Individual trust development in computer mediated teamwork

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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])](image)

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 figure 2.

![Figure 2. Sample A scale balance model for initial stage](image)
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 twice in 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).

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

Table 1. Initial stage individual trust development value
4.1 which is shown in the figure 8. Individual trust over two stages by using scale balance model. We have chosen the sample group 1 to have an analysis on the first stage and the second stage trust development. In the next section, we are going to use the scale balance to compare the stage results. All these results will be put into the scale balance model for analysis.

Table 2. Second stage individual trust development value

<table>
<thead>
<tr>
<th>Group Name</th>
<th>Risk</th>
<th>Benefit</th>
<th>Utility Value</th>
<th>Interest</th>
<th>Effort</th>
<th>Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group1</td>
<td>2.7</td>
<td>3.6</td>
<td>3.6</td>
<td>3.4</td>
<td>3.8</td>
<td>2.9</td>
</tr>
<tr>
<td>Group2</td>
<td>2.5</td>
<td>3.5</td>
<td>3.7</td>
<td>3.5</td>
<td>3.6</td>
<td>3.1</td>
</tr>
<tr>
<td>Group3</td>
<td>2.1</td>
<td>4.6</td>
<td>4.3</td>
<td>4.2</td>
<td>4.2</td>
<td>2.9</td>
</tr>
<tr>
<td>Group4</td>
<td>2.4</td>
<td>5.7</td>
<td>3.8</td>
<td>3.9</td>
<td>3.8</td>
<td>2.5</td>
</tr>
<tr>
<td>Group5</td>
<td>2.6</td>
<td>3.5</td>
<td>2.9</td>
<td>3.6</td>
<td>3.7</td>
<td>2.9</td>
</tr>
<tr>
<td>Group6</td>
<td>2.0</td>
<td>4.1</td>
<td>4.1</td>
<td>4.0</td>
<td>4.0</td>
<td>2.4</td>
</tr>
<tr>
<td>Group7</td>
<td>2.0</td>
<td>4.6</td>
<td>4.2</td>
<td>4.4</td>
<td>4.5</td>
<td>3.3</td>
</tr>
<tr>
<td>Group8</td>
<td>1.9</td>
<td>3.8</td>
<td>3.4</td>
<td>4.0</td>
<td>4.0</td>
<td>2.7</td>
</tr>
<tr>
<td>Overall</td>
<td>2.3</td>
<td>3.9</td>
<td>3.6</td>
<td>3.9</td>
<td>4.0</td>
<td>2.8</td>
</tr>
</tbody>
</table>

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.

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.

Table 2. Second stage individual trust development value

<table>
<thead>
<tr>
<th>Group Name</th>
<th>Risk</th>
<th>Benefit</th>
<th>Utility Value</th>
<th>Interest</th>
<th>Effort</th>
<th>Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group1</td>
<td>2.7</td>
<td>3.6</td>
<td>3.6</td>
<td>3.4</td>
<td>3.8</td>
<td>2.9</td>
</tr>
<tr>
<td>Group2</td>
<td>2.5</td>
<td>3.5</td>
<td>3.7</td>
<td>3.5</td>
<td>3.6</td>
<td>3.1</td>
</tr>
<tr>
<td>Group3</td>
<td>2.1</td>
<td>4.6</td>
<td>4.3</td>
<td>4.2</td>
<td>4.2</td>
<td>2.9</td>
</tr>
<tr>
<td>Group4</td>
<td>2.4</td>
<td>5.7</td>
<td>3.8</td>
<td>3.9</td>
<td>3.8</td>
<td>2.5</td>
</tr>
<tr>
<td>Group5</td>
<td>2.6</td>
<td>3.5</td>
<td>2.9</td>
<td>3.6</td>
<td>3.7</td>
<td>2.9</td>
</tr>
<tr>
<td>Group6</td>
<td>2.0</td>
<td>4.1</td>
<td>4.1</td>
<td>4.0</td>
<td>4.0</td>
<td>2.4</td>
</tr>
<tr>
<td>Group7</td>
<td>2.0</td>
<td>4.6</td>
<td>4.2</td>
<td>4.4</td>
<td>4.5</td>
<td>3.3</td>
</tr>
<tr>
<td>Group8</td>
<td>1.9</td>
<td>3.8</td>
<td>3.4</td>
<td>4.0</td>
<td>4.0</td>
<td>2.7</td>
</tr>
<tr>
<td>Overall</td>
<td>2.3</td>
<td>3.9</td>
<td>3.6</td>
<td>3.9</td>
<td>4.0</td>
<td>2.8</td>
</tr>
</tbody>
</table>

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.

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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 analysis 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 identify 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 student groups. There will also be further interviews with the student groups and a further analysis of the individual trust for student groups. There will also be further interviews with the student groups.

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6. REFERENCES


