

A Framework for Service Formalization and Negotiation for Trust Maintenance in Digital Environments



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ABSTRACT: Virtual environments are increasingly being used as a medium for conducting business activities. Compared with the physical environments, they offer a faster medium for carrying out activities, especially so when geographical distances are great. The key factor impeding the adoption of e-business is trust. This is because trusting agent and trusted agent might never meet each other in face-to-face or at best this is limited. However, building trust is difficult and requires significant effort. Once trust has been well established, it needs to be maintained. In order to maintain trust, the trusting agent and trusted agent need a Service Level Agreement (SLA) as a guideline to carry out the interaction and to monitor performance progress during trust maintenance. In this paper, we propose a framework by which both parties can reach an SLA based on their requirements. The framework includes service formalization and service negotiation. Service formalization is a way to gather information about the other party's requirements. Service negotiation is a process by which an agreement can be reached if there are any conflicting requirements. A case study is presented to illustrate the operability of the framework.

Keywords: Service Formalization, Service Negotiation, SLA, Trust Maintenance

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1. Introduction

Trust is always embedded in every relationship and it links two specific parties: a trusting party (trusting agent) and a party to be trusted (trusted agent). In a service environment, the trusting agent is a service provider provisioning business or providing service and the trusted agent is an individual or a business entity requiring access to the trusting agent's services. As stated by (Kanawattanachai and Yoo 2002), trust is a key element for the successful operation of business in virtual environments. Relationships in a virtual environment are characterized by anonymity, uncertainty, lack of familiarity, lack of face-to-face meeting etc (Javermpaa, Knoll et al. 1998; Javermpaa and Leidner 1999). In such scenarios, trust is a pivotal means or mechanism used to reduce or mitigate the risk or complexity of the interaction (Gwebu, Wang et al. 2007). For instance, customers in e-commerce may have no opportunity to physically examine the product or see the service before they decide to buy. Their purchase decision is based on their trust level in the product and/or service that they will receive which would be represented by what they see on a computer screen. Hence, selling and buying online may happen only if buyer and seller have sufficient trust each other. Trust as we can infer from our discussion, is a key enabling factor for the success of business in general and e-business in particular.

In all successful business relationships, the building and maintaining of trust between the business partners is essential in

delivering on business partners' requirements. Trust could positively influence a customer's decision regarding the future purchase of a product or a service. A trusting agent can build trust with interacting parties by delivering according to the Service Level Agreement (SLA) parameters for that interaction. However, trust is dynamic, not static. Since trust changes over time, this supports the argument for integrating the context and time dependence dimension of trust into theories of relationship development in virtual environments (Chang, Dillon et al. 2006; Wilson, Straus et al. 2006). Given the dynamic nature of trust, trust will evolve and change over time in relationships as knowledge and information about other parties' willingness and capability to deliver task as required will also evolve in those relationships. Hence, trust has a life cycle pattern. Some studies have described this evolution pattern of trust. For instance, (Currall and Epstein 2003) divide trust evolution pattern into three phases: developing, maintaining and destroying.

The development and maintenance of trust is neither a simple nor quick process. Building or developing trust is a continuing process and is time consuming. Once a sufficient level of trust has been established, it would be mutually beneficial for both interacting parties to 'maintain' this level of trust, so that the business relationship can be sustained. It is in the mutual interest of both interacting business entities to take appropriate steps or measures to ensure that their trust relationship is sustained over time. If appropriate steps to sustain the trust relationship over time are not taken, then this may result in a decrease in the levels of trust, corresponding to that of negative trust or distrust. Once distrust exists in a relationship, it cannot be rebuilt in a short time (Currall and Epstein 2003; Dwyer and Beauvais 2006; Babar, Verner et al. 2007). Therefore, constant effort is required from both entities in order to maintain the trust level as a part of business strategy. However, only a limited number of researches focus on trust maintenance stage. All the existing body of trust literature focuses on the trust building phase. This research is an effort to address issues in the trust maintenance stage. We define trust maintenance as "*the phase (which may last over more than one time slot) which starts from the time slot at which positive trust has been established to the time slot at which trustworthiness values falls to a level corresponding to negative trust*". The focus of both parties (the trusting agent and the trusted agent) in this phase is to preserve the status quo of trust level in the relationship.

As trust in virtual environments is more cognitive than affective, the maintenance of trust can best be done by measuring the degree to which a service task has been accomplished. Further, (Sako 1998) suggest that competence to deliver a service task and task responsibility are central elements in the measurement of trust in a business setting. Business trust has conceptualized and categorized as factors in the predictability of behavior as 1) contractual trust (will the other party perform or behave according the contractual agreements?); 2) competence trust (will the task performance be on high quality?), and 3) goodwill trust (will the other party commit to benefiting the other?).

In order to maintain trust, both parties should have a benchmark or a basis to evaluate their performance in carrying out an interaction. This is because trust level can be calculated by correlating actual performance and agreed performance (Hussain, Chang et al. 2004). Specifically, in a services environment, actual performance can be seen as the actual service delivery, while agreed performance is the set of agreed service requirements from both parties. Therefore, a formal agreement on service requirements such as an SLA is needed for trust maintenance. A Service Level Agreement is defined as a negotiated agreement between two parties where one is the service provider and the other is the service requester (Zulkernine, Martin et al. 2009).

Unlike the trust building phase, in the trust maintenance phase, each of the interacting parties has to make a concerted attempt to maintain or sustain the level of trust in the relationship. In contrast to trust building, it may involve activities such as both parties articulating the service requirements, negotiating on the service requirements, re-negotiating on certain service requirements, etc. However, in the existing literature, there is no methodology or framework by which two interacting business parties may agree on an SLA for trust maintenance. As a result, a method for reaching an agreement of service requirements between both parties is an important step in the process of trust maintenance. In this paper, we present the design of such a framework that involves service requirements formalization and negotiation to draw up an SLA. Additionally, we describe the application of the proposed framework by making use of a case study. The rest of the paper is organized as follows. Sections 2 and 3 present the background of our work. Section 4 describes the case study. Section 5 presents the proposed framework. Section 6 discusses the application of the framework to the case study. Finally, Section 7 concludes this paper and sets the ground for further research.

Trust Life Cycle

Trust can be seen as the degree of the other parties' competence and ability to deliver on the service task. However, as the relationship progresses, we may find that the level of trust may either increase or decrease (relative to the initial trust level). The direction of the movement of trust value (increase / decrease) and the amount of increase / decrease depends on the capability and willingness of the other interacting party. Over time, one may find that trust between two parties reaches to a high level (which may be greater than positive trust). At this stage, if both parties see value in their relationship and would like to sustain their trust based relationship in the future, then they should take appropriate actions to maintain trust. However, if such trust maintaining actions are not taken, then it could result in the erosion of trust (trust dropping to levels corresponding to negative trust).

(Jones and George 1998) contend that there is a developing trust continuum path from conditional to unconditional trust. In the first stage of the relationship, both parties develop their trust based on initial knowledge and information about each other. This brings the level of trust to conditional trust. Conditional trust may be enough for an exchange relationship to function at a certain level, but it still needs to be monitored and controlled. Furthermore, the authors state that the best level for establishing a relationship is when the trust level is at the unconditional trust stage. Unconditional trust implies that both parties involved in the business relationship are able to achieve the task. It will create positive affect and friendship, which result in high relationship performance (Jones and George 1998). In addition, (Rousseau, Sitkin et al. 1998) noted that more recent research in the trust field emphasizes its dynamic nature. The trust level in such relationships is no longer seen as static; instead, there are several different phases in trust life cycle (e.g., building, stability and dissolution). Therefore, trust is a dynamic rather than a static process as a business relationship can also be seen as a dynamic social system. The pattern of the trust life cycle is illustrated in Figure 1.

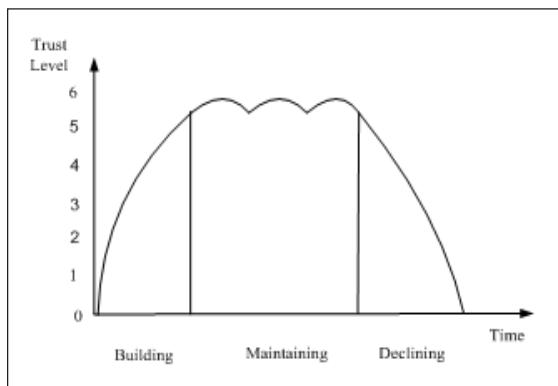


Figure 1. Trust Life Cycle

Clemmensen, Khryashcheva et al. (2008) argue that trust development in a virtual environment is comprised of three stages which are predisposition to trust, trust formation and trust maintenance. Predisposition to trust exists in initial relationships which are established based on cultural similarity (country, upbringing, etc), personal and psychological characteristic among team members. During the second stage, trust formation occurs when trusting party becomes a formal member of a group. In initial group meeting, they share resources in order to finish a task. Trust arises based on the willingness of network members to share information and any other resources to achieve the team's task. Trusting agents will form or assign a trust value to a trusted agent based on the trusted agent's competence and ability to share resources and to finish a task. The final stage is trust maintenance. The trust maintenance stage occurs when the importance of task increases. Hence, once trust has been well established in the second stage, members in a virtual network start to maintain its trust with attention being given to the high quality of information about trust dimensions (willingness, competence and ability).

Based on the above review of the trust evolution in virtual environments, it is clear that in a business relationship for virtual environments, trust has a life cycle and pattern. The pattern starts with developing/formation/building, maintaining and declining/destroying. However, the vast majority of the existing literature on trust focuses on 'building trust' and ignores how trust could be maintained (Fachrunnisa, Hussain et al. 2009). Moreover, the existing literature treats the terms building, developing and maintaining trust in virtual environments as synonymous. In this research, we clearly separate the different stages of trust evolution and we focus on the maintenance stage as the aspects of this stage have not yet been studied in detail. In this paper, we investigate the role of the SLA in trust maintenance. Additionally, we present a framework or a methodology for agreeing on an SLA for trust maintenance. The contribution of this paper to the existing body of literature is twofold (a) it presents the

unique importance of SLA for trust maintenance; and (b) it proposes a framework for determining an SLA for trust maintenance.

The Role of SLA in Trust

Trust can be seen as the outcome of the consistent execution of a business contract. The consistency of service delivery as promised is the basis to assign trust values to business in virtual environments. Therefore, a business contract such as an SLA is needed to check the consistency of delivery service promises. (Singleton, McLean et al. 1988) argued that an SLA is mutually established and agreed upon by both Service Requestor and Service Provider. It specifies a product and/or service to be delivered with a certain requirement to meet their business objectives. Additionally, trust reflects the trusting agent's belief that the trusted agent will fulfill the requirements through future actions. Therefore, an SLA can be viewed as a basis on which trust evaluation and trust establishment would be carried out.

Babar, Verner et al. (2007) has identified some factors that play a vital role in establishing and maintaining trust. One of them is contract conformance. They note that contract conformance which includes promises about quality and timely delivery plays a significant role in maintaining trust relationships. With a contract conformance, both parties can confirm whether or not they obey all clauses in business agreement. It will help to gain trust from clients. Babar, Verner et al. (2007) defined contract conformance as an agreement between two parties on how they make a virtual collaboration in certain domains such as software outsourcing. Additionally, Gwebu, Wang et al. (2007) also noted that a well-defined relational contract is one of the mechanisms for building trust in a virtual network. Well-defined relational contracts that contain a clear and effective reward, credible punishment and sanction systems, and an effective reputation management system help trusting parties to perceive trust.

In addition, trust in service environments may increase as a result of repeated service experience (experience-based). It means that the trusting agent (e.g., customers) will incrementally gain higher trust in the trusted agent (service providers) over time as a result of repeated positive interactions. This is because the trusting agent does not have a set of defined expectations of service quality in online environments (Zeithaml, Parasuraman et al. 2000). These perceptions are formed during the SLA process and are either confirmed or refuted over the ensuing interaction (operational competence) (McKnight and Chervany 2006). In contrast, in traditional environments, the trusting agent usually engenders trust by physically observing the service provider's competence and ability to deliver the service (observation-based).

Therefore, Balasubramanian, Konana et al. (2003) argue that institutional safeguards, for instance trading regulations and formal statements about the service to be delivered have a significant impact on trust formation in a virtual environment. A repeated good experience will reinforce the perception of trusting agent about service attributes in virtual environments such as reliability of information and efficiency of transaction execution. Reliability of information can be found in trading regulations or business contracts. Moreover, efficiency of transaction execution can be seen as an actualization of its regulations statement. Hence, an agreed regulation that governs business interactions between trusting agent and trusted agent will help to maintain their trust level.

Moreover, Sapiro (1987) stated that the need to produce institutional structures that administer business activities are higher when there is a minimum personal relationship between service providers and customers. In the trust field, situational normality and structural assurance are basic form of institution-based trust (McKnight and Chervany 2006). Situational normality is defined as the proper ordering of cognitive cues. Hence, we argue that a formal contract which contains cognitive signals between trusting agent and trusted agent is an expression of ordered activities that should be met in business activities. It can be concluded that formal agreement is an institutional structure that should produce to facilitate trust maintenance.

However, none of those works proposing a mechanism by which both trusting agent and trusted agent reach this agreement contract. In addition, Kasper-Fuehrer and Ashkanasy (2001) argued that a common business understanding is important in the virtual context. Common business understanding is defined as an agreement between virtual partners in order to establish a business relationship. They propose that there are three significant specifications in common business understanding. The first is a clear specification: the design, quality, and functionality of the product or service. The second is specification of the level of cooperation, which requires agreement about time deadlines, liability, prices, profit allocation, and resource input. The third is formal specification of agreement between the virtual partners. In a virtual business relationship, these specifications need to be communicated clearly between both parties to achieve a mutual agreement.

Thus, by designing and agreeing to contracts, agreements and regulations, business parties may implicitly declare their

service standards in a business relationship. In order to maintain a trust relationship, it is incumbent upon both parties to develop their own (formal or informal) guidelines for their business relationship. Such agreements may include clarification of members' tasks and responsibilities, agreement on contracts, deadline of task, rewards and punishment. In this sense, clear guidelines, spelled out in the early stage of the partnership, serve to reduce misperceptions and to foster the establishment and maintenance of trust (Handy 1995; Kusari, Cohen et al. 2005). Such a specification of the set of agreed business activities is extreme importance in virtual environments (in particulars), as it would facilitate the following:

- a) Enable both the interacting parties to determine or find out the business requirements of the interacting partner.
- b) Enable each interacting party to make a judgment of whether the service capabilities being offered by its interacting partner would be sufficient for its business requirements from the interaction.
- c) Know clearly the criteria on which the assessment process would be carried out.

However, the existing literature does not propose any mechanism for concluding the 'specification of set of agreed business activities' for trust maintenance. Apart from the importance of agreeing on the SLA, from the trust maintenance perspective, the following properties are unique:

- (i) Since the level of trust between the interacting parties is high, one of the interacting parties (or possibly) both, may be willing to negotiate or consider or agree on the business requirements of the interacting party.
- (ii) Given the special nature of relationship in trust maintenance, the parties may need to go through repeated or iterative negotiation on service criteria, before agreement is reached.
- (iii) Each interacting party would need to clearly determine and subsequently articulate what its business requirements are from the interacting party

In the existing literature it is clear that there is no framework or methodology for agreeing on an SLA for trust maintenance, that takes into consideration the above requirements.

Case Study

In this section, we illustrate a case study and discuss the issues associated with an SLA for trust maintenance purposes. Let us consider the following example of relationship between mobile phone manufacturer as service provider (trusting agent) and a wholesaler mobile phones dealer as service requester (trusted agent).

Easy Phones is a large mobile phone manufacture. In order to distribute their products, Easy Phones engages with some wholesalers or retailers. Let us consider that Easy Phones has three retailers, Angela, Budi and Cherry. Among these retailers, Easy Phones found that, over time, Angela is a trustworthy retailer. This is because Angela always reached the highest sales volume and has been prompt in payment. Additionally, let us consider that as a retailer, Angela also has many suppliers, one of which is Easy Phones. From Angela's point of view, Easy Phones is also a trustworthy supplier since they always deliver their service on time and meet Angela's requirements. In this case, both Easy Phones and Angela see that their relationship, which has been built over time, is highly valuable. Let us assume that the trust level in the relationship has been positive over a pre-defined duration of time. To continue a healthy relationship, both parties need to maintain their relationship value. Easy Phones and Angela agree that they would like to maintain trust in order to provide the best possible outcome to each other. In other words, both the interacting parties (Easy Phones and Angela) would like to get a clear idea of their interacting parties' requirements from the interaction, so that (a) they can make a decision on whether they can deliver on the other parties' requirements and (b) know clearly what is expected of them from the interaction. However, in the existing literature there is no framework that can be used to achieve this for trust maintenance purposes.

Here we formalize Easy Phones and Angela's requirement to maintain trust as follows:

- Since Angela and Easy Phones have decided to maintain their trust relationship, they need to clearly determine what their business requirements are and articulate them. Once the business requirements have been articulated, subsequent negotiation between them can occur.
- A guideline is needed which can be used as a benchmark for trust evaluation.
- In order to obtain information on what interacting parties want from a relationship, a service requirement statement /

formalization is needed. Service formalization is a method for determining what they require and need from the trust maintenance. This formalization framework will allow Easy Phones and Angela to formalize their requirements and standards from the relationship.

- A negotiation framework is required to make an agreement on service requirements. This is due to the fact that Angelas' service requirements may differ from Easy Phones' service requirements. Therefore, there is a need for a negotiation process by which both parties can discuss any conflicting requirements and reach an agreement.
- A process to derive an SLA based on formalization and negotiation is needed. The SLA would serve as the assessment platform for their trust relationship in trust maintenance. With this SLA, Easy Phones and Angela can check their performance positions which in turn measure their trust level.

Even though there are many discussion on creating SLA between service provider and service requester in the existing literature (Lau 2006; Yan, Kowalczyk et al. 2007; Zulkernine, Martin et al. 2009), none of them are discuss any pre activities such as service formalization and service negotiation to reach SLA. From trust maintenance context, one may consider SLA as a draft of the capability and willingness of standards requirement that both Easy Phones and Angela have agreed to. It also contains any strategies and tactics that they agree upon in order to finish the service task. Therefore, service formalization and service negotiation are important steps in determining the SLA.

However, in the existing literature, there is no framework by which an agent can formalize its service requirements. Service requirements formalization would enable each interacting party to clearly determine its service requirements and articulate them. Furthermore, this would enable each interacting party to discover what the other interacting agent wants. We propose service formalization as a step or a process of articulating the business requirements of both the interacting parties. Once the service formalization has occurred, then the interacting parties can negotiate the service requirements between themselves. Each interacting party should know the service criteria that they want in their interaction. In the existing literature there is no mechanism by which either of the interacting parties can formalize their service requirements. As a result of this, the interacting parties would not be in a position to discover the service requirements of their interacting partner. Therefore, a method to obtain the service provider's and service requester's requirements with the structured model is needed.

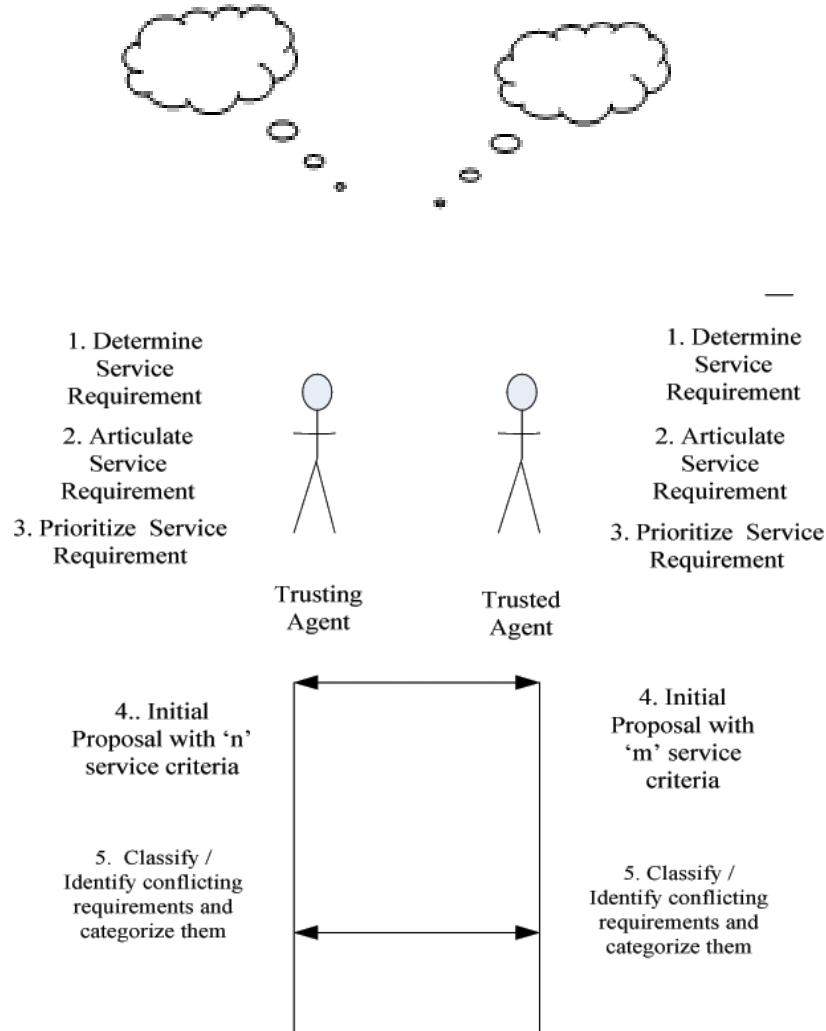
In addition, a negotiation process by which both trusting parties can discuss their service requirements is limited in the existing body of works. Most of the literature considers negotiation as a process to satisfy or meet service requirements from the service requesters' perspective only. However, for trust maintenance purposes, an agreement on service requirements should consider the requirements from both parties' perspectives.

Additionally, as mentioned previously, for trust maintenance, the interacting parties may need to negotiate iteratively on certain service criteria. However, the existing literature does not propose such a mechanism for service negotiation in trust maintenance. Therefore, in this research, we propose a framework by which SLA between two interacting parties can be reached, based on service formalization and service negotiation. The two mechanisms, service formalization and service negotiation, will enable the trusting agent and trusted agent to reach an agreement. An agreement on service requirements from both parties is necessary in trust maintenance due to some basic assumptions. Firstly, both parties see a value, either monetary or non-monetary, in their relationship. Secondly, both parties are being vulnerable in a reciprocal action to maintain or preserve this value. Thirdly, they engage in a joint effort to reach their common goal in such a business relationship.

The Proposed Framework for Service Formalization and Service Negotiation

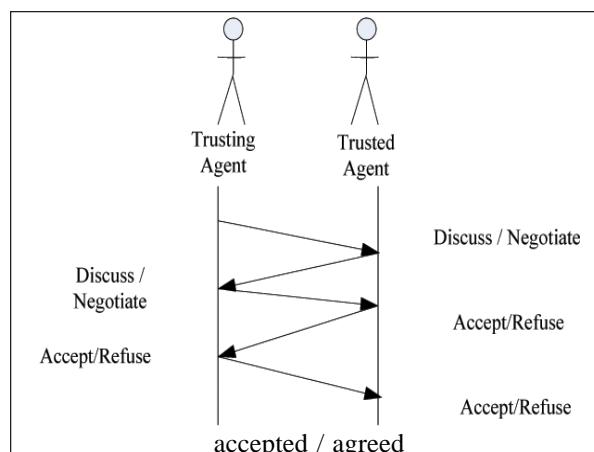
We argue that in a service relationship with trust maintenance purposes, service formalization and service negotiation are valuable steps that enable each interacting party to agree on the SLA. As mentioned in the previous section, service formalization would enable each interacting party to ascertain its service requirements and document them. This would additionally enable the interacting party to get an idea of its interacting parties' requirements. Subsequently, during the service negotiation process each interacting party can negotiate the service requirements keeping in view their service capabilities. Therefore, a framework of formalization and negotiation to create a Service Level Agreement that requires effective communication between trusting agent and trusted agent is needed. Details of the framework are depicted in Figure. 2 below.

- a. Formalization of service requirements

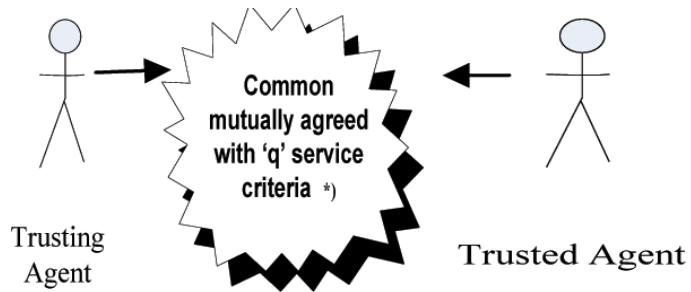


b. Negotiation for each conflicting requirements

- S_1 negotiation / Negotiation for Conflicting Service Criteria 1 (one)
- S_2 negotiation / Negotiation for Conflicting Service Criteria 2 (two)
-
- S_n negotiation / Negotiation for Conflicting Service Criteria n



c. Service Level Agreement



$$*) q \geq m \geq n$$

Figure 2. The Proposed Framework

The above framework shows that initially, both trusting agent and trusted agent are starting to formalize their service requirements. Both trusting agent and trusted agent are expressing the service that they want and expect from the interaction. It includes three steps or activities: determining service requirement, articulating service requirements and prioritizing service requirements. Based on these three activities, both parties will have an initial proposal of service requirements which contains service criteria, quality descriptors and the importance level of its service criteria. The number of service criteria might be different from both parties ('n' from trusting agent and 'm' from trusted agent). From their initial proposal, both parties can classify or identify any of their conflicting service requirements which need to be negotiated during the negotiation phase.

In the negotiation phase, both parties negotiate iteratively on each conflicting service requirements. Once they reach an agreement about all the service requirements to carry out during the interaction, they will have an SLA which contains an agreement about a set of service requirements. As explained previously, the number of service criteria of the trusting agent is 'n' and the number of service requirements from the trusted agent is 'm'. Therefore, in an SLA, the number of agreed service requirements ('q') could be the same as 'n', 'm' or the accumulation/combination of 'n' and 'm'. We present the details of this framework in the next section.

Service Formalization (Pre-Negotiation)

We define service formalization as '*the process of deciding and articulating the service requirements with a quantitative, qualitative or hybrid expression*'. Service formalization is an extremely important step that would contribute to the successful delivery of service requirements. Before the interaction, if the service requirements or criteria are not carefully considered by the interacting party and articulated in unambiguous terms, it will not be possible for the interacting partner to know what is expected of it. Service formalization is the step that leads to service negotiation. Understanding or coming to know of interacting parties' needs about the service is an extremely important step in eventually delivering on the requirements. Service formalization is widely used in software engineering; however, we propose its use in services computing as a means of deciding and articulating the service requirements of each party. This would additionally serve the purpose of the other interacting party knowing what is required or expected of it. Trust maintenance can be viewed as providing service (possibly customized service), for a special valued partner. In order to do so, each interacting party needs to ascertain (a) its service requirements and (b) the service requirements of its interacting partner.

The provision and delivery of service based on customized requirements makes the service requester feel that the service provider values their needs. This is an important element of maintaining trust. In relationship with trust maintenance purposes, a close connection between service requester and service provider must be facilitated in order to have a quick response on what both parties want. We argue that trust can be maintained only by consistently delivering on the agreed service requirements. Providing and composing high quality of service can be done by comprehending both parties' requirements prior to the service exchange.

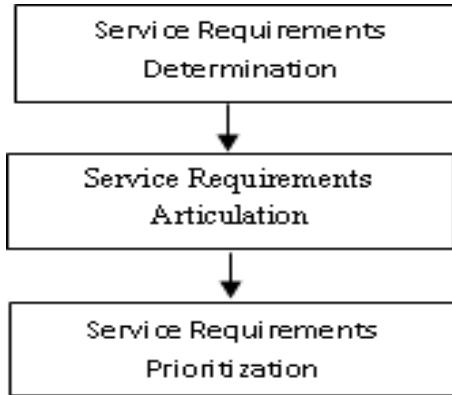


Figure 3. Service Formalization

The steps involved in the service formalization phase are as follows:

Step 1 – Service Requirements Determination

Step 2 – Service Requirements Articulation

Step 3 – Service Requirement Prioritization

Service Requirements Determination

We define service requirements determination as the process of ascertaining the service requirements or needs. In other words, it can be construed as the processing of ascertaining the needs that the interacting party has from the interaction.

Let us continue with the above example involving Easy Phones and Angela. The first phase of this framework is service formalization. Without the service formalization phase, neither party will not know exactly what is required of it in the business relationship. It is also a kind of mutual self learning for both parties by which service provider and service requester can learn about their own potential needs in the interaction. The service provider will be providing the right service for service requester. On the other hand, the service requester will be willing to fulfill the requirements in order to obtain the right service.

In this case, both trusting agent and trusted agent are starting to determine their service requirements. Both Service Requester and Service Provider are stating the service that they want and expect from the interaction. As the purpose of this activity is to maintain trust, both parties try to provide a high-end service to their interacting party. For trust maintenance purposes, both parties are aware of their service context. However, it still needs to express clearly the next context detail and requirement of the service delivery to facilitate the growth of trust level during the trust maintenance phase.

Service Requirements Articulation

We define service requirements articulation as the process of expressing the service requirements in terms of service criteria and its associated quality descriptors. Moreover, in order to provide a mechanism to articulate service requirements, we propose a template of service formalization that suitable for structured information. By designing a service formalization template, business parties may implicitly declare or articulate their service requirements clearly in a manner that is easily understood by the interacting parties. This template varies depending on the type of service and parties interaction. It contains, service criteria, quality descriptors and preference or level of importance.

Service Requirements Prioritization

We define service requirements prioritization as the process to valuating the importance of each service criterion. This value has three levels as follows:

0 – Unimportant

1 – Important

2 – Very Important

The service formalization template is used for both service provider and service requester. Therefore, the outcome of service formalization is a statement of service requirements from the service requester and a statement of service requirements from the service provider. Table 1 below shows the template for service requirements formalization. It contains service criteria, quality descriptors and level of importance.

Service Criteria	Level of Importance	Quality descriptors
S_1	$C_{11} \dots C_{1n}$	P_1
...
S_n	S_{n1}, \dots, S_{nN}	P_n

a. Service Requester (Trusting Agent) Requirements' Statement

Service Criteria	Quality descriptors	Level of Importance
S_1	$C_{11} \dots C_{1m}$	P_1
...
S_m	S_{m1}, \dots, S_{mN}	P_m

b. Service Provider (Trusted Agent) Requirements' Statement

Table 1. Service Formalization Template

We define service criteria as a decisive factor or requirements of the service being requested or provisioned. For example, if the service is about providing logistics transportation, one of service criterion is 'time' to deliver goods from city A to city B.

We define quality descriptor as a statement expressing the quality requirements for those criteria. The quality requirements could be either quantitative, qualitative or hybrid. Let us use the above example of 'time' as a service criterion in logistics transportation. In order to state the description of service criterion 'time', '5 days' or 'a month' is a service descriptors or quality descriptor for 'time'.

Service Criteria	Quality Descriptors	Level of Importance
S_1 = Quantity of order	$C_{11} = 2500$ units	2
S_2 = Price	$C_{21} = 500 \$$	2
S_3 = Delivery time	$C_{31} = \text{Once in three months}$	1
S_4 = Order and purchase method	$C_{41} = \text{Fax}$ $C_{42} = \text{Email}$ $C_{43} = \text{Online ordering form}$	1
S_5 = Payment method	$C_{51} = \text{Credit Card}$ $C_{52} = 30\% \text{ before shipping and } 70\% \text{ after shipping}$	2
S_6 = Additional services	$C_{61} = \text{Two years spare part warranty}$ $C_{62} = \text{Product advertisement network}$ $C_{63} = \text{Product upgrade information}$	1
S_7 = Bonus	$C_{71} = \text{Holiday voucher}$ $C_{72} = \text{Cash back}$ $C_{73} = \text{Workshop decoration}$	1

Table 2. Trusting Agent's (Angela) Requirements Statement

Let us continue the previous example by illustrating how Easy Phones and Angela formalize their service requirements.

Table 2 describes the service requirements statement from Angela's perspective. In this case, Angela proposes seven (7) service criteria for the service that she requires and expects from Easy Phones. In each service criterion, quality descriptors explain the quality requirements of its service criterion. For example, service criterion 4 (S4) which is order and purchase method, Angela wants ordering and purchasing to be done through fax, email or online ordering form.

On the other hand, let us assume that based on previous numerous interactions, Easy Phones also have service criteria that they want and need from Angela. The number of service criteria from the Easy Phones' perspective only five (5). They do not offer the additional services and bonus that Angela wants. Table 3 below represents Easy Phones' requirement statement.

Service Criterions	Quality descriptors	Level of Importance
S ₁ = Quantity of order	C ₁₁ = 3000 units	2
S ₂ = Price	C ₂₁ = 550 \$	2
S ₃ = Delivery time	C ₃ = Monthly	2
S ₄ = Order and purchase method	C ₄₁ = Online ordering form	2
S ₅ = Payment method	C ₅₁ = Cheque C ₅₂ = 100% before shipping	1

Table 3. Easy Phones' Requirements Statement

Once both parties have each other's service requirements, they start to negotiate and bargain on any conflicting requirements. In the next section, we discuss how both parties negotiate their conflicting service requirements.

Negotiation

Pruitt (1983) stated that negotiation is a process whereby negotiating parties interact and communicate to discuss how they distribute and redistribute work load and commitment. Moreover, Bichler, Kersten et al. (2003) described negotiation as an iterative decision making process between two or more agents (parties or their representatives). The parties exchange information, starting with some detailed offers, counter offers and arguments, deal with interdependent tasks, and search for an agreement which is a cooperation and conciliation decision.

Moreover, negotiation is widely argued to be an important business activity when reaching an agreement (Kim and Segev 2005). In addition, there are many discussions in the existing literature on how to negotiate service requirements for SLAs (Da-Yin and Chung-Liang 2005; Demirkan, Goul et al. 2005; Kim and Segev 2005; Lau 2006; Yan, Kowalczyk et al. 2007; Cao, Wang et al. 2008; Watanabe, Kimita et al. 2010). However, none of the above literature proposes a framework for negotiating service requirements that takes into account (a) the iterative negotiation process (b) negotiation on service criterion (c) negotiation on quality descriptors and (d) negotiation on the level of importance of service criteria.

In order to enable the trusting agent and trusted agent to carry out structured negotiation between them, we propose service description map (SDM). After both parties (trusting agent and trusted agent) formalize their service requirements, they translate those requirements into a SDM which represents a comparison of service requirements from the perspectives of the trusting agent and the trusted agent. The structure of the SDM is as shown in table 4 below:

Transaction ID:								
Time Frame:								
Trusting Agent ID:								
Trusted Agent ID:								
Service Criteria	Trusting Agents' Offer		Trusted Agent's Offer					
	C ₁	..	C _n	Imp	C ₁	..	C _n	Imp

Table 4. Service Description Map

In this step, both parties review and discuss their service requirements. For trust maintenance purposes, a service requirement is described from the perspective of both the trusting agent and trusted agent. If the service requirement from the trusting agent's perspective is difficult or cannot be delivered to the trusted agents and vice versa, an adjustment to the requirements should be performed to accommodate the interest of both parties.

Continuing with the example of Easy Phones and Angela's service formalization above, there are some differences in the requirements of both parties. In order to reconcile these two different views during the negotiation process, both parties agree to translate their service formalization to service description map.

Table 5 is an expression of both parties' service requirements via the Service Description Map.

Transaction ID: xxx

Time Frame: 1 January 2014 – 31 December 2014

Trusting agent ID: Angela

Trusted agent ID: Easy Phones

Service Descriptors	Angelas' Offer				Easy Phones' Offer			
	C ₁	C ₂	C ₃	Imp	C ₁	C ₂	C ₃	Imp
S ₁ = Quantity	2500			2	3000			2
S ₂ = Price	500\$			2	550\$			2
S ₃ = Delivery time	1 * 3 months			1	1 * 3 month			2
S ₄ = Order and purchase method	Fax	Email	Online Form	1	Online Form			2
S ₅ = Payment method	Credit Card	30% before and 70% after shipping		2	Cheque	100% before shipping		1
S ₆ = Additional services	Two years warranty	Advertisement network	Product upgrade information	1	n/a	n/a	n/a	n/a
S ₇ = Bonus	Holiday voucher	Cash back	Workshop decoration	1	n/a	n/a	n/a	0

Table 5. Service Description Map

The SDM compares the trusting agent's offer with the trusted agents' offer. By checking this service description map, both parties can identify criteria or quality descriptors for which they have conflicting service requirements. The sets of the conflicting requirements would be the ones that require negotiation between the interacting parties. The steps of the negotiation phase are as follows:

a. Identify contradicting requirements

Based on service description map, both parties can identify which service requirements that they have not agreed yet. These contradicting or conflicting requirements would be the main issues to negotiate.

b. Prioritize the contradicting requirements

The objective of this phase is to prioritize the set of all conflicting requirements. Once both parties have identified some contradicting requirements, they should make a prioritization on how to make a deal in negotiation. Each contradicting requirement has a certain value of importance level.

The negotiating parties (trusting agent and trusted agent) can determine a comparative preference value in their service description map. If there is more than one conflicting requirements, the service criteria with the highest importance level would be the first to be considered for resolution or trade off purposes.

c. Negotiate contradicting requirements

Any information about contradicting requirements and their level of importance level is available from the second step. During the negotiation process, both parties should be able to adjust their contradicting requirements until an agreement reached.

Based on the above SDM from the interaction between Easy Phones and Angela, there are some conflicting requirements (*italicized*) and some same value (**in bold**) of requirements from both parties. The negotiation process starts with the highest level of importance of conflicting requirements. In this case, it starts from S_1 , S_2 , S_5 , S_4 , S_6 and S_7 . The T_1 , T_2 , T_3 ... T_n is the number of iteration negotiation time. Once both parties have agreed on each of service requirements, the negotiation is finished and both parties reach an agreement on service criteria, quality descriptors, and level of importance.

S_2 : Price						
Trusting Agent's level of importance: 2						
Trusted Agent's level of importance: 2						
Trusting Agents' Offer			Trusted Agents' Offer			
Time	C_1	C_2	C_3	C_1	C_2	C_3
T_1	500\$	0	0	550\$	0	0
T_2	510\$	0	0	550\$	0	0
T_3	525\$	0	0	525\$	0	0
T_4	Agreed					

Table 6. S_1 Negotiation

In the S_1 , S_2 , S_5 , S_4 , S_6 Easy Phones and Angela can reach an agreement on the service requirements. The number of iterations in each conflicting service requirement varies depending on how both parties discuss and bargain. For example, in S_1 (Quantity of delivery) both parties reached an agreement after four iterations. The quality service descriptor value of agreed requirements could be from one of the agents or it could be a new negotiated value. There is a possibility that both parties may not reach an agreement value for conflicting requirements. In this case, this service criterion is excluded from the agreement contract. Once the negotiation phase is completed, both the interacting parties go through the set of requirements, which have been made mutually agreed to. If based on the negotiated and agreed requirements, both the interacting parties agreed to proceed with the interaction, then it goes ahead. This process is depicted in Figure. 3 below.

S ₂ : Price						
Trusting Agent's level of importance: 2						
Trusted Agent's level of importance: 2						
	Trusting Agents' Offer			Trusted Agents' Offer		
Time	C ₁	C ₂	C ₃	C ₁	C ₂	C ₃
T ₁	500\$	0	0	550\$	0	0
T ₂	510\$	0	0	550\$	0	0
T ₃	525\$	0	0	525\$	0	0
T ₄	Agreed					

Table 7. S₂ Negotiation

S ₅ : Payment Method						
Trusting Agent's level of importance: 2						
Trusted Agent's level of importance: 1						
	Trusting Agents' Offer			Trusted Agents' Offer		
Time	C ₁	C ₂	C ₃	C ₁	C ₂	C ₃
T ₁	Credit card	30% before shipping and 70% after shipping	--	Cheque	100% before shipping	0
T ₂	Cheque	30% before shipping and 70% after shipping	--	Credit Card	100% before shipping	0
T ₃	Cheque	100% before shipping	--	Cheque	100% before shipping	0
T ₄	Agreed					

Table 8. S₅ Negotiation

S ₄ : Order and Purchase Method						
Trusting Agent's level of importance: 1						
Trusted Agent's level of importance: 2						
	Trusting Agents' Offer			Trusted Agents' Offer		
Time	C ₁	C ₂	C ₃	C ₁	C ₂	C ₃
T ₁	Fax	Email	Online Form	Online Form	—	—
T ₂	Online Form	—	—	Online Form		
T ₃	Agreed					

Table 9. S₄ Negotiation

Let us consider the negotiation process between Easy Phones and Angela in S6 (Additional Services). Angela demanded a three option of additional service; however, none of them is being agreed to by Easy Phones. After some iterative negotiation interaction threshold, both parties agree to remove this service criterion from the relationship agreement. Once both parties finish bargaining on each conflicting service requirements, they send this agreement to the third party agent. The third party agent will create a service level agreement for both parties. In the next section, we illustrate how to translate this agreement into an SLA.

Service Level Agreement (Post Negotiation)

S ₆ : Additional Services						
Trusting Agent's level of importance : 1						
Trusted Agent's level of importance: n/a						
	Trusting Agents' Offer				Trusted Agents' Offer	
Time	C ₁	C ₂	C ₃		C ₁	C ₂
T ₁	2 years warranty	Advertisement network	Product upgrade information	—	—	—
T ₂	—	Advertisement network	—	—	—	—
T ₃	—	—	—	—	—	—
T ₄	Agreed					

Table 10. S₆ Negotiation

S ₇ : Bonus						
Trusting Agent's level of importance: 1						
Trusted Agent's level of importance: 0						
	Trusting Agents' Offer			Trusted Agents' Offer		
Time	C ₁	C ₂	C ₃	C ₁	C ₂	C ₃
T ₁	Holiday voucher	Cash back	Workshop decoration	—	—	—
T ₂	—	Cash back	—	10% discount	—	—
T ₃	—	—	Workshop decoration	—	—	Workshop decoration
T ₄	Agreed					

Table 11. S7 Negotiation



Figure 4. Negotiation Process

Once all service criteria along with their quality descriptors have been agreed upon by both parties during the negotiation phase, the agreement documented in a service description map would be sent to a third party agent. The third party agent is a neutral party whose role is to monitor the interaction. Then, this third party agent will translate the service description map to a Service Level Agreement. The outcome of this is an SLA and Binding Contract. A Service Level Agreement (SLA) is a

documented written agreement between service provider and service requester about the required levels of service. SLAs should mention the performance and satisfaction metrics that will be used by both parties to measure the success level of interaction.

Some points that important should be included during the drafting of SLAs are the following:

- The contact information of each agent
- The context or description of service relationship
- The criteria of service
- The agreed quality descriptor for each criteria
- The level of importance of each criterions
- The time window of SLA
- Measurement of the success

This service level agreement is used as a basis for both parties to monitor their interaction. The trust level would be calculated based on the correlation of agreed requirements as stated in Service Level Agreement and the actual value that delivered by the trusting agent and trusted agent (Hussain, Chang et al. 2004). They will have a clear idea of the interacting parties' requirements and subsequently the Third party agent will take the role of judge to monitor the performance progress of both parties during trust maintenance. We argue that if both parties' requirements are formalized and negotiated, they will be able to deliver service based on their needs and wants. It will ensure that the trust level remains significantly positive and should even increase by the end of the relationship. The detail of the Service Level Agreement based on Service Description Map in interaction between Easy Phones and Angela is provided in Table 12.

Transaction ID:	xx
Time Frame:	1 January 2011 – 31 December 2011
Trusting agent ID:	Angela
Trusted agent ID:	Easy Phone
Service Context	Mobile Phones Trading

Service Criterions	Quality Descriptors	Level of Importance	
		Trusting Agent	Trusted Agent
S ₁ : Quantity	C ₁₁ : 2750 unit	2	2
S ₂ : Price	C ₂₁ : 525 \$	2	2
S ₃ : Delivery Time	C ₃₁ : Once in three months	1	2
S ₄ : Order and Purchase Method	C ₄₁ : Online Form	1	2
S ₅ : Payment Method	C ₅₁ : Cheque C ₅₂ : 100% before shipping	2	1
S ₆ : Bonus	C ₆₁ : Workshop Decoration	1	0

Table 12. Service Level Agreement

Discussion

Our proposed framework is designed to create an SLA with the purpose of trust maintenance in a relationship. It contains two activities, service formalization and service negotiation. The outcome of those two activities is an SLA which contains a set of service criteria that are agreed by the trusting agent and the trusted agent along with their quality descriptors and importance

level. To reach this agreement, each agent should ascertain its service requirements and find out exactly what the other party wants. We propose the use of service formalization for these activities. The output of the service formalization phase is the service requirements document, which is translated to the Service Description Map. From the Service Description Map, both parties can identify the conflicting requirements and start to negotiate each conflicting quality descriptors, service criterion and its importance value. Hence, the main purpose of negotiation is to discuss any conflicting requirements. The negotiation is an iterative process until agreement is reached. If all service requirements are agreed to, then this agreement is sent to the Third party agent. The Third party agent will then translate this to a Service Level Agreement.

This SLA would be a benchmark or a basis for evaluating the performance of both parties when carrying out a business interaction. It is also a guide to how both parties carry out the interaction. This binding contract contains any metrics value as a threshold for how both parties should perform. For trust maintenance purposes for service in a virtual environment, both trusting agent and trusted agent will monitor each other's performance in service delivery to ensure that they perform as prescribed in the SLA. There are various points of the monitoring process that trusting agent and trusted agent may alter. Firstly, there are input controls, which are the formalization of service requirements. Secondly, process controls, by controlling the trusted agent's performance, ensures that they employ prescribed service requirements, and thirdly, output controls which measure the outputs of the trusted agent and trusting agent against established metrics that have been pre-defined in the SLA. This ensures that prescribed performance standards are met.

Conclusion and Future Work

In service environments, it is essential to have adequate support for the service requester and service provider to achieve agreements on QoS value. It will support the trust maintenance purposes between service provider and service requester. This paper presented a framework which enables service provider as trusted agent and service requester as trusting agent to formalize their service requirements and negotiate it until agreement has been reached. We present a service formalization template by which both parties can articulate their service requirements in a structured way. This structured information will facilitate the negotiation process in order to reach a Service Level Agreement. Our future work includes the means by which both parties monitor the performance progress based on this SLA and position their trust level during the relationship.

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