware application is defined as the degree to which user believes that using groupware would enhance his/her daily work performance. This suggests that designers/developers should be able to improve perceived usefulness by adding appropriate features and functional capabilities to the groupware application. The importance of this construct can be derived from Davis' TAM

(1989), in which it is said that perceived usefulness affects attitude and behavior both directly and indirectly. When outcome of using a system is perceived to be valuable to the user, then the user will more like to accept the system. Davis (1989) showed that ease of use had a direct effect on perceived usefulness. As a result, the following hypotheses based on TAM-relationship are proposed:

P3 : Perceive ease of use has a positive effect on the perceived usefulness of a groupware application
P4: User's perception on usefulness influence their attitude of satisfaction in using groupware

c.   User's perception about system ease of use (PE)

The perceived ease of use of the groupware application is defined as the degree to which the user believes that using groupware application will be free of effort [6]. Designers and developers of groupware should be able to make the application easier to use by making it easier for users to invoke the functions. As a result, the following hypothesis based on TAM-relationship is proposed:

P5: User's perception on ease of use influence their attitude of satisfaction in using groupware

d.   Attitude of Satisfaction in using the groupware application (EA and UA)

The TAM posits that perceived usefulness and perceived ease of use has a direct effect on attitudes towards using a new technology [7]. Attitude is the degree to which the user is interested in specific systems, which has a direct effect on the intention to use those specific systems in the future and the actual usage of the systems [6]. As a result, the following hypotheses based on TAM-relationship are proposed:

P6: User's attitude of satisfaction in usefulness using groupware have a positive effect on the use of groupware
P7: User's attitude of satisfaction in ease of use using groupware have a positive effect on the use of groupware

e.   Anticipated system use behavior (IU)

When using a system, users' will respond to various ways to the actions of the system. The usage of the system is also affected by perceived ease of use and perceived usefulness [8], [7]. As a result, the following hypothesis based on TAM-relationship is proposed:

P8: User's anticipated behavior or intention to use the application influence user's actual system usage of a groupware application

4   Methods

A survey was developed to explore the TAM model across three different cultures,consisting of Indonesia, Malaysia and Germany. Data were collected by means of a five-page questionnaire (paper-based and web-based). The survey instrument consisted of 39 items to assess seven constructs of the proposed research

model (Fig.2). These items were self created and some were adapted from previous studies [2], [9], [10], which then refined to make them specifically relevant to the present research. These seven constructs were measured on a six-point Likert scale ranging from (1) "strongly disagree" to (6) "strongly agree".

Prior to the hypothesis testing, the measurement scales were examined in terms of the construct validity. In this study, construct validity and reliability were examined using SPSS v.16. Internal consistency was measured by applying the Cronbach's alpha test to each question in the constructs. The measurement items possessed adequate reliability with Cronbach's alpha 0.897 and all constructs had items with Cronbach's alpha above 0.80.

5   Results

The collected data and the proposed structural model were analyses and examined using the Structural Equation Modeling (SEM) approach. SEM is a comprehensive statistical approach to testing hypotheses about relations among the observed and latent variables and allows researchers to perform path analytic modeling with latent variables [11]. The software package used in this study is AMOS 16.0 test the structural model using Newton-Raphson iterative method.

The testing of the research model shown in Fig. 1 involves the evaluation of the structural model and its related measurement model. The measurement model represents the relationships between the latent variable and observed variables, and is tested to determine if the measurement possess satisfactory psychometric properties, in order to determine if the items in the questionnaire measure what they are supposed to measure. It is only possible to proceed evaluating the structural model for theory testing when the measurement model has adequate psychometric properties [12].

The data analyses were made to determine whether the differences between the three sample countries were significant. The total collected data in this study is 599 respondents. A minimum sample of 100 to 200 is considered adequate for structural equation modeling analysis [13]. The result of the analysis revealed that cultural specific preference as one of the external factors in TAM model was significant in explaining usage behavior in both Indonesia and Malaysia, but not in Germany.

The initial analysis was performed for all three models to assess the measurement model for each country's users (see Table 1). CMIN/degrees of freedom (d.f), goodness-of-fit index (GFI), adjusted goodness-of-fit index (AGFI), and root mean square residual (RMSR) were used to measure the model fitness. The model value for each country shows that the model overall shows good result (<5). This shows that the validity of the model can be trusted. The model value described the sample (GFI) and then it is readjust (AGIF). The data is analyzed using 95% confidence level (alpha = 0, 05). Most of the fitness measures were acceptable.

Table 1. Goodness of Fit Result

Goodness of Fit	Indonesia	Malaysia	Germany
d.f	4.879	3.216	2.634
GFI	0.781	0.684	0.83
AGFI	0.701	0.641	0.739
RMSEA	0.124	0.092	0.128

The statistical significance causal relation was examined, the summary result may be found in Table 2. The model Malaysia (Fig. 3) presents a good fit, which mean the collected data matches the research model. For Indonesia (Fig.2) and German (Fig. 4) model presents a good fit, but several data results did not match the result model.

Table 2. Summary of Hypotheses Result

Hypothesis	Country	Result	Relation value	Significant p value
P1 : Cultural specific design preference influence user's perception on system usefulness while using groupware application	Indonesia	Supported	2.524	<0.05
	Malaysia	Supported	0.243	<0.05
	Germany	Not supported	-0.001	0.99
P2 : Cultural specific design preference influence user's perception about system ease of use while using groupware application	Indonesia	Not supported	0.043	0.893
	Malaysia	Supported	0.878	<0.001
	Germany	Not supported	0.082	0.281
P3 : Perceive ease of use has a positive effect on the perceived usefulness	Indonesia	Not supported	-0.513	<0.05
	Malaysia	Supported	0.649	<0.05
	Germany	Supported	0.434	<0.05
P4: User's belief on usefulness influence their attitude of satisfaction in using groupware	Indonesia	Supported	0.394	<0.05
	Malaysia	Supported	1.032	<0.001
	Germany	Supported	2.258	<0.05
P5: User's belief on ease of use influence their attitude of satisfaction in using groupware	Indonesia	Not supported	0.075	0.988
	Malaysia	Supported	0.858	<0.001
	Germany		0.787	<0.05
P6: User's attitude of satisfaction in usefulness using groupware have a positive effect on the use of groupware	Indonesia	Supported	1.689	<0.05
	Malaysia	Supported	0.855	<0.05
	Germany	Supported	0.548	<0.05
P7: User's attitude of satisfaction in ease of use using groupware have a positive effect on the use of groupware	Indonesia	Not supported	0.2	0.696
	Malaysia	Supported	2.336	<0.05
	Germany	Not supported	-0.13	0.86
P8: User's anticipated behavior or intention to use the application influence user's actual system usage	Indonesia	Supported	0.09	<0.05
	Malaysia	Not supported	0.046	0.356
	Germany	Not supported	-0.051	0.6
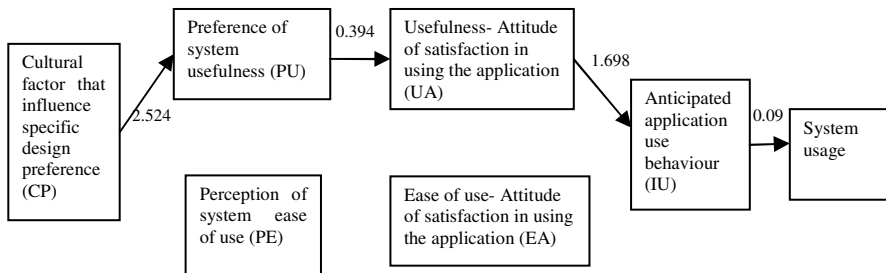
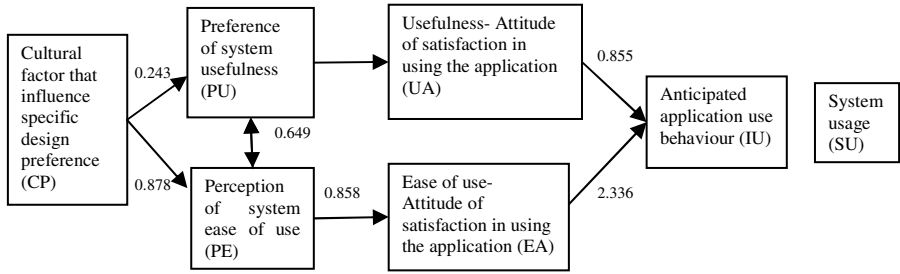**Fig. 2.** Signification relation result for Indonesia

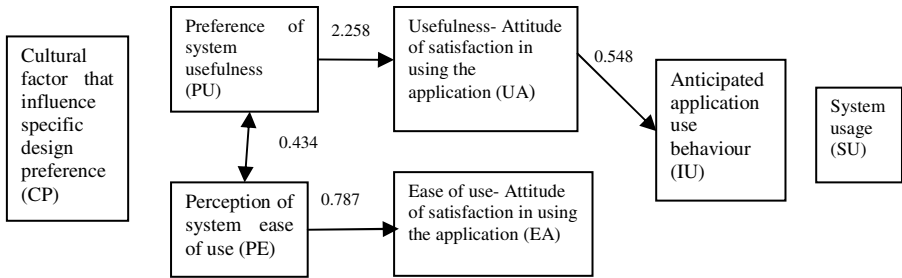**Fig. 3.** Signification relation result for Malaysian model

Fig.4. Signification relation result for Germany

6   Discussion

User preference and behavior within global virtual teams differ across cultures. Culture awareness is the crucial topic in international collaboration. Each culture has its own cultural values and style of communication. To better communicate with each other, one must distinguish some enormous difference between the cultural backgrounds. Designers and developers of global intercultural collaboration application need to be aware of the views of user's preference in order for the system to be useful. An example of a collaboration application is known as groupware. Groupware is a categorized as a social technology [14], where groupware is specifically designed and developed to support group of users working together in order to achieve common goals. In this research, the intent was to predict user's acceptance of a cultural designed groupware through the lens of the TAM by adding cultural factors that influence specific design preference to the model and explore whether user's are willing to adopt and use groupware application with cultural-influenced interface design.

The consideration of culture, as a social influence and how it affect the commitment of user toward the use of groupware system seems important for understanding, explaining, and predicting system usage and acceptance behavior. The findings of this study suggest that cultural influence play an important role in determining the acceptance and usage behavior in adapting new groupware

technologies. The result of this empirical study validates the proposed research model and hypotheses, and demonstrates that the hypotheses can be supported. Cultural specific design preference influences user's preference of system usefulness and user's perception of system ease of use. When users get greater satisfaction with culturally design interface system (e.g., it is interesting, not too hard, and meets the needs of users at different levels), the stronger their feelings about its usefulness and ease of use. In term of ease of use, it is when the system design is developed in a more culture-friendly form, users will feel more comfortable and find the system familiar and easier to use.

The findings demonstrate the existence of cultural differences in terms of users' specific design preference toward groupware acceptance. Users (from all three countries) show diverse preferences in features and acceptance process. Cultural specific design preference showed by the result is significant only for Indonesia and Malaysia, although the acceptance process seems to run differently from the two Asian groups (Indonesia and Malaysia). For the Indonesian user, acceptance's path is routed through cultural specific design preference, usefulness, attitude of satisfaction, and system usage, without having any relation to its perception of ease of use. This suggest that Indonesian user is only satisfied by the usability of the system rather than the easiness of the system, especially since the system use behavior and system usage is also affected by the system usefulness. The Malaysian model path flows to move more strongly along the ease of use side path. The "usefulness" path shows weaker significant relation compare to its "ease of use" path and the anticipated application use behavior did not show any significant relation to the system usage. The results suggest that Malaysian attitudes of satisfaction are attributable to user's preference and perception of system ease of use.

In the Indonesian model as elsewhere [15-18], perceived usefulness is the key aspect of adoption in comparison to perceived ease of use. One interpretation that can be used for this study is that as the groupware system become easier to use and users become more aware in the usage of the technology, the variation perceived ease of use dimension is reduced. The most interesting observation with the German users is that culturally design preference shown no significant relation to user's belief of usefulness and perception about system ease of use. Although result shows usefulness and ease of use seem to drive attitude of satisfaction, but only satisfaction of usefulness show significant relation towards users anticipated system use behavior. The German model indicated a non-significant relationship between cultural preference to both usefulness and perceived ease of use. This may suggest that the German user perception of usefulness and ease of use are not dependent to the design of the system that is made customized for multicultural users.

The result of this study suggest that Indonesian users find usefulness a more important variable toward the acceptance of a new application, Malaysian users find ease of use as more important, while German users seems to find a system to be acceptable when it meets their preferences in the system usefulness and ease of use, and not affected by the culturally specific interface design. This implies that Indonesian will be willing to try to cope with a useful interface design, even when it rather complicated to use. Malaysian, on the other hand, will have the tendency to

give up more easily when dealing with a complicated to use interface. Also, Malaysia's perception of ease of use influences anticipated system use behavior. This connote that when users find a groupware system that is easy to use, they will also be satisfied in using the system. Indonesian users, conversely, preference of system usefulness influence their attitude of satisfaction implies that when preferences for the design features are met, users will be satisfied with the groupware application usage. For Indonesian users, there seems to be no need to find out whether the system is easy to use. Maybe Indonesian users find that their needs and demands for ease of use are met when the system is designed the way they want it to, in which certain functionality levels must be met. Within the German users, the interface design of the groupware application seems not necessary to be influenced by cultural factors, since there is not significant relationship between cultural factor influencing specific design preference to neither system usefulness nor ease of use. However, both system usefulness and ease of use do influence their attitude of satisfaction in using the application. This would suggest that German users put more emphasis on the functionality provided by the systems than on the way the interface system is designed.

7   Conclusion

In this study, it shows that TAM provides explanation for groupware adoption and usage in all three countries studied, although with less effect for Germany. Relationships among primary TAM constructs found in this research are largely consistent with those typical in previous TAM research. The impact of usefulness in user's attitude of satisfaction on user's anticipated application use behavior is not as strong as that of user's belief on ease of use in user's attitude of satisfaction in using groupware. It shows that user's would be more intended to use a system that is easy to use rather that useful but complicated to use, especially since modern applications are becoming more and more sophisticated. The differences found in each culture can be concluded that culture does play an important role in determining users' preference in working with a groupware application. The main purpose of this study is to provide guidelines to developers in establishing an easy to use groupware and a useful groupware for its targeted users. In terms of user-interface design, an application that is comfortable and easy to use user-centered should be designed.

The main contribution of the expected result from this study is a requirement set provided for developers and designers to design a synchronous groupware applications for users of different cultures, in order to make technology to adapt to user's needs. Another expected result from this study, the result will be use as a requirement set for next generation groupware PASSENGER 2 that is currently under development at the Institute of Computer Engineering, University Duisburg-Essen. By implementing the cultural analysis to the PASSENGER 2 system, it will make this new groupware as an intercultural collaboration supporting tool, as well as a flexible synchronous groupware that can adapt to user's preference setting and provide the environment that promotes interest and respect for the backgrounds of all participants.

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