Individual Trust Development in Computer Mediated Teamwork

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ABSTRACT

Facilitated group collaboration is evolving into a new generation in Web 2.0 using new technology such as online group systems. Building trust is vital to group collaboration. Risk, benefit, utility value, power and interest are six factors that influence individual trust development. This paper further develops the Scale Balance Model based on the Individual Trust Development Model in order to investigate individual trust development in facilitated group collaboration. There is a two stage investigation using a survey from face-to-face student groups with Web based group system support. The model is used to analyse the individual trust development in the sample. The results of applying the improved model can help give feedback and advice for future collaboration research.

Categories and Subject Descriptors

H.5.4 [**Information Interface and Presentation**]: Hypertext/Hypermedia– *Architectures, Theory, User issues*

General Terms

Measurement, Performance, Design, Human Factors

Keywords

Trust, Collaboration, Communication, Human, Web, IT

1. INTRODUCTION

Web science has been developing very fast during the recent years. In the age of Web 2.0, there are various new collaboration tools and technologies emerging such as Facebook, Second Life, GroupSystems™(ThinkTank). Many organizations have turned to group collaboration support technologies in order to increase

efficiency and effectiveness [1]. There are both face-to-face collaboration and distributed collaboration in teams, both of which have advantages and disadvantages [2]. The internet technology and the global society are also developing very fast whilst the collaboration and facilitation technology has been used in computer mediated teams which could be either face-to-face or purely distributed.

Group Support System (GSS) is an information communication and sharing technique that has been an indispensable collaborative tool for enabling efficient and effective communication over time and distance barriers [3]. It is reported by Wenger [4] that as members of a Community of Practice (CoP) [5], the facilitators/managers are also valued according to what they bring as practitioners in terms of information and their willingness and ability to share it, rather than any predetermined hierarchical or status value. The thinkLet which is comprised of five general patterns: diverge, converge, organize, evaluate, and build consensus was proposed by Briggs and Vreede [6] to help group collaboration and decision making. It is also estimated that the market for collaboration software, especially for Web conferencing and team-based collaboration tools, will grow rapidly [7] [8] [9]. GroupSystems™ which is a Web based collaboration system has been chosen as the key technology for implementation of collaborative tools using thinkLets in recent research [10] [11].

However, trust which is categorized as the most important unique factor for computer mediated teams has already been influential, particularly in global collaboration [12]. Kollock [13] deals comprehensively with the individual's perceptions of risk within a range of community based contexts, where risk and trust are dynamically related. To the engineer, trust is also seen as a feature and a subsystem which is an engineering problem that could be overcome, someday, with the right combination of usability design, standards, and architectural decomposition [14]. There are many studies about trust between each other in a team and also trust in an online environment [12] [15] [16] [17].

Individual trust is the trust based on individual factors. These factors represent conflicting priorities of the individual. They are therefore represented as balances [14]. However, there is little research about individual trust within the team/group

collaboration. How individual trust could affect the group collaboration and decision making, and why and how the individual could trust the team seems to be a potential area to be explored. Risk, benefit, utility value, interest and effort are important factors related to individual trust in the group collaboration [14] [18] [19]. Nolan et al.[14] has deconstructed individual trust into its six measurement parts: Risk which is associated with providing information to unknown recipients and acting upon information received from them; Benefit which is an overall perception that involvement will provide individual gain; Utility value which is measured by high information quality such that it can be absorbed into immediate practice; Interest which indicates an inherent interest in the system and the information available; Effort which is exerted to acquire information; Power which is an individual's ability to influence others by means of his/her superior knowledge and/or access to information. Therefore, for example, the first balance in Nolan's individual trust development model [14] represents the conflict between the individual's perceived utility and risk.

In order to analyse the individual trust development for computer mediated teamwork over time, we have applied the individual trust development model which has been further developed by us into a scale balance model in the context of online group collaboration. In section two, we are going to introduce the scale balance model and the results of the face-to-face student group on Web based collaboration. In the next section, the individual trust development of student groups which are chosen to do a face-to-face two stage collaboration with online group system support will be analysed with the scale balance model. The conclusion and discussion will be given in section five.

2. METHODS

2.1 Individual Trust Development Model

A trust development model which focuses upon the interaction between levels of participation and trust-specific factors is stated by Nolan et al. [14]. The concept of balance between each individual trust factors has been introduced in this model initially used for online communities. Please see figure 1 which shows individual trust balance results in initial, middle, and final stages.
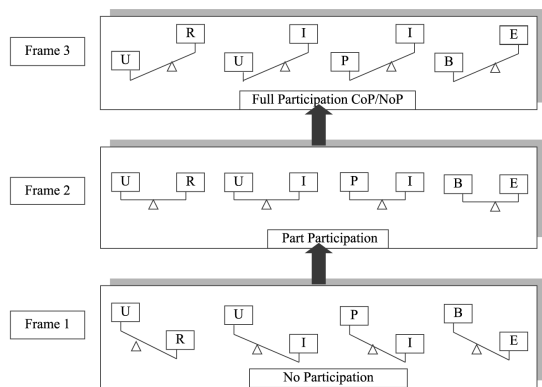

Figure 1. Trust development model for online community

(Adapted from Nolan et al. [14])

In this model, U stands for Utility, R stands for Risk, I stands for Interest, P stands for Power, B stands for Benefit, and E stands for

Effort. It is also proposed by Nolan et al. [14] that each factor is evaluated relative to one or more of the others. The "balance" between them dictates an individual's readiness for collaborative behavior. A series of sets of the factors representing the weighing which is apportioned by individuals as they interact with others in a virtual community is used to illustrate this evaluative procedure [14].The model is composed of three frames which stand for three stages over time. In different stages, the balance changed and each factor displaces another factor. With the individual trust development over time, the balance between factors is changing.

2.2 Scale Based Individual Trust Development Balance Model

Although this individual trust development model is firstly used for individual trust development for online communities, it is also applicable for individual trust building for computer mediated teamwork. We have further developed the model by adding a scale. The scale from 1 to 5 is added to the left on the edge of the box which can give each factor a detailed value which is measured from the bottom line of each small box. This can make us see the balance in more detail even for some imperceptible balance which can also show different degrees of the balance slant. This scale balance model uses a data input from 1 to 5 which is coming from a survey designed according to the six factors definitions for individual trust development. A sample scale balance model for initial stage collaboration is shown in figure2.
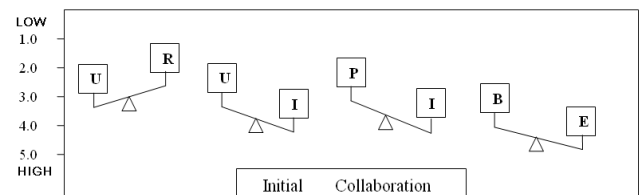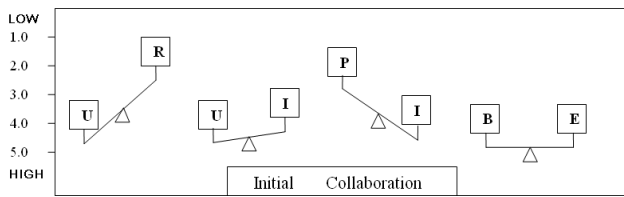

Figure2. Sample A scale balance model for initial stage

In this balance model as with the initial one, U stands for Utility Value, R for Risk, I for Interest, P for Power, B for Benefit and E for Effort. For instance, risk value 5 is the highest risk whilst the risk value 1 is the lowest risk. Power value 1 is the lowest power and power value 5 is the highest power. For this sample group, the position of each factor in the figure is based on the data from the survey. For instance if the survey shows an average value of the risk factor in a sample group is 2.2, we give a risk factor a value as 2.2 in the model. Therefore some pairs of balance boxes could have a higher position and some others may have a lower position.

Take the figure 2 for example, in this sample group, Utility outweighs Risk, Interest outweighs Utility Value and Power, Effort outweighs Benefit. It indicates that Utility Value adds more value to an individual's decision making process in collaboration than Risk, whilst Interest displaces the Utility and Power value for better effect in influencing individual's trust status and decision making process in group collaboration. At the same time, Effort which has a larger value means the participants perceived they had done more effort than the benefits they received.

Figure 3. Sample B scale balance model for initial stage

However, different groups may have different values for the six factors for individual trust development in the group collaboration. Figure 3 shows us another sample from another group in the initial stage of collaboration. When we compare sample A and B, we can find that they both have some factors that outweigh some other factors. They have different degree slants in outweighing which means that, some groups have larger contrast whilst some others may have very tiny differences. When comparing those two factors, they may also have the same result in outweighing. For instance, sample B has a larger outweighing trend than sample A by comparing utility value and risk which means the utility value versus risk in sample B has a greater degree of influence with a bigger outweighing than group 1. It could also mean that sample B may have a better initial collaboration result from the view of the individual trust.

We can also compare different balance changing trends for individual trust development factors over different stages for the same group. This is made easier by this model as it turns qualitative information into quantitative. Therefore it adds a quantitative aspect to the visualization of the balances. Both of these aspects of the evolved model seem to be useful. The scale balance model will be useful for us to analyze the individual trust development in facilitated group collaboration. On one hand, by comparing the difference between groups, we can use the scale balance model to help find out the different changing trends of the balance of the six individual trust factors among different groups in order to investigate the reasons behind good or bad group collaboration. On the other hand, we can also find out for one sample group, how their individual trust develops over time and then investigate the reasons.

3. CASE STUDY ANALYSIS
3.1 Survey
Based on the definition of the six factors of individual trust mentioned by Nolan et al [14] and a facilitated group session of suggestions by some other researchers, we have used the six factors to design the individual trust development survey for the computer mediated collaboration teams.

The survey is designed and integrated into GroupSystems™ session using its online voting and analysis report function. Two surveys were taken after two stages of group collaboration experiments of the student groups. In order to help the team participants to understand the questions, we separated the questions into several statements. There were 36 statements which attempted to capture the participant's position on the 6 factors. The participants of the survey in each group were required to respond to the statements on a scale of 1 to 5. 1 represents strong disagreement and 5 represents strong agreement. For instance, value 5 for risk is the highest risk. The value of the collected data

is set according to the level of agreement and disagreement. Each value of the factors in each group was calculated. For instance, in a group, *interest* was calculated according to the responses to six statements. Averages from the responses by each group were calculated. This was conducted at the first and second stage of the collaboration in order to identify the changes in individual trust.

3.2 Sample
The plan was to use the scale balance model to first analyse the individual trust development over stages for Web based group collaboration in a face-to-face environment. Students who come together for a group project are frequently used target users for researcher testing or evaluating techniques and models in the group decision and collaboration research area [20][21][22][23]. Thus we decided to choose eight groups from a university. There were six students in each group. They were at the same lab sessions over two semesters. The student groups were using GroupSystems™ (ThinkTank) as facilitated group collaboration software. They were all novices to the GroupSystems™ at the first day of the team project but they seemed to be using the software competently after some brief training.

Each group had the same team project which was to evaluate and redesign a website. They could see and talk with each other in the lab. They also discussed face-to-face in the collaboration process with their group members for some sub sessions such as *popcorn sort* to build consensus. There was also a facilitator from the university to help facilitate the collaboration sessions in the lab. They have different tasks in each session. The collaboration sessions were running once a week and our surveys were taken twice in the two semesters. The facilitator was doing the facilitation role running all the sessions for all eight groups of participants in the lab at the same time. Some common thinkLets had been used in the collaboration process and scripts design such as *free brainstorming, popcorn sort, one page, fast focus, straw poll, bucket walk,* and *crowbar* [5]. For the survey session, anonymity which encourages more open and honest discussions was applied [9].The value of the variables in the survey is associated with the scale value for the scale balance model.

3.3 Results
With the survey, we successfully collected data from the two stages, which was the initial stage in the use of the GroupSystems™ at the beginning of the first semester and then the second stage at the end of the first semester. The overall trend was that there was little change to the previous value, but for different groups there are many slight changes. The data has been put into the following table1 (initial stage) and table 2(2nd stage).

Factors Group Name	Risk	Benefit	Utility Value	Interest	Effort	Power
Group1	2.2	3.6	2.9	3.9	4.3	2.7
Group2	2.6	4.0	3.5	4.0	4.1	3.3
Group3	2.2	4.0	3.7	4.2	4.3	2.6
Group4	2.6	3.8	3.5	4.0	3.6	2.8
Group5	2.3	3.2	3.4	3.6	3.7	2.7
Group6	2.5	3.6	3.5	3.8	3.9	2.9
Group7	2.0	4.3	4.2	4.1	4.3	2.4
Group8	2.1	3.7	3.7	3.8	4.4	2.5
Overall	2.3	3.8	3.6	3.9	4.1	2.7

Table 1. Initial stage individual trust development value

Factors Group Name	Risk	Benefit	Utility Value	Interest	Effort	Power
Group1	2.7	3.6	3.6	3.4	3.8	2.9
Group2	2.7	3.5	3.3	3.5	3.6	3.1
Group3	2.1	4.6	3.7	4.3	4.2	2.9
Group4	2.4	3.7	3.8	3.9	3.8	2.5
Group5	2.6	3.5	2.9	3.6	3.7	2.9
Group6	2.0	4.1	3.9	4.1	4.0	2.4
Group7	2.0	4.6	4.2	4.4	4.5	3.3
Group8	1.9	3.8	3.4	4.0	4.0	2.7
Overall	2.3	3.9	3.6	3.9	4.0	2.8

Table 2. Second stage individual trust development value

The data can also be seen in another way like figure 6. In order to be understood easier, each of the groups and the overall group could have a figure like this which compares their first and second stage results. All these results will be put into the scale balance model for analysis.
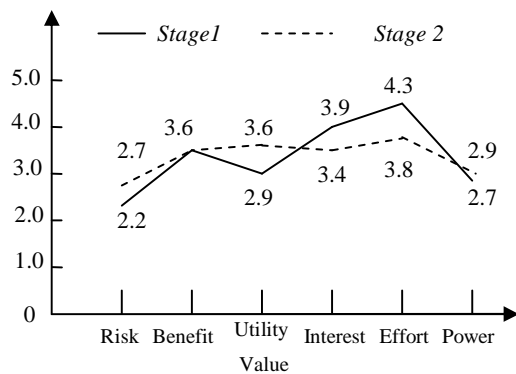

Figure 6. Group 1 two stages collaboration trust results

We can also find that from the table there are some changes when comparing with the first stage value. The overall trend is positive as three factors have been changed towards the ideal value. In the next section, we are going to use the scale balance to compare the first stage and the second stage trust development.

4. INDIVIDUAL TRUST DEVELOPMENT
4.1 Analysing Individual Trust Over Stages
We have chosen the sample group 1 to have an analysis on the individual trust over two stages by using scale balance model which is shown in the figure 8.
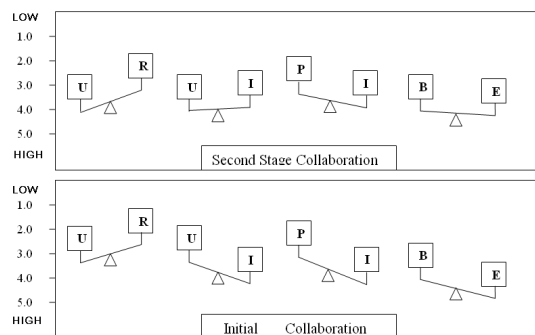
Figure 8. Group 1 Individual trust development

In group one, in relation to the initial stage, *risk, utility value* and *power* went down, *benefits* stayed the same, *interest* and *effort* went up. In the outweigh status, there is one significant change which is that *utility value* changes to outweigh the *interest* which means *utility value* is taking a more important role in decision making in the group collaboration process than *interest*. Their original interest in the information coming from the interaction transformed into a high *utility value* as they appreciated the quality of that information within the scale balance model. This combines the benefits of the model which visually represents the key variables and their relationships with the empirical evidence. This is useful for system design, the facilitator, and other researchers in collaboration. In this example it would enable the facilitator to compare between groups or for the same group over different periods of time to assess performance, measure trends and carry out further analysis.

Furthermore, even when some factor outweighs some other factor, it has different degrees in outweighing which means that, some groups have larger contrast whilst some other may have a very small difference when comparing on those two factors despite also having some result in outweighing. Therefore the scale enabled us to represent the empirical evidence of the research accurately.

4.2 Further Investigation and Development
By investigating into the reason for the significant change, we have also interviewed the students in the group, and we found that the change of the utility value versus interest was caused by several reasons. Taking the *interest* for instance, apart from interest turning into utility, some people lost interest. This was identified by a specific question. Fewer people were interested in collaborating with others in the team compared to the previous time, and less people were interested in the topics of the team project than before. Furthermore, some people were more interested than others in continuing to work together and some thought that certain contributions were not useful. These opinions may have been caused by conflict during the team collaboration such as certain contributions being rejected. This also indicates that the facilitator may need to consider some more work to improve their facilitation skills in group control and intervention as these comments and the factors show room for improvement. However, for the *utility value*, although they have lost some interest, they have gained more information and can absorb that information from the collaboration more easily than before. Furthermore they had the opinion that what they had gained in the collaboration could be put into practice. The facilitated collaboration was successful because the students gained more utility value over those two stages. This further investigation illustrates that the usefulness of the scale balance model for trust goes beyond just assessing trust when applied to the collaboration area. It can be used in a collaboration effort for useful analysis by using any of the balances over time or between cases.

5. CONCLUSIONS AND FUTURE WORK
Individual trust development is vital to computer mediated teamwork. We have applied and further developed a method which is a scale balance model to support individual trust development analysis. We have chosen eight student groups who are going to do an interactive team project with a Web based group support system (GroupSystems™) in a face-to-face environment. From the two stages of the survey, we have found

that there are changes in each group. The average trend in the first two stages is positive. Although there are slight changes in the first two stages, it is also obvious to see the change in the scale balance model for some groups. This would help in future collaboration research.

Compared with the original model which was in the context of online communities, we have tested it in the new context of group collaboration. We have also improved some features and functions by adding scales and making it more detailed in order to compare the balance between factors. Compared with the initial model, firstly, it translates qualitative data to quantitative enabling better anlaysis of the individual trust development of a group and between groups. Secondly, the initial model can not compare the different degrees of the same outweighing trend but the scale balance model can help with that. Furthermore, we can also easily indentify small balance changes in the individual trust development over stages. It is also considered that the enhanced model is able to help investigate the individual trust development in computer mediated teamwork area.

In the future, we will complete the survey for the third stage using student groups. There will also be further interviews with the student groups and a further analysis of the individual trust for Web based group collaboration in the face-to-face environment. Further cycles would be useful to validate our initial findings and the value of this tool in this environment. More details about improving facilitator skills by using this model will be investigated in future research. More feedback and solutions to help building a high level of trust will also be given. A further study of individual trust development for pure distributed global facilitated collaboration will also be considered in the future. Furthermore we aim to compare and identify the best solutions for building individual trust for the both face-to-face and purely distributed group collaboration.

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