
Trust-based partner identification method for e-supply chain (B2B) integrator – a case study of Malaysian construction industry

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Abstract: Lack of trust has been identified as one of the issues that hinder collaboration among business partners. Hence, there is a need to conduct a study in ensuring the entire supply chain components collaborates in a socially trustful environment. Thus, this paper reports on the findings of the study that has been conducted which investigates the trust values perceived by the business community. As a contribution, a trust-based model for trusted partners' identification is proposed which will be later transformed into an IT implementable expert system. For the purpose of constructing and validating the method, the Malaysian construction industry is chosen as the case study due to its size and importance to the economy. Thus, this paper puts forward the background of the research, some relevant literatures which lead to trust values elements formulation, data collection and a glimpse of the proposed method for trusted partner selection.

Keywords: trust; B2B; e-supply chain; construction company; collaboration; Malaysia.

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1 Background and need for research

In a typical supply chain (SC) setup, multiple parties/business components work together either directly or indirectly in order to fulfil a customer request (Chopra and Meindl, 2004). For example, an SC could consist of components such as suppliers, manufacturers, warehouses, transporters, advertisers, retailers, customers, etc. (Bartlett et al., 2007). All of these components must work collaboratively in order to ensure the success of SC. Like in other scenarios that involved collaborative work, trust has been identified as one of the major determinants for the success SC collaboration (MacDuffie and Helper, 2005; Haque, 2004; Carlsen, 2009) and establishing the long-term business relationship (Liu, 2012; Shahabuddin, 2011). In the recent years, many industries have been found to start integrating SC components electronically (Shahabuddin, 2011; Haji-Pakir and Alina, 2010; Esper et al., 2010; Anumba and Ruikar, 2009; Giménez and Lourenço, 2008; Alias and Yusuf, 2007; Sandberg, 2007; Wang and Lalwani, 2007; Ab.Aziz et al., 2011a; Issa et al., 2003). Hence, the term electronic supply chain or e-SC has now become a common word in the business world. Similar to its traditional, manual-based counterpart, the success of e-SC also relies on trust. Hence, there are quite a number of researches which concentrate on the trust issue in e-SC. However, majority of those reported are concerned with the IT aspect of trust in the implementation of e-SC. Thus, information security issues such as authentication, encryption, and privacy protection are the popular focuses of these researches (Ba et al., 2003; Kim and Prabhakar 2004).

Although security methods such as public-key cryptography, digital signatures, SSL and the like are undeniably important to ensure the success of e-SC, it is also believed that the social aspect of trust should also be in place before a component is willing to become a part of an e-SC in the first place. This is necessary since e-SC involves information exchanges among components in the chain. This information was the results of e-business transactions conducted by SC components in carrying out their tasks can only be willingly shared with the other components if the originator is certain they would not be abused (Ab.Aziz et al., 2011a). Hence, trust is considered a key to guarantee the smoothness of the information exchange processes which occur during the e-business transactions of companies across the SC. This look into the social aspect of trust has been found to be lacking in the literature.

Hence, this paper is reporting the work that has been conducted on identifying the trust values as determinants in deciding whether a partner is trustful. With the trust values being identified and translated into measurable metrics, it is believed that an expert system can be developed to help a business constructs its own web of trustful SC components. For this work, the Malaysian construction industry has been selected to be the domain of the research. The selection was mainly due to the industry being claimed as one of the most complex and stubborn industries (Bussler, 2002; He, 2005) and hence, due to this characteristic, it is believed that the findings for this industry can be adapted to the other less complex industries without many difficulties. The rest of this paper will continue with some related work on trust and e-SC in Section 2, methodology of study in Section 3, results and discussions in Section 4, and conclusions and future direction in Section 5.

2 Trust and e-SC

Malaysian Industry Development Board (CIDB), Karib (2009) stated that limited trust, little corporation and poor communication are the culprits that hinder implementation of integration in the SC Malaysian construction industry. Trust has been claimed as the main factor in ensuring acceptance of a business technology (Sinkovics et al., 2011; Chong and Ooi, 2008; Chong et al., 2009; Ren and Hassan, 2009). Undeniably, it is also one of the key factors for business relationship success (Liu, 2012; Khare et al., 2011; Smyth et al., 2010; Covey et al., 2008; Ratnasingam et al., 2002; Shurtleff, 1998; Hu et al., 2011; Saunder et al., 2004; Shockley-Zalabak et al., 2010; Tung et al., 2001; Slyke et al., 2004; Laeequddin et al., 2012). Indeed, a business relationship should be built on trust and without trust, the relationship might soon collapse. Trust in e-SC leads to lower cost, increases sales, increases profit, create greater market (Cazier et al., 2006; Welty and Becerra-Fernandez, 2001; Hu et al., 2011) and increase the level of performance and productivity of SC components (Carlsen, 2009; Vuorenmaa and Helo, 2011; Khare et al., 2011).

Trust can be explained in many ways according to individual perspectives or filters. For instance, Kuttainen (2005) discussed trust in the perspective of IT and stated trust as a key to ensure trustful environment when conducting e-SC transactions. Similar perspective was also shared by Aschmoneit and Lenz (2001) and Cazier et al. (2006). Mukhtar et al. (2009) proposed a framework for securing the IT component of SC by analysing their SC process before making any decision to invest in any e-SC, because SC are complex (Vuorenmaa and Helo, 2011). Sen and Banerjee (2006) reported, since mid-1980s, trust is linked to IT and this is agreed by Saunders et al. (2004) which advised not to view trust and IT separately.

On the other hand, a few researchers (Blomqvist, 1997; Gottesdiener, 2007; Tullberg, 2008; Laeequddin et al., 2012; Laeequddin and Sardana, 2010; Jones et al., 2010, 2000; Liefeld and Wang, 2010; Hu et al., 2011; Abdullah et al., 2012; Xiao et al., 2010; Chong et al., 2009) look at trust in SC in terms of business perspective. They claimed, the past performance of a business helps decide whether the company can be trusted for future collaboration. Besides the above, knowledge and experience of a business can also be the determinants for trust (Pavlou et al., 2003; Carlsen, 2009; Houwink et al., 2011). Furthermore, trust can also be explained in terms of the environment or domain it is

required. Different domain will see trust in a different way. For example, in the medical domain, trust seldom means information privacy (Golbeck et al., 2003; Ratnasingam et al., 2002; Tung et al., 2001). From the gathered literatures which were published between the years 1999 until 2012, it can be seen that values that constitute trust vary according to situations or domain. However, as presented in Ab.Aziz et al. (2011a, 2011b) few of the trust values consistently appeared in almost all references. The four values are competence, reliability, openness and identification.

Competence basically means the ability to perform a task physically and intellectually (Liefeldt and Wang, 2010; Zambaldi et al., 2010; Ren and Hassan, 2009; Covey et al., 2008; Cazier et al., 2006). For instance, competence is the use in evaluating the skills, experience, capabilities, and efficiencies (Covey et al., 2012; Azadeh et al., 2011; Ratnasingam et al., 2002). In addition, it used to measure how the company can survive in the marketplace (Shockley-Zalabak et al., 2010; Laeequddin and Sardana, 2010). Therefore, B2B relationship is profoundly depended on competence (Wu and Li, 2009). Those who have this value definitely understand their capabilities and works to overcome weaknesses (Gottesdiener, 2007; Ghosh and Fedorowicz 2008; Potocean and Mulej, 2008).

Reliability is related to commitment and consistency in behaviour, quality and continuous in performance (Ratnasingam et al., 2002; Shahabuddin, 2011). It also about commitment of trading partners in keeping their promises (Welty and Becerra-Fernandez, 2001; Jones et al., 2010, 2000) or in other words, 'walk the talk'. Recent research (Löfvblad et al., 2012; Salam, 2011; Xiao et al., 2010) suggests that momentum of commitment and consistency must be same in both parties in finishing projects or work which influence productivity, efficiency and strengthen the business relationship.

Openness and identification's definition is more diverge. Saunders et al. (2004) and Haque (2004) stated openness is about willingness the other party to share information about their businesses while Hoy and Tschannen-Moran (1999) defined openness as honesty and integrity in the information shared, and to be present during communication among partners and for decision-making process (Shockley-Zalabak et al., 2010; Shaghali et al., 2010). In other words, openness related to integrity in the relationship that can improve collaboration and helps in reduction of uncertainty that may cause difficulties and conflicts in communication.

Identification similarly has many definitions. It has been defined as similarity and connection among two or more parties in Shockley-Zalabak et al. (2010) and verification of information in Koh et al. (2009) and as company preferences in Carlsen (2009). Nevertheless, identification can be summarised as any connection and similarity that can be found among trading partners on shared value, purpose, experience, objective, environment product or services that have a positive relationship with trust for collaboration.

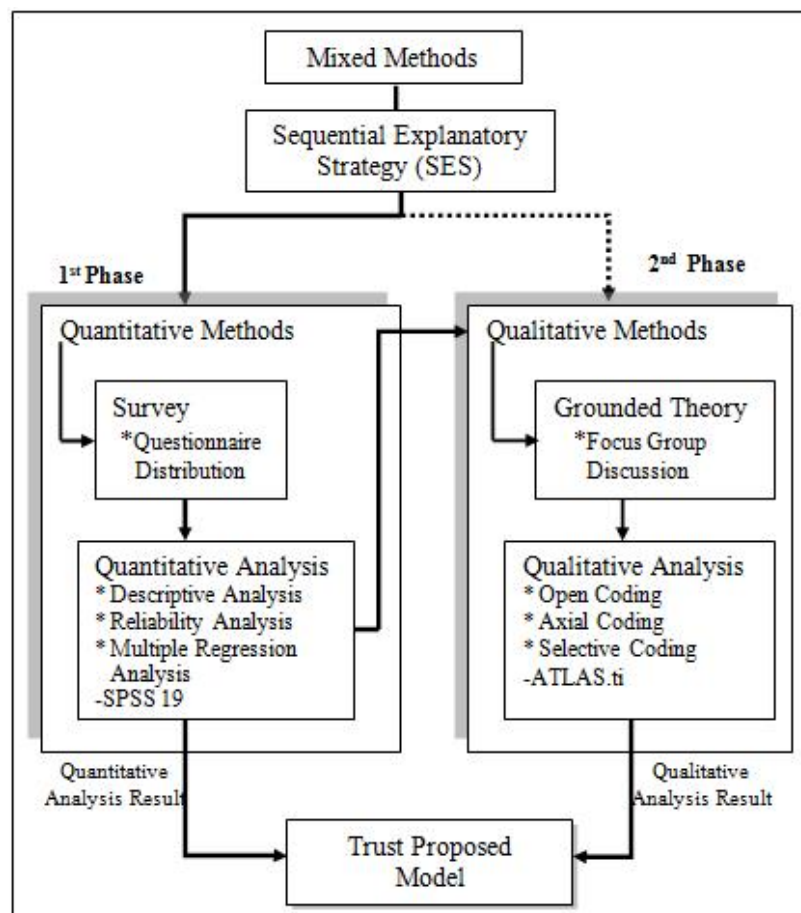
3 Methodology

Based on the initial findings of values for trust from the literature, a study was then conducted to see the relevancy of the values to the Malaysian construction industry. There are three research methodologies commonly known to be used by researchers especially in the field of social research which are quantitative, qualitative and mixed method (Ab.Aziz et al., 2011a; Creswell, 2003; Tashakkori and Teddlie, 2003). However,

for this study, the methodology that was chosen is the mixed method. Mixed method research consists of both the quantitative and qualitative methods. In this study, the two methods are necessary in order to cater for the quantitative and qualitative types of research questions that it has. Furthermore, for the purpose of this research, the technique used to collect and analyse data as well as interpret findings is the sequential explanatory strategy (SES). Using SES, data are collected in phases or sequentially (Ab.Aziz et al., 2011b).

In other words, this study started with the first phase which was using the quantitative method and later followed by the second phase which was using the qualitative method. This sequence of data collections followed the rule of SES method (Tashakkori and Teddlie, 2003; Creswell, 2003). The main advantage of SES is it helps this study in meeting the research objectives and answers all the research questions by providing stronger inferences (Ab.Aziz et al., 2011a). In fact, SES is very useful when unexpected results arise from the quantitative study which requires further examination. Research methodology framework for this study is shown in Figure1.

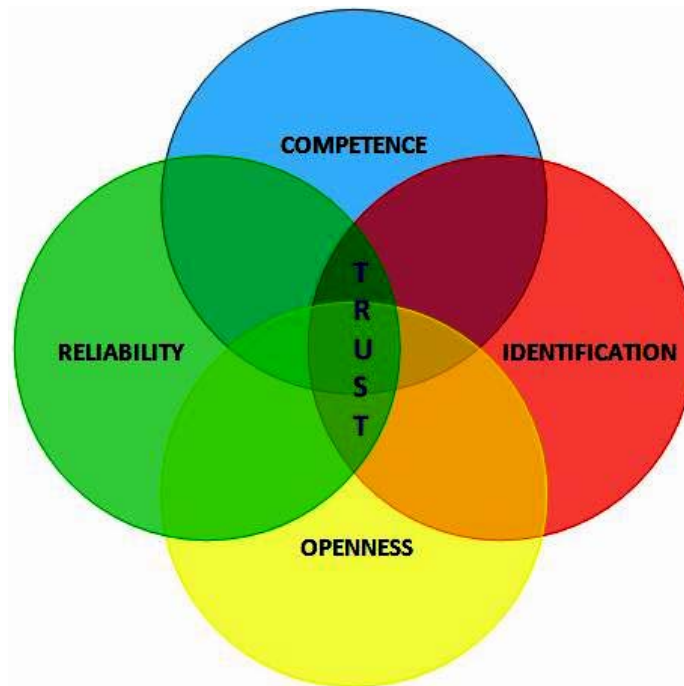
Figure 1 Research methodology framework



A few researchers such as Hoy and Tschannen-Moran (1999), Haque (2004), Mora-Monge (2007), Chong et al., (2008, 2009) and Shockley-Zalabak et al. (2010) agreed that the survey methodology is one of the best ways to measure trust. Thus, in this study similar approach was carried out in the quantitative part (first phase) of the research methodology. A survey questionnaire was formulated based on a set of research hypotheses that have been formulated in the earlier stage of the research (Ab.Aziz et al., 2011b). The purpose of the survey was basically to confirm the applicability of the trust values in the SC of the Malaysian construction industry. The survey form contains 17 items with each having Likert scale rating from 1 to 5 (1 is denoted very little and 5 is denoted very great). Sample of the questions asked in the survey shown in Appendix.

Five hundred survey forms were distributed to employees of several construction related companies all over Malaysia. The companies were identified based on the list of companies produced by Malaysian Construction Industry Development Board (CIDB). However, only 120 of the respondents filled up and returned the survey forms and their responses were used for data analysis. As mentioned by Field (2009), this number of responses is considered acceptable according to the rule of thumb which states that the minimum acceptable sample size required to test the individual predictors within the model is $(104 + k)$, where k is the number of predictors.

Figure 2 Trust values for Malaysian construction industry (see online version for colours)



For this study, the predictors number is four and the calculation of sample size is $(104 + (4)) = 108$. The minimum sample size for this research is 108, nevertheless successfully collected is 120. From the 120 responses gathered, confirmatory factor

analysis was performed using statistical software (SPSS-Multiple Regression Analysis, Stepwise method and Reliability Analysis). The results showed that the four trust values as being depicted in Figure 2, are all relevant to the Malaysian construction industry but with varying degree of relevancy. The detail results of the analysis can be found in the results and discussion section.

Based on the findings from the quantitative study, a round of the qualitative study was then conducted. In this case, the qualitative study was meant for finding the metrics in representing the four identified trust values. For this, grounded theory (GT) was used. According to Ayala and Elder (2011) and Onwuegbuzie et al. (2009) GT is one of the best methods to gain in-depth understanding that cannot be achieved using the quantitative method. Usually evidences for GT analysis are gathered from interviews or focus group. For this study, focus group discussion (FGD) was conducted.

In order to conduct an FGD, the right groups must be identified. Normally an FGD is made up of people who have similarities on the understanding, knowledge, and experience on a certain topic, issue or case (Ab.Aziz et al., 2011a). As for the size of FGD participants, various numbers were reported such six to ten participants (Litosseliti, 2003) and six to eight members (Bloor et al., 2001; Rabiee, 2004). On the other hand, Onwuegbuzie et al. (2009) and Suzuki et al. (2009) agreed that 6–12 should be a good number, while Krueger and Casey (2000) believed it should be 10–12 participants.

There are three groups, each group consists of 4 participants. This is acceptable since as mentioned by Jordan et al. (2007) and Rabiee (2004), that FGD can be conducted in mini groups with the number of participants can be as few as three depending on the research purposes and more appropriate if the aim is to explore complex, controversial, emotional topics, sensitive issue or to encourage details accounts. Hence, for this study, mini FGD groups were adopted. The first group consists of researchers from the Construction Research Institute of Malaysia (CREAM), the second group is the contractors and the third group is from the supplier side. For the respondents' profile, they represent the senior executives, middle level and top level positions of their respective companies. Below are the detail conducts of the mini FGDs which includes pre, post and the sessions themselves. Due to the difficulties in assembling the three groups at the same common place and time, the three FGDs were conducted at different dates, times and venues but following the same procedures.

- 1 Pre-FGD session: Before an FGD session was conducted, several procedures were carried out such as identifying the objectives and goal of the FGD, preparing the FGD questions, identifying the moderator to conduct the FGD as well as identifying the participants of the FGD. This was followed by telephone calls and the sending of invitation letters to participants and also several follow ups which led to the agreement on the date, time and venue for the FGD session.
- 2 FGD session: During the FGD session itself, the participants were asked to sit in a circle. They were each given a piece of paper containing the transcribed FGD questions. Then the moderator threw the first question and asked each of the participants individually respond. After that they were asked to discuss or debate the issue among themselves. In doing this, the participants were encouraged to share their ideas, opinion, knowledge, experience and observation. The same procedures

were followed for the rest of the questions. In order to capture the activities and information transpired during the session, the session was recorded on tape and the participants were also encouraged to write any valuable information on their transcripts.

- 3 Post-FGD session: After the session was successfully completed, a thank you e-mail was sent to each of the participants. The information gathered from the session was then analysed using qualitative analytical software called ATLAS.ti. The result of this qualitative study is presented in the results and discussion section.

4 Result and discussion

4.1 Quantitative analysis result

This sub-section presents the results produced from the survey explained in the previous section. Majority of them, 50%, are from the contractor side. Before the analysis, on trust values were conducted using the responses, reliability analysis of the questionnaire was first conducted using the cronbach's alpha test which resulted 0.80 implies all questions relatively high internal consistency and acceptable (Field, 2009). Once all questions have been proven to be consistent, further analysis of the responses were then conducted. As mentioned in the previous section, the survey questions were constructed based on four research hypotheses:

H_1 Identification has a positive relationship with trust for collaboration in SC.

H_2 Competence has a positive relationship with trust for collaboration in SC.

H_3 Openness has a positive relationship with trust for collaboration in SC.

H_4 Reliability has a positive relationship with trust for collaboration in SC.

In order to validate the hypothesis, the questions asked according to the trust values identified as shown in Appendix. The questions were designed in two perspectives which are individual trust perspective (ITP) and organisational trust perspective (OTP).

The ranking of trust values started with identification, competence, openness and reliability as in Table 1. The weightage for each value is shown in the table as in Beta in column. Percentage of variance in trust for collaboration can be explained by measure the R^2 or coefficients as in R square column. All four variables explain 78% to 100% the variance of trust for B2B collaboration. Alpha reliabilities for the four subscales are acceptable because the range is from 0.78 to 1.0.

Results of confirmatory factor analysis and structural equation modelling provided strong evidence the trust values is valid and not differ by SC components group (manufacturer, supplier, distributor, contractor and etc.). In other words, the instruments measure what it claims to measure. Results strongly support a model which indicates that reliability, identification, competence and openness are strong predictors of trust for collaboration, which in return influences for integration. For hypothesis, the result is rejecting H_0 and accept H_1 , which H_1 : all four values do explain the variance trust for collaboration.

Table 1 Model summary-multiple regression statistics

#	Model	R square	Beta in
1	Identification	0.747	0.864
2	Competence	0.889	0.436
3	Openness	0.989	0.456
4	Reliability	1.00	0.188

Notes: *Trust score ranking: 1 – Identification; 2 – Competence; 3 – Openness;
4 – Reliability

*R2: 0.747 to 1.0

0 1
Weak Strong

To calculate Trust score, the regression equation as below:

$$\begin{aligned}
 \text{Trust Score} &= \alpha + H_1(\text{Identification}) + H_2(\text{Competence}) \\
 &\quad + H_3(\text{Openness}) + H_4(\text{Reliability}) \\
 &= \alpha + H_1(0.864) + H_2(0.436) + H_3(0.456) + H_4(0.188)
 \end{aligned}$$

The trust score shows the ranking of each trust values included the weightage in the domain selected and helps to design qualitative study.

4.2 Qualitative analysis result

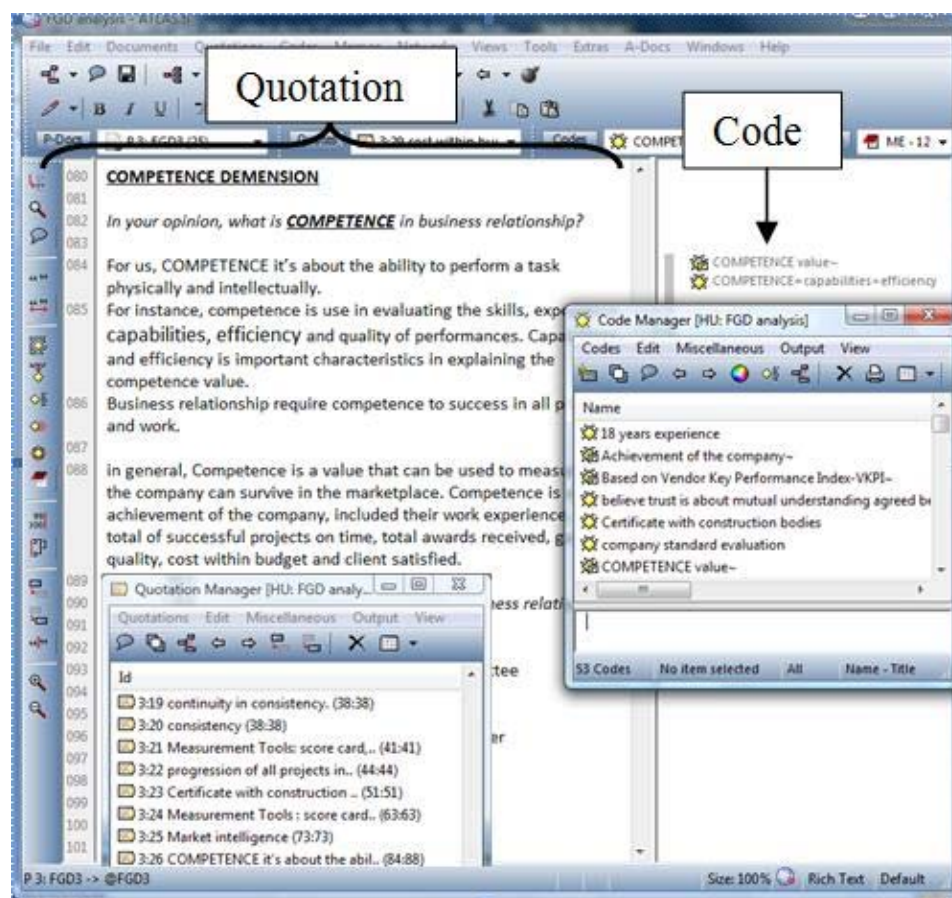
This sub-section elaborates on the GT results obtained from the FGD sessions. As mentioned in the methodology section, the purpose of the qualitative study is to capture the metrics for each of the four trust values identified in the previous quantitative study. ATLAS.ti was used to analyse the data gathered. Using ATLAS.ti, the analysis steps started with open coding. Open coding is the process of generating initial concepts or categories from the original data/transcripts (Onwuegbuzie et al., 2009). In other words, open coding summarises texts into codes to represent some phenomenon or events. There are three files created for this study. In addition, for analysis, this software uses three types of coding i.e., open coding, axial coding and selective coding (Onwuegbuzie et al., 2009).

To do the above, individual transcripts for each FGD selection were first compiled into one group transcript. Then the group transcript content was entered into ATLAS.ti. The entered data were analysed line by line, statement by statement, paragraph by paragraph, story by story, and incident by incident to extract important idea by the group and later transform into a meaningful code i.e., known as open coding.

For example, the text “Competence is about achievement of the company, included their work experience, ability, total of successful projects on time, total awards received, good quality, cost within budget and client satisfied” in quotation margin coded into “capability + efficiency = competence” in code margin as shown in Figure 3. The code means capability and efficiency are the characteristics for competence value for solid trust. All quotation and code created are listed in the quotation manager and code manager as shown in Figure 3. In other words, Figure 3 shows how the screen of the ATLAS.ti looks like when the above step was carried out.

This same step was then performed with the other two FGD groups. This process was done separately for each FGD group. In Figure 3, original transcript is in quotation margin located the left side, was interpreted into codes which located in the right side of the file that also known as open coding. The codes were named according to indicators of categories. For example, as showed in Figure 3, the event in the paragraph explains about how important skills, experience, efficiency, and the ability to perform task physically and intellectually in a business relationship. The event for the paragraph was coded as 'competence' and the quotations explain the code i.e., about the important of good performance, achievement in business, and experienced in a specialised area.

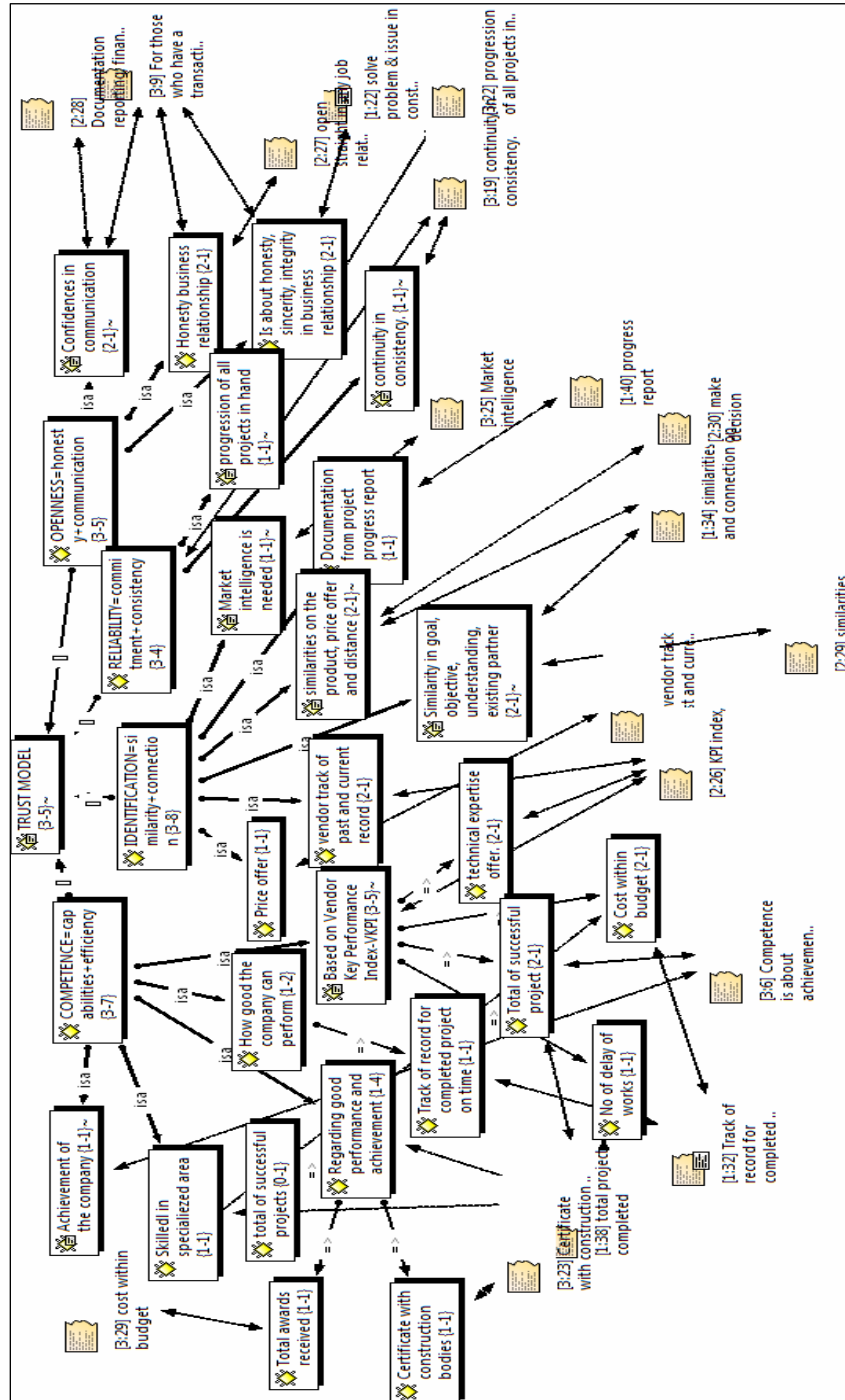
Figure 3 Open coding – ATLAS.ti (see online version for colours)



Note: Open coding purposely to help in summarise and interpret the original text into concepts and ideas.

Once the open coding process completed, the axial coding analysis follow. Axial coding is about making a connection between the codes. Once the connection between codes are completed, selective coding process follow. Selective coding is about creating a full story or theory on the events that connected into one network. The network then named as 'Trust' as shown in Figure 4.

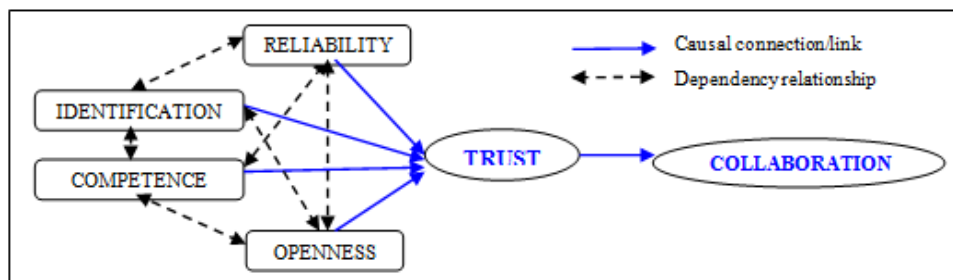
Figure 4 Trust network –ATLAS.ti (see online version for colours)



Note: Axial coding connects the codes together, and selective coding links the categories into one network called trust.

For the case of the FGDs's collected data, the transcripts gathered from one FGD session were entered into the software. Answers were analysed to find consistencies and differences. Consistencies between codes in the files show similar idea on the topic discussed. Quotations and memos helps explain the codes which allows the characteristics each code be identified. Findings from the qualitative analysis help create the trust proposed model for this research. Results strongly support a model of four trust values. The trust values characteristics in Figure 5 become as prerequisite for trusted partner selection, which in return influences for integration. Results strongly support a model which indicates that reliability, identification, competence and openness are strong predictors of trust for B2B collaboration, which in return influences for integration.

Figure 5 Trust proposed model (see online version for colours)



Note: Each trust values have a connection to each other in order to create solid trust for B2B collaboration trustful environment.

5 Conclusions

As a conclusion, the qualitative analysis result strongly supports findings in the quantitative analysis. The SES is considered the right method for this study. The findings from this study make several contributions to the current literature. First, results shows trust contains four values i.e., competence, openness, reliability and identification that can be use as method to identify the trusted partner. The identification method through trust values can be a good model that can be extended to other industries or business with a similar process. The most important thing is to find the method to identify trusted partners between SC components and build the trustful environment.

Second, trust can be measured using the trust values identified which, if lacking any of the values; the trust is not considered as solid trust or can say distrust exists in the B2B relationship. Third, proposed trust model transforming into IT implementation prototype. The prototype is purposely to help in analysing the right trading partner to trust before any collaboration or partnering decision is made.

The integration in SC highly depends on the collaboration that is built from trusted partners. The collaboration combines or links the entire SC components into one centralised centre or the application can interact with each other. All the transaction can be done easily from the initial/beginning transaction until completed as one full cycle. However, further research should be done to investigate the characteristics of trust values to confirm the identified is suitable for all industry.

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Appendix

#	Questions	Trust value
<i>Individual trust perspective</i>		
1	I feel connected to the person in charge at my company's trading partner.	Identification
2	I am able to make decisions that affect at my company with the person in charge at my company's immediate trading partner.	Openness
3	I am able to communicate directly with the person in charge at my company's trading partner when things go wrong.	Openness
4	I am free to disagree with the person in charge at my company's trading partner.	Openness
5	I believe the person in charge at my company's trading partners keep his/her commitments.	Reliability
6	I am highly satisfied with the capability of the person in charge at my company's trading partner.	Competence
7	I perceive that the person in charge at my company's trading partner behaves in a consistent manner from day-to-day.	Reliability
8	I am highly confident that the person in charge at my company's immediate trading partner keeps confidences.	Openness
9	I believe my values are similar to the person in charge at my company's immediate trading partner.	Identification
<i>Organisational trust perspective</i>		
10	My company perceives that its immediate trading partner's organisation does keep its commitment.	Reliability
11	My company is highly satisfied with the overall quality of the products and/or services of its immediate trading partner organisation.	Competence
12	My company is highly satisfied with the capability of its immediate trading partner organisation.	Competence
13	My company is highly satisfied with the capacity of its immediate trading partner achieve its objectives.	Competence
14	My company receives adequate information regarding how its immediate trading partner's organisational decisions relating to my company are made.	Openness
15	My company feels connected to its immediate trading partner's organisation.	Identification
16	My company's values are similar to the values of its immediate trading partner.	Identification
17	My company receives adequate information regarding the long-term strategies of its immediate trading partner organisation.	Openness