

A Case Study of Individual Trust Development in Computer Mediated Collaboration Teams

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Abstract

Individual trust development is vital to online collaboration in teams. A semi-virtual case study, which is composed of eight collaborative student groups using Web based computer support, is tracked by the authors over one year. Surveys, interviews and documentation are applied in the data collection. A scale balance model and trust spider diagram are used to analyze the data for all three stages of this case study. A sample group is analyzed in this paper. This research offers insight into how individual trust develops over time in computer mediated collaboration. The results of each group in this case are discussed. Some new trust factors which may be important to individual trust development are also presented in this paper.

1. Introduction

The proliferation of technologies such as the internet and practices such as working from home have pushed the world forward onto a new level of collaboration. People are using the computer and new technology for communication and collaboration online instead of the traditional face-to-face. In recent years, there are various kinds of technologies and tools such as IBM Lotus, Second Life and GroupSystems™ which are being used by participants to communicate and collaborate. Furthermore, the need to solve complex problems often requires the ad hoc formation of teams with diverse skills and backgrounds. The degree of trust formed in these groups along with the technology will influence the outcome.

It is estimated that the market for computer mediated collaboration software, especially for Web conferencing and team-based collaboration tools, is growing rapidly [1] [2]. GroupSystems™ which is a computer mediated collaboration system has been chosen as the key technology for implementation of collaborative tools in recent research [3] [4].

Social factors have been found to be decisive. Trust has been identified as being most influential of all the factors in computer mediated collaborations [5]. Trust is defined as 'the willingness of a party to be vulnerable to the actions of another party based on the expectation that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other party' [6]. Kollock [7] deals comprehensively with individual perceptions of risk within a range of community-based contexts, where trust and risk are dynamically related. There are also many studies about trust between members in a team and also trust in an online community [5] [8] [9] [10].

Individual trust is based on factors which represent conflicting priorities for the individual. They are therefore represented as a series of balances between pairs of conflicting priorities [11]. Existing research has presented some trust factors and models in the context of a computer related trust area [11] [12] [13]. However, there is little research about how individual trust developed within computer mediated collaboration teams over time. This seems to be an area worth exploring.

In order to analyze the individual trust development over time for computer mediated collaboration, in this paper, we have chosen to conduct a case study of students in groups over one year. The performance was assessed at three points; the beginning, middle and end. Extending earlier research [14] which collected data for the initial stages, we have collected data for the final stage collaboration with documentation analysis and interviews. Section two introduces the research method and case study design. Section three presents the data collection. Section four analyzes the data using different technologies, discusses the developing trends and presents the new factors. Section five draws conclusions from the current work and outlines future research.

2. Research methods and design

2.1. Instruments of measurement

One method of measuring trust is the experimental measurement of trust [15]. Another method for measurement of trust is surveys of trust. Rotter [16] introduced the use of a paper pencil questionnaire to study trust as a personality trait. There are many researchers using surveys which include questionnaires and interviews in experiments to measure trust [17] [18] [19].

Regarding trust development over time in the IS environment there are also surveys, interviews and experiments combined together to measure trust development over time for computer mediated and face-to-face teams in case studies [19] [20] [11]. In this case study, a combination of survey, interviews and documentation research methods were used to collect data.

2.2. Individual trust factors

For the purpose of this study, Nolan *et al.* [11]'s six individual trust factors have been adapted. These are: *Risk*, *Benefit*, *Utility value*, *Interest*, *Effort*, and *Power*. Nolan *et al.* [11] 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*. It is also proposed by Nolan *et al.* [11] that each factor is evaluated by individuals in relation to one or more of the others. Therefore the "balance" between them indicates an individual's readiness to collaborate.

2.3. Measurement techniques

As a further improvement to the individual trust development model [11], a scale was added [14]. This scale enables the variables to be rated which in turn allows comparisons to be made within groups, between groups and against benchmarks. This can be done either for one instance, or over time as in this research.

Furthermore, the slant of the balances can have varying degrees which also enables better analysis. This scale balance model uses a data input from 1 to 5 which is based upon a survey designed according to the six factors for individual trust development [14].

A spider diagram has been used by researchers to compare the different trends of the multiple dimensions in one chart [21][22]. An ideal value for the six individual trust factors has been stated by Cheng and Macaulay [23] and a trust spider diagram is developed to help investigate the individual trust development in online collaborations. It is stated that we would like to have higher Benefits, Power, Utility value and Interest but lower Risk and Effort in order to have a high level of individual trust [23]. Ideal values and real values of the six factors are contrasted in different stages to help the researchers to investigate the individual trust development over time.

2.4. Case study design

The research methodology chosen was that of the case study. By following earlier research [14] [24], we selected a *survey*, *documentation* and an *interview* as the main data collection techniques for the case study.

Eight student groups from the same university were chosen. They would complete the same team project, in lab sessions, for one year. As it was a requirement of their coursework, each student had to participate. There were six students in each group. Each student was using GroupSystems™ as a Web based collaboration software. They were all novices to the GroupSystems™ software at the first day of the team project. Each group had the same team project which was to evaluate and redesign a website. In some sessions, 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. In each session different tasks were given. The online collaboration sessions were completed once a week and our surveys were planned to run at three points during the year. Anonymity which encourages more open and honest discussions was applied in the survey [3]. The value of the variables is associated with the scale value for the scale balance model and trust spider diagram. At the same time, as this was part of their course, we took the documentation file of the students' performance for the whole year. In the end of the academic year, we conducted some interviews of the students in order to investigate further.

Table1. All three stages individual trust value

Factors Group	Risk	Benefits	Utility Value	Interest	Effort	Power
Group1	2.2-2.7-2.8	3.6-3.6-4.0	2.9-3.6-4.1	3.9-3.4-3.9	4.3-3.8-3.9	2.7-2.9-2.6
Group2	2.6-2.7-2.6	4.0-3.5-4.2	3.5-3.3-3.5	4.0-3.5-4.3	4.1-3.6-4.2	3.3-3.1-2.5
Group3	2.2-2.1-2.5	4.0-4.6-4.3	3.7-3.7-3.9	4.2-4.3-4.0	4.3-4.2-4.8	2.6-2.9-3.3
Group4	2.6-2.4-3.0	3.8-3.7-3.8	3.5-3.8-4.2	4.0-3.9-3.4	3.6-3.8-4.2	2.8-2.5-2.3
Group5	2.3-2.6-2.3	3.2-3.5-4.7	3.4-2.9-4.7	3.6-3.6-4.3	3.7-3.8-5.0	2.7-2.9-3.6
Group6	2.5-2.0-3.0	3.6-4.1-3.6	3.5-3.9-3.9	3.8-4.1-3.4	3.9-4.0-3.7	2.9-2.4-2.8
Group7	2.0-2.0-3.3	4.3-4.6-1.7	4.2-4.2-2.7	4.1-4.4-2.5	4.3-4.5-5.0	2.4-3.3-4.0
Group8	2.1-1.9-2.5	3.7-3.8-3.8	3.7-3.4-4.3	3.8-4.0-4.7	4.4-4.0-4.7	2.5-2.7-3.3

3. Data collection

3.1. Survey

Based on the definition of the six factors of individual trust mentioned by Nolan *et al.* [11] for facilitated group session, we have used the six factors to design the individual trust development survey for the computer mediated collaboration teams [14].

The survey is designed and integrated into the GroupSystems™ sessions using its online voting and analysis report function. The first and second surveys were taken already at the beginning and middle [14]. The third survey was taken at the end of the project. The questions were presented in the form of several statements. There were 36 statements which attempted to capture the participant's position on the 6 factors [14]. The participants of the survey in each group were required to respond to the statements on a scale of 1 to 5. 1 represents the strongest disagreement and 5 represents strongest agreement. For instance, value 5 for risk is the highest risk. The value of the collected data was set according to the level of agreement and disagreement. Each value of the factors in each group was calculated. For example, for a group interest was calculated according to the responses to six statements. This was conducted at all three stages of the collaboration in order to identify the changes over time.

Table 1 shows the individual trust values for all eight groups at the three stages of the collaboration project. For instance, in group 1, in the initial stage the risk value is 2.2, in the middle it is 2.7 and in the final stage it is 2.8.

3.2. Interview

At the end of the yearlong project, we interviewed

some students individually. Semi-structured audio-taped interviews were used in the data collection. At least two members from each group were asked to take part in the interviews. A monetary compensation was given as an incentive to the interviewees. Interview questions were designed according to the team building theory [25] and individual trust factors [11]. Interviews were taken at the end of the projects in order to get a holistic view of the individual trust development over time. Each interview took between half an hour and an hour depending on the participants' responses. The interview data helped investigate the development trend and process of the individual trust development for computer mediated collaboration over time. There were also some new trust factors which were important and are found in this particular case.

3.3. Documentation

Documentation was gathered from the student teams regarding their achievement and results from the computer mediated collaboration of different groups. The documentation included marks from the individual reports, and group reports for the team project. This documentation was collected at the end of the team project.

4. Case study analysis

4.1. Sample group survey analysis

By following the earlier research [14], we have completed the survey for the third stage for all eight groups in this case study. Group1 is used as an example of the analysis done with a scale balance model and a trust spider diagram.

These two models are useful in investigating the individual trust development over time [26]. For each group we created a scale balance model based on the data. As an example, in figure 1 we show group1.

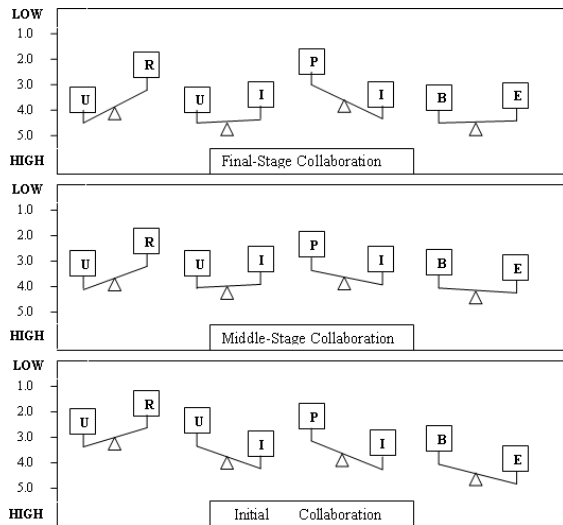


Figure 1. Group 1 individual trust development over stages

In this scale balance model, *U* stands for *Utility Value*, *R* stands for *Risk*, *I* stands for *Interest*, *P* stands for *Power*, *B* stands for *Benefit* whilst *E* stands for *Effort*. The position of each factor in the figure is based on the data from the survey [14]. This model visually represents the key variables and their relationships with the empirical evidence [14]. When we analyze group 1 data using this model, we find that from the initial stage to middle-stage, risk, utility value and power went down, benefit stayed the same, interest and effort went up. However, from the middle-stage to the final stage, we find that risk, benefit, utility value, interest, and effort all went up, but power went down. For the balance we find that there are two significant changes, which are the benefit versus effort and power versus interest. Although all those four values increase, we find that benefit shows a more important role in collaboration decision making than effort compared with the middle-stage. At the same time, interest has showed a significantly more important role than power from the middle-stage to the final stage. In this example the model would enable someone analyzing the data to compare between groups or for the same group over time to assess performance, measure trends and carry out further analysis. We have also conducted analysis for all the groups over time and among groups at the same time using this model.

Taking the same group, we have also used the trust spider diagram to help analyze the trust development (figure 3). In the spider diagram, each line stands for

one factor in the individual trust development. Each unit represents one value which is from 1 to 5. The data is associated with the survey data. There are five units on each line of spider diagram. Ideally, we need low risk and effort which are marked at level 1 and other factors are all marked at level 5 which means that we need high power, benefits, utility value, interest to

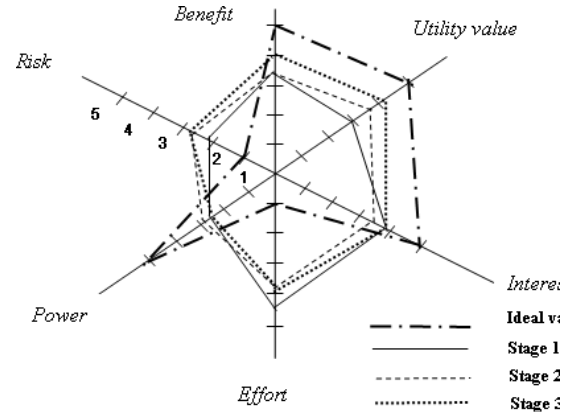


Figure 2. Trust spider diagram for group1 over stages

make the individual in a high level of trust in the facilitated collaboration process [23].

In this spider diagram, between the stage 1 and stage 2, we can see that risk, utility value and power increased more than before whilst interest and effort decreased. However, the benefit remains the same. It only has two negative factors compared with the ideal value, so individual trust in this group developed towards the direction of the ideal value. From the stage 2 to stage 3, we can see that we got an increase of every factor excluding power. At this stage we can also see from the shape of the spider net that factors at stage 3 are getting closer to the ideal value when compared with stage 1 with only two factors moving slightly away from the ideal value, those of risk and power. This trust spider diagram analysis was implemented for each group and it was found that six groups developed positively towards the ideal value and two groups moved away from them.

4.2. Interview data analysis

Interview data helped us get feedback from the computer mediated collaboration beyond what the survey captured. For instance, we find that the risk has always increased. However, there are various kinds of problems which have increased the risk.

There were also benefits, such as "...I learnt a lot, more and more, from collaborating online...", this indicates that people continued to achieve benefits from the online collaboration. If we consider utility

value we can see that it increases as the project moved on. For interest, they are interested in the new project and collaboration in the beginning. However, because of getting tired from the long-term collaboration and some other work, they lost some interest. However, in the final stage, they found more utility value, they didn't have much other work to do, and they got more interest. For effort, in the beginning, it took a lot of effort to collaborate with each other in the new online environment, but they seemed to get used to the system over time and spent less effort. Some other individual reasons such as other commitments prevented them from putting as much effort as in the first stage. However, in the final stage, they had to finish the project and they needed to solve all kinds of problems as soon as possible, so they put more effort which caused the effort to increase again. For power, in the middle stage there is more power than the first stage. Some of the participants in the team developed their ability to influence others in the team during the first two stages. However, in the end they all had more interest, so they all contributed, and their individual power value decreased significantly.

Some new factors which are not included in the model were also mentioned in the interviews. These comments were made in response to questions about the development of individual trust in the team. In one such case an interviewee said "...He is not motivated to do the work, I have to do double...". Therefore, motivation may be considered as a new factor. Other problems occurred such as "...One guy likes doing things in his own style, doesn't care about others ...", this shows that one group member was doing things in his own way which was a little selfish. One participant said "...Some members were not willing to cooperate effectively...". A number of interviewees made similar comments. There were a variety of problems which each group faced. Therefore, besides the six factors, by applying qualitative analysis, we found some new factors from the interview transcripts which are selfishness, willingness to cooperate, motivation, timing, complaining and the degree of skill as some new important factors affecting the individual trust development over time for this case study.

4.3. Documentation analysis

By using the scaled balance model and trust spider diagram, we identified some changes of the six trust factors. In the following table, N stands for factors changing negatively, U stands for unchanged factors, and P stands for factors changing positively. PD stands for the value of positive development which is the P

value minus N value ($PD=P-N$). The groups were then ranked according to the value of PD. This is an indication of how trust developed. With support from all the documentations, we have obtained the final project ranking record of all the groups. In the cases where the value of PD was below 0 that indicates that trust decreased.

When we compare the positive development of trust to the marks the groups received, they are not all positively related. There are three groups (1,5,8) where the better the trust developed, the higher the marks and three groups (4,6,7) which are not like this. Some explanation for this was given in the interview data. Although group 7 was the worst group in relation to trust development, its final project mark was the highest. The reason for this was identified in the interviews as despite some interpersonal problems;

Table 2. Group performance over three stages

Trust Development Ranking	Group Number	Factors Changing Trend				Project Ranking by Mark
		N	U	P	PD	
1	Group 5	1	1	4	3	4 (66.25)
2	Group 8	2	0	4	2	5 (63.00)
3	Group 1	2	1	3	1	6 (61.09)
4	Group 2	2	2	2	0	3 (67.40)
4	Group 3	3	0	3	0	2 (72.59)
6	Group 6	3	1	2	-1	7 (60.00)
7	Group 4	4	1	1	-3	8 (57.00)
8	Group 7	5	0	1	-4	1 (73.40)

some members still did good work for the group. For group 2, there were also problems relating to individual trust building and development. Group 2 had some problems influencing trust development in the middle stages and group 3 had some problems near the end. However, the other members worked hard to make the group earn better marks. For group 7 and 3, we have also found from the surveys that there was a high value for effort and power. This means that each individual had made a big effort and had the ability to contribute although they might have some concerns related to trust.

5. Conclusion and future work

Individual trust development is vital for computer mediated collaboration teams. A semi-virtual collaboration student case which involved face-to-face

interaction support was selected as a case study composing of eight mini cases (groups). We have successfully collected data from a quantitative survey, semi-structured interviews, and documentation from three different stages during the one year case study. We have also successfully applied the scale balance model and the trust spider diagram in the data analysis of this case study.

By combining the different sources of data, we have found that by using the GroupSystems™, three teams were developing positively towards the ideal value, two teams stayed mostly unchanged, and three teams had negatively developed their individual trust. We also found that around the middle stage there were more issues, and the individual trust was usually lower in comparison to the beginning and the end. The multiple methods of data collection and analysis applied enabled us to identify that groups either developed trust which led to a successful collaboration and high mark, or if the trust development was weaker certain individuals within the group had to take control and do the majority of the work. Beside the individual trust development of the groups, there were also some new trust factors coming from the interviews which could be useful in this computer mediated collaborative student experiment environment which were selfishness, willingness to cooperate, motivation, timing, complaining and skill. These will be a possible direction for future research.

In the future, we are going to explore the individual trust development in computer mediated collaboration in more cases by using these research methods. We will compare the different cases and find out the differences and similarities in the individual trust development perspective. Within this process we shall assess the validity of the new factors we have identified. Quantitative methods will be used to assess the significance of these new factors.

6. References

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