A Longitudinal Case Study on Risk Factor in Trust Development of Facilitated Collaboration

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Abstract. Computer-mediated collaboration is widely used in various organizations. Trust has proved to have an influence on online collaboration. This paper aims to conduct an in-depth investigation on an important trust factor during online collaboration, which is risk. The research samples were collected from Chinese part-time MBA students. They were invited to use the group support system (GSS) designed under the theory of facilitated collaboration with the thinkLets method to support the online collaboration. During this longitudinal research, questionnaires were collected at three stages, namely, at the beginning, during and at the end of the experiment, interviews were also conducted. Results show the level of trust was raised over time. Among all the trust factors, risk shows the most significant change, and the level of risk is decreased. Finally, the correlation analysis was conducted to detect the relationship between risk and trust in facilitated collaboration.

Keywords: Risk · Trust development · Facilitated collaboration · Trust factors

1 Introduction

Rigorous business competition drives people to take inter-organizational alliances, when an individual's ability is limited. Collaborations among team members turn out to be essential. Research shows that most fortune 100 companies collaborate frequently, but only 13 % of the team collaborations were considered to be effective [1]. This may result from a lack of trust among team members. Trust has its importance to collaboration teams [2, 3], and plays an important role in overcoming barriers, such as conflicts avoidance [4].

Increasingly advanced information technology has made online collaboration possible and popular. Teleconference, social network services, video conferences and discussion groups are adopted by a growing number of companies [5]. Moreover, as noted by Serçe et al. [6], compared with traditional collaboration, an online team is a set of geographically dispersed and functionally diverse organization, calling for a higher level of trust to improve work efficiency.

Researchers have attempted to decompose trust into different parts, namely trust factors that have an influence on trust. The overall level of trust can be figured out by evaluating each trust factor. Measuring trust over time could help assess the role of

© Springer International Publishing Switzerland 2015
B. Kamiński et al. (Eds.): GDN 2015, LNBIP 218, pp. 309–320, 2015.
DOI: 10.1007/978-3-319-19515-5_24

collaboration tools, but most studies on trust factors in computer mediated collaborations failed to take the change of trust factors into account [7, 8]. Cheng et al. [9] investigated trust development over time according to the six factors in the use of computer mediated collaboration tools, but has not systematically explored one certain factor in detail and found out the most significant one.

Among various trust factors, risk is the most frequently mentioned one which could be seen as the anticipated hazard of interpersonal relationships [10]. Minimizing risk makes team members willing to trust each other and contributes to effective collaboration [11]. Therefore we investigate the following questions related to the development of risk factor.

Research question 1: What is the change trend of risk factor in the context of facilitated collaboration? After collaboration over time, does the overall level of trust change?

Research question 2: What is the correlation between risk and the overall level of trust?

This paper is structured as followed. Section 2 begins by laying out the background of relevant studies. Research method and data collection will be given in Sect. 3. Section 4 is concerned with the investigation of research data through the mix use of qualitative and quantitative analysis. Then, in Sect. 5, we analyze the results and have a discussion, then give a brief summary and critique of the findings as well as our limitations.

2 Research Background

2.1 Facilitated Collaboration

As an approach that aims to design collaboration process, collaboration engineering has been developed into an emerging research field [12]. Collaboration engineering can be considered as a combination of facilitation, design and training approach that can be supported with group collaborating tools [13]. A facilitator is needed to decompose tasks and instruct processes. Facilitation is a participative leadership, and contributes to improve a group's communication and information flow [14]. Facilitated collaboration had been applied to various areas, such as education, military, business community and so on. By offering sustained collaboration support, collaboration process is designed and deployed for a recurring task.

ThinkLets is a core concept in facilitated collaboration which include generate, reduce, clarify, organize, evaluate and build consensus [15]. It is the smallest unit of intellectual capital for the creation of collaborative tools, and provides a transferable, reusable block for process design [15]. Based on various tasks, users could choose the most appropriate thinkLets methods to simplify the collaboration process [13].

Group support system (GSS) is a suite of software to support groups in their collaborative effort. The importance of the design of collaboration process is amplified when GSS is used [12].There are various kinds of group support systems, such as GroupSystems (developed at the University of Arizona), SAMM (from the University of Minnesota) and discussion platform which is developed with the agile method on the WAMP platform (Windows/Linux+ Apache+ Mysql+ Php) [16].

2.2 Trust Development

According to Holton [17], trust is a situation when individuals feel comfortable and open in sharing their insights and concerns. There is a volume of published studies describing trust. The topic of trust issues in online collaboration has been addressed by many scholars [3, 18], and trust is considered as a dynamic construct [19].

Costa et al. [20] examined the development of social trust in project teams, research data was collected at the beginning, middle and end of the project. On the basis of what Lewicki and Bunker [21] identified during three stages of trust development, namely calculus based trust, knowledge based trust and identification based trust. Recently in 2013, Bhati et al. [22] examined how trust developed between branch managers and loan officers in different phases over a period of time. In distributed teams, trust development is also investigated through longitudinal study [23, 24]. However, most of the research data on trust development are pure students who hardly have any work experience.

In an investigation into trust development of business online community, Nolan et al. deconstructed six factors in the perspective of individual trust which represents the conflicting priorities. Those factors are presented in their research as: risk, benefit, utility value, interest, effort and power [25]. The ideal state of those components is minimizing risk and effort, maximizing other parts [9].

2.3 Risk and Trust

Among six trust factors, risk is associated with providing information to unknown recipients and acting upon information received from them [25].Willingness to take risks has been suggested as one of the few characteristics common to all trust situations [26]. Risk is evaluated on every possible outcome of a particular action. Risk and trust are two facets of decision-making [10]. Besides, risk and perspective-taking were considered as two elements of trust in behavioral economics [27].

Under the condition of risk, the tendency to trust is relatively weaker [28]. Therefore, it is necessary to discover a way of minimizing risk in virtual collaboration. Scholars once analyzed risk management through repeatable distributed collaboration processes, showed the trend in risk management, and tried to identify possible risks in the early stage to control them [29]. Besides, in facilitated collaboration thinkLets were thought to reduce risk in online collaboration [30, 31]. We investigate risk that have an influence on trust in online collaboration with the help of collaboration engineering.

3 Research Method

3.1 Case Background

Various methods have been developed and introduced to measure trust development, in which a case study approach was used to conduct an in-depth, holistic investigation [32]. Considering the approach used in other similar studies [25, 33], we are going to use an exploratory case study approach.

In our research, 73 part-time MBA students with 38 males and 35 females are selected. As part-time MBA students, almost all of these participants have a minimum of three years work experience. We divide the students into 15 groups composed of four or five students randomly. The groups are all assigned the same project task to find out the problem in an E-business website and work out the solutions.

In the classroom, team members could directly exchange, share and discuss ideas. While after class, they can use QQ, Wechat, Skype, and other online communication software for collaboration. Besides, participants are encouraged to use discussion platform to facilitate their collaboration process. Discussion system is a self-developed online platform designed according to the process of thinkLets, and is instructed by the principle of collaboration engineering [16]. In general, with fixed class time as well as suggested instructions, the influence of irrelevant variables can be reduced efficiently.

3.2 Data Collection

In order to track the development of trust, we conduct survey three times during the project. That is to say, we divide the whole period into three equal stages, the initial stage, the middle stage and the final stage. At the start of each stage, the professor assigns the corresponding task. As an after class assignment, all the students are required to complete questionnaires designed by Cheng et al. [34]. In different stages, we have received 219 pieces in total. Gross error and redundant data were eliminated by statistical means. Finally, valid obtained data was 71 for each stage.

Especially, we have adopted a combination of semi-structured interviews to explore and analyze trust development in different stages during team collaboration. The design of the interview questions were based on the theoretical basis of former researchers [9]. In an attempt to make each interviewees feel as comfortable as possible, the pilot interviews were conducted informally by professionally trained interviewers, then we've modified the possible misunderstanding of the interview questions which may mislead our target participants. We have also investigated the backgrounds, group culture of the target participants, for the ease of improving interview questions and making the data of in-depth interviews more effective.

A total of 34 students are volunteered to be interviewed at the final stage. According to the transcripts of interviews, the interviewees include facilitators and ordinary group members during their team collaboration.

4 Data Analysis

4.1 Reliability and Validity Tests of the Questionnaires

We test the questionnaire's validity and applicability in order to measure targets' attitudes or behaviors accurately and comprehensively.

Cronbach's α is a statistic referring to the average of split-half reliability coefficient obtained from all the possible scale project division methods, which is the most commonly used method of reliability measurement. Different scholars hold different views on the boundary value of the reliability coefficients. Some believe that in general

studies it should be at least 0.8 to be accepted, and at least 0.7 in exploration studies. In practice, it only need to be 0.6, while further revision is needed when the questionnaire has a Cronbach's α which is less than 0.6. We used Cronbach's α to analyze the reliability of the six trust factors and found all of them above 0.8, which explained a high reliability and research value.

4.2 Average Values of Six Trust Factors over Time

Research data were collected in three different stages, namely the initial stage, the middle stage, and the final stage. For each stage, we conducted a questionnaire survey for each student and calculated the arithmetic means of six trust factors of each group. We further calculated average values of six factors in each group according to three stages, see Table 1.

With effective communication and clear goals, six trust factors will gradually approach the ideal value [9]. Among them, the ideal values of risk factor and effort factor are both 1. The decrease of the two factors means an increase in trust. Meanwhile, the ideal values of benefit factor, utility value factor, interest factor, and power factor are 5. The rise of these four factors shows increase in the trust.

In order to exhibit the change trend of trust factors over time, we have adopted a spider diagram according to three different stages. Figure 1 shows that risk has a significant downward trend while the four factors of benefit, utility value, interest and effort display an upward trend, but the trend is less pronounced. Effort factor shows a downward trend after the first rise.

Table 1. Average value of six factors of part-time MBA students

	Risk	Benefit	Utility value	Interest	Effort	Power
Stage1	2.31	4.30	3.96	4.35	3.94	3.09
Stage2	2.08	4.30	3.99	4.35	4.13	3.28
Stage3	1.82	4.36	4.21	4.45	4.06	3.22

4.3 The Significant Change of Risk Factor

As for changes of six trust factors, we need to measure their rates of change in order to get a further understanding of the influence of their tendency towards the trust, so we introduced the calculation method of the year-on-year rate [35].

$$\text{year - on - year change ratio} = \frac{(\text{current value - base - period value})}{\text{base -perriod value}} \times 100\,\%$$

We defined the initial stage as the basic period and calculated the year-on-year rate of the middle stage and the final stage, as is showed in the Table 2.

From Table 2, it follows that risk shows the most obvious change of a downward trend, while the changes of benefit factor and interest factor are less obvious. By drawing a line chart of the change of the risk, we further validate the most obvious change of risk, which is in a decline trend Fig. 2.

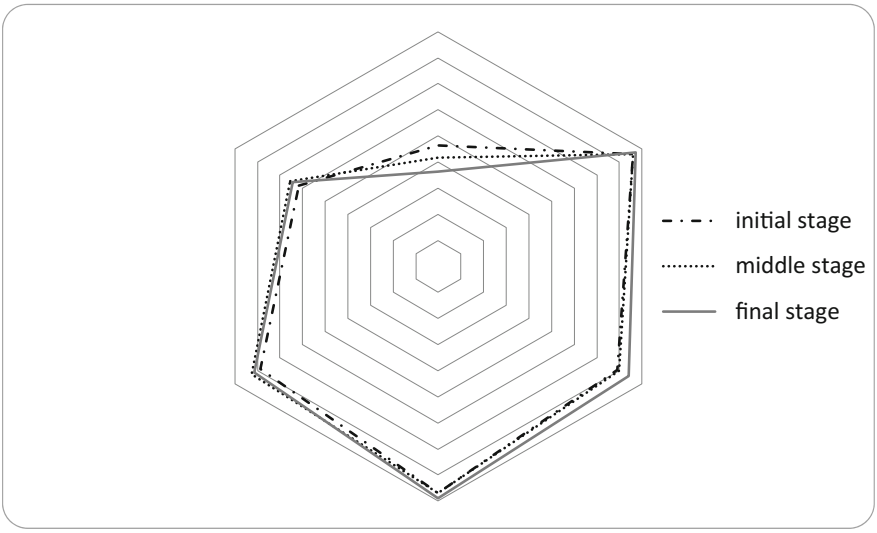

Fig. 1. The spider diagram of trust factors over time

Table 2. Year-on-year rate of change of the part-time MBA students

	Risk	Benefit	Utility value	Interest	Effort	Power factor
Stage1						
Stage2	-9.96 %	0.00 %	0.76 %	0.00 %	4.82 %	6.15 %
Stage3	-21.21 %	1.40 %	6.31 %	2.30 %	3.05 %	4.21 %

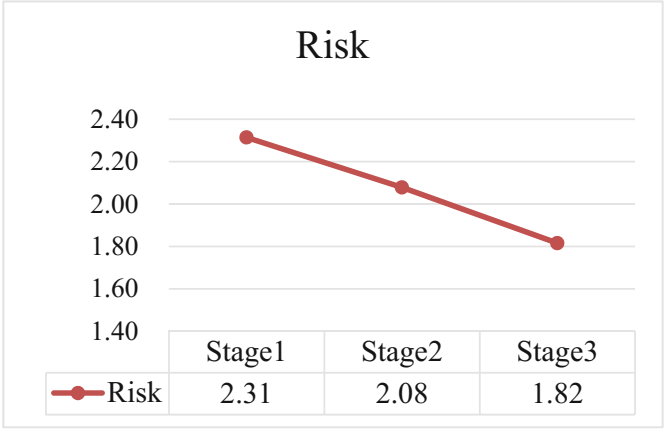

Fig. 2. The change of risk of the part-time MBA students

4.4 The Development of the Overall Level of Trust

We use the standardized residual between the trust model of the part-time MBA students and ideal trust model [9] to measure the index of the trust. The smaller the trust standardized residual is, the higher the trust will be.

$$\text{standard residual} = \frac{\sum_1^n (\text{observation} - \text{regression estimate})^2}{n-1}$$

$$\text{Trust Measure} = \text{sr}_{\text{Risk}} + \text{sr}_{\text{Benefit}} + \text{sr}_{\text{UtilityValue}} + \text{sr}_{\text{Interest}} + \text{sr}_{\text{Effort}} + \text{sr}_{\text{Power}}$$

Thus, we gathered the standardized residual of trust of each stage and the corresponding year-on-year rate of change

Table 3 shows the values of the trust of the sample rise as the experiment proceeds, which is in the decline trend of the standardized residual of trust. The year-on-year rate of change reaches 7.55 % at the final stage, which indicates that the use of thinkLets teamwork system helps improve the trust and the efficiency and effectiveness of teamwork. Meanwhile, the ratio of 7.55 % also shows the statistical validity of the method using the standardized residual to calculate the index of trust.

Table 3. Change of the trust standardized residual

	Trust standardized residual	Year-on-year rate of change
Stage1	23.12875	
Stage2	22.97709	0.66%
Stage3	21.38339	7.55%

4.5 The Correlation Between Risk and the Overall Level of Trust

Through the calculation of correlation index, we efficiently proved that the rise of the trust is attributed to the significant decrease of risk.

Correlation is a description of the uncertainty of the relationship between two or more variables. Correlation Analysis refers to the statistical analysis method or process on Correlation between variables. We use Pearson's Correlation Coefficient for correlation analysis on Trust Measure and six trust factors, which can be obtained from:

$$r = \frac{\sum X - \frac{\sum X \sum Y}{N}}{\sqrt{\left(\sum X^2 - \frac{(\sum X)^2}{N}\right)\left(\sum Y^2 - \frac{(\sum Y)^2}{N}\right)}}$$

Pearson's Correlation Coefficient r is used to determine if there is a correlation between the two data sets, X and Y. It varies between -1 and 1. When r>0, it shows a positive correlation; when r < 0, it shows a negative correlation. The absolute value of r indicates the degree of correlation between the variables. The closer the absolute value

is to 1, the stronger correlation it shows. The results of correlation analysis on risk and trust standardized residual are shown in Table 4.

Table 4. Correlation analysis between risk value and the standardize residual

Stage	Risk	Trust standardized residual	Pearson correlation index	Correlation's year-on-year rate of change
Stage1	2.1623	23.12875	0.338	
Stage2	2.0722	22.97709	0.351	3.85 %
Stage3	1.8651	21.38339	0.481	42.31 %

As is shown in Table 4, the trust standardized residual shows a downward trend, that is, with the decrease of the risk, trust rises. The Pearson correlation coefficient between them at the initial stage is 0.338, up to 0.481 at the final stage, with an increase rate of 42.31 %. From the significant increase of the correlation, we conclude that: as for the sample of the part-time MBA students, by collecting data from the time series, risk presents the most obvious trend in the six trust factors. risk has a significantly negative correlation with the trust and the decline of observably result in the rise of trust, further leading to the rise of the efficiency of the team collaboration.

5 Discussion and Conclusion

Previous researches have recognized that trust is an important factor influencing the outcomes of online collaboration [18, 36]. In this paper, based on the previously proposed trust factors, we conducted a case study using facilitated collaboration tool, the discussion system.

5.1 Discussion of Research Findings

The overall level of trust is increased through computer-supported facilitated collaboration

We have calculated the standardized residual to evaluate the level of trust in the three stages respectively. The standard residual decreases by 7.55 % from stage2 to stage3, which shows the increase of the overall level of trust.

This finding are also supported by the interview comments, Someone has mentioned that I feel involved in my team because sometimes my opinion get the most votes, sometimes my vote is quite important for our team. I'm all satisfied with other teammates. The level of trust is obviously increased. While another participant holds that according to three months collaboration, we're familiar with each other. The trust level is indeed improved.

Among six trust factors, risk is the most significantly changed factor with a decreasing trend.

The spider diagram shows the obvious change compared with other factors. Besides, according to quantitative analysis of year-on-year change rate, from early

stage to middle stage, the change range of benefit, utility value and interest is smaller than 1 %, while risk decreased by about 9.96 %. From middle stage to final stage, the result is more desirable that the change rate of risk is 21.21 %. However, the second significantly changed factor, the utility value, only increased by 6.31 %.

At the meanwhile, one participant said that the system has a simple but efficient function to break the emotional barriers. Especially in the later stage, we are familiar with each other, we don't hesitate to deliver our opinions. There is almost no risk. Another active participant told us that I felt that sending message anonymously helps me to share my opinions freely. With the collaboration going on, the level of risk is decreased.

Through facilitated collaboration, the level of risk decreases over time and trust increases accordingly.

Through simple calculation of mean value of trust over time, the level of trust decreases. Then, the correlation analysis of the level of risk and trust shows their negative correlation over time. Besides, the year-on-year change rate is increased significantly, from 3.85 % to 42.31 %, that means during the mid-to-late period of collaboration, the decrease of risk significantly increase the level of trust.

The correlation between risk and trust is also highlighted by the qualitative analysis. If someone holds that through long period of collaboration, then personal preference is no longer a private one, so risk is decreased. From strangers to acquaintances, the level of trust is indeed increased. Besides, a facilitator in another group told us that the platform is easy to use and makes our collaboration effective, I'm accustomed to this software, so risk is decreased, thus at least, trust toward the software is increased.

5.2 Theoretical and Practical Implications

Theoretically, through quantitative analysis, this study shed light on the investigation of trust factors. Risk is validated to exist in the initial level of online collaboration, and changes significantly through longitudinal research. According to facilitated process, the level of risk is decreased over time, which is consistent with the research findings of previous researches in different background [6, 7], similar experimental setting in different case context [33, 34], and towards the ideal states of six trust factors [9]. By investigating risk in facilitated collaboration, we fill the research gap of deep investigation of a certain factor through the use a thinkLets method, and find out an important role of facilitated collaboration, that is, to reduce risk in online collaboration.

From a practical viewpoint, the results show that facilitated collaboration contributes to reduce risk over time. It offers valuable reference to introduce facilitated process to real business online collaboration. Through the introduction of a facilitator, online business discussion may be more effective. Additionally, it also provides clues for software developers to design more useful tools.

5.3 Limitations and Future Research

We have conducted a case study using the part-time MBA students, however, this is a special context which has not been tested in other contexts and it may not be applied. Therefore, future research will be considered using various sources of research

samples. An in-depth interview analysis of the reasons for our conclusions could also be considered. Moreover, the emphasis of our research is one of the trust factors, risk. In future research, we would like to make a correlation analysis of six trust factors and the overall level of trust, and compare all the trust factors in facilitated collaborations.

Acknowledgments. The authors would like to thank the National Natural Science Foundation of China (GrantNo.71101029) and the Program for Young Excellent Talents of UIBE (Grant No. 13YQ08) for providing funding for part of this research.

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