

A Visualization Approach for Modeling Trust in E-Commerce

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Abstract— E-commerce is presently operating under its expected capacity, mainly because traders find it very difficult to trust one another online for trading decisions. It is therefore very important to develop an effective trust management system that assists e-commerce participants to make good trust decisions. This paper describes a visualization approach towards such a system. The benefits of this approach are three-fold: First, it gives a better understanding of the components that can be used in a trust management system. Secondly, it illustrates that the components contributing to the trust making process can be different from one environment to another. Thirdly, it shows that the way one person trusts can be different from others. This approach, rather than using the same static attributes to calculate trust for everyone, uses specific attributes based on each truster’s goals. Moreover, by using GRL and UCM as notations for trust modeling, this approach provides a visual representation of trust, its components and the trusting process.

I. INTRODUCTION

A. A Broader Picture of Trust

Recent use of electronic environments has increased a lot and “millions of computer users worldwide have begun to ... engage in commercial online activities”[9]. In addition lots of virtual communities have been created. Moreover the uncertainty about the quality of products or services and the ability of sellers to stay anonymous has lead to a high level of risk [2, 9]. Consequently, trust management has been measured as one of the most important components in any electronic environment; however, this issue is still under research and there is not yet a well defined system. [2, 8, 21, 13]. In recent years many researchers have focused on trust related issues [1-3, 5, 6-18, 21-23], but only a few have tried to provide a broad and complete picture of trust [1, 3, 11]. Without providing a unified and broad framework for trust, it is very challenging to define suitable trust management models and formalization.

B. Selecting a Template (Heading 2)

The main intent of URN is to help with functional (behavioral) and non-functional (e.g., availability and scalability) requirements. [1].

The first component of URN is Goal Requirement Language (GRL), which helps to define goals and objectives of a system. It demonstrates the components that have contribution toward goal achievement and can be used to

show the impact of selecting one way of goal achievement against another. Using soft goals (cloud symbols) GRL allows depicting relationship between concepts with fuzzy and semantic nature [1] that can be used to model trust related concepts which have some level of uncertainty and fuzziness [2, 13].

Moreover, the entire trust process is based on behaviors and actions of involved parties [3, 7, 8, 11] and is defined in the boundaries of trustee and truster [9]. In addition, a trust process ends in two scenarios or paths - trust or distrust [11]. Consequently, UCM – second component of URN- which is a behavioral and scenario based notation with the ability to demonstrate different paths, parties and their activity boundaries [20], can be used to illustrate the notion of the trust. As demonstrated in Table I URN has enough components to depict trust environments.

This paper attempts to use URN to both model the components that affect our main goal namely the establishment of trust between trustee and truster, and to define trust and the trust making process. This visual representation helps with better understanding of trust definition and components that contribute to trustworthiness. It also serves as a good starting point for designing a trust management system with a more complete view of requirements.

TABLE I. URN COVERAGE OF TRUST DEFINITION

Trust	UCM	GRL
Behaviors	Behaviors	Tasks
Actors	Actors	Actors
Boundary	Boundary	Boundary
Paths	Paths	Paths Comparison
Actors’ Goals		Goals

II. LITERATURE REVIEW

As far as trust is a multifactor and subjective concept [11] researchers have focused on it from different perspectives and came up with different formalization methods. Efforts of researchers in the areas of philosophy, psychology, sociology, transaction economics, organization theory and technology have provided a disparate literature for trust [3].

Researchers like Deutsch have focused on the psychological aspects of the trust [11]. Psychology, in most cases, looks at trust from two perspectives, namely individual aspect and the social side of it. Moreover, psychology has focused on the mutual effects of risk and trust. It considers expectation and context as the two main parameters that help to increase or decrease the probability of performing an action based on trust. [9]

Other researchers like Barber have focused on the social aspects of the trust. These researchers in most cases study the influence of trust in group and group relationship [11].

Many researchers have also concentrated on trust from technological point of view. As an example, some researchers have tried to study the impact of the trust on e-business and e-commerce environment [2, 9]. Moreover, other researchers have discussed the aspects of the trust from the security perspective [15]. They look at trust from two main points of view: “Hard trust”, which deals with security issues, and “Soft trust” which deals with “control, comfort and caring”. [16]

A number of researchers have studied trust with focus on online reputation and agent communication perspective [12]. There are two main streams in this branch of research. While some researchers try to develop a model for distributed, open and peer-to-peer online communication [10, 22], others try to find out a way for better centralized approach [7, eBay, onSale].

Finally, with the emergence of web services as one of the main components of software applications and business models, researchers also discuss the trust related issues in this field [12]. They usually discuss how one can establish a business based on the services of other companies, and have enough trust on those companies to confidently guarantee the whole service that the business provides for its consumers through a combination of third party services.

III. MODELING TRUST WITH URN

A. A Visual Definition of Trust

Although many researchers from different perspectives have been working on trust; yet, no single and clear definition of trust has been agreed upon. However, some definitions are more acceptable than others.

One of the considerable definitions is Deutsch’s (1962). Since this definition uses a structural approach, it can be useful for computer science. Deutsch’s implies the following in a trust process [11]: The individual is confronted with an ambiguous path, a path that can lead to an event perceived to be beneficial (Va+) or harmful (Va-). He perceives that the occurrence of Va+ or Va- is contingent on the behavior of another person and he perceives that the strength of Va- to be greater than the strength of Va+. If he chooses to take an ambiguous path, he makes a trusting choice; otherwise, he makes a distrustful choice.

Among all various definitions of trust [3, 7, 8, 11, 14], some common points can be observed and are used to

generate Figure 1. First there are always two parties – truster and trustee – involved in the process of trust. The truster likes to rely on trustee for a service or function. The truster, in the process of trust decision making, decides whether she should select the trust or distrust path. This process is illustrated by a stub, a diamond symbol used to create hierarchical process maps in UCM models. Finally, the trust process can end in the positive or negative outcome, based on the behaviors of the trustee. As demonstrated in Figure 1, the behavior of the trustee is out of the boundary of truster and therefore is not controllable and predictable. In this case, the previous records that are available from trustee can help to reduce the risk and the complexity of trust decision making process [3, 9].

Table II illustrates the figure 1 in the context of e-commerce and more specifically online second hand book buyers.

TABLE II. BOOK BUYERS SCENARIO

Truster	Online second hand book buyer
Trustee	Online book stores with second hand items
Trust Decision making	Should I buy second hand books online? Which would be the best store to do that?
Trustee’s Responsibility	Offer the book and deliver it with the same qualitative values that is promised
Good End	Get the book with required qualitative values
Bad End	Receive a wrong book, or receive the book without required qualitative values
Finding the way	Buy the book from friends, or buy the book from traditional book stores

In addition to trust process - figure 1, studying the goals of truster from the trust process can help to define and formalize the trust decision making process and the criteria that are used in this process by the truster. Figure 2 shows the goals of a trust process - Figure 1. Using GRL, figure 2 shows the effects of trust and distrust – the two available paths for truster – on soft goals or quantitative values of the process result.

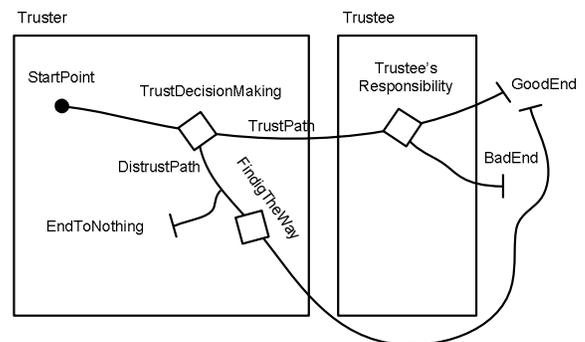


Figure 1. Trust’s Visual Definition with UCM

In Figure 2 the main goal of trustee – ellipse – is always to reach to the good end. In addition, trustee willingness to trust somebody is the result of the effects of the soft goals (e.g. time effectiveness, cost effectiveness etc.)

Trust can help to reduce the complexity of performing a task by using someone else’s experience in that task. In the same way, trust helps to decrease the duration to accomplish the task. Moreover, using someone else’s services may make the whole task more cost effective. Having someone trusted to do a specific piece of work may also increase the confidence for success. However, it may increase the risk, especially when one doesn’t have enough knowledge or prior interaction with the trustee.

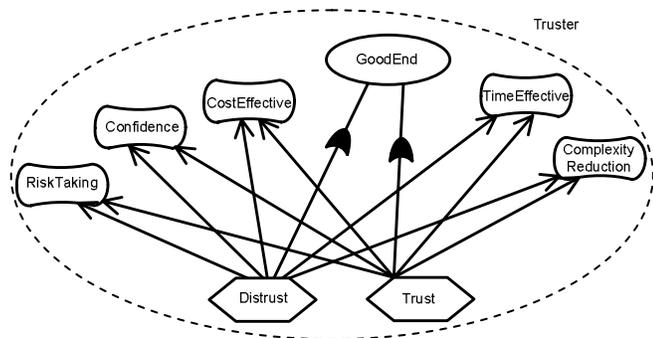


Figure 2. Truster’s Goals in trust process

In addition to the discussed issues, Figure 2 shows a comparison between trust and distrust. This model helps to select the right path in each individual case, and the path with better effect on the soft goals will be chosen.

People can have different goals from a trust process; or even in case of having similar goals their considered value for each of goals could be different. These goals and their values have significant effect on the decision making or its threshold values [11 p42]. As indicated in [11 p42] the threshold values are the points where people, based on the associated values to the trustee, decide between trust and distrust.

B. Trust Components - Trustee’s goals

In this section we focus on trustee’s goals. The main goal of a reasonable trustee is to increase the associated trust to her. To do that, trustee behaviors should be in accordance with Figure 3. This model is developed based on [3] trust framework.

As depicted in Figure 3, most components that have influence on trust, enforce their contribution through cognitive (logical) or affective (emotional and psychological) type of trust [3, 11] which are shown as first layer of this model after the main goal - Trust.

The second layer of figure 3 which has contribution in trust value through the first layer includes increased competency, predictability, ethical behavior and visibility of trustee’s positive intention [3].

As illustrated here, although reputation can play a significant role to increase the credibility and predictability

of trustee [8], it should not be the only considered factor in a trust management system, as in the case of some existing works [21, 22].

The last layer (shown in hexagon s) illustrates some of the tasks or behaviors of trustee that help to increase trust through first and second layers. To illuminate, the ability to show the underlying motivation to the trustee has a significant effect on convincing the trustee that the trustee has positive intention [11]. Moreover, a good visual representation of the trustee and her services helps to increase the predictability of trustee’s behavior for trustee. Finally, the quality of provided services can affect reputation.

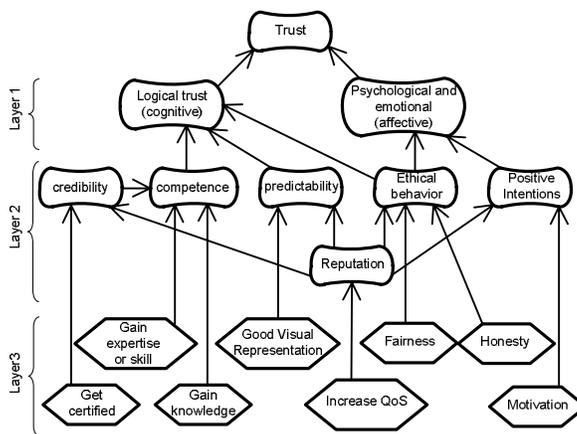


Figure 3. Trust Components – Trustee Tasks to build the trust

These tasks can have different values in different scenarios and some scenarios may have their own individual specific tasks to be performed for trust increment.

C. A New Trust Management Model

A combination of the Figure 2 and 3 are represented as Figure 4 which shows the relationship between trustee’s behavior, and trustee’s goals and how the trustee’s attributes can contribute to the trustee’s soft goals. It can be considered as a conceptual model for a system which evaluates different parties’ trustworthiness to propose the best trustee to the trustee based on the trustee’s goals, not on some predefined and limited attributes as in the case of some current systems. As mentioned before and elaborated in the context of Figure 2, trust is a subjective concept based on people’s soft goals and is therefore different according to the points of view of different people.

It is also demonstrated in figure 4 that most of the trustee’s behaviors are toward reducing risks for the trustee which shows the importance of the risk factor in a trust management system. Calculating the risk factor helps trustee to “demonstrate trust intention or trust behavior only when the level of trust exceeds the level of perceived risk” [8].

In addition, as illustrated in Figure 4, competence can play a significant role. As the result, a trust management system should be able to calculate the competence factor of

the trustee to compare it with the goals of the truster, and specify whether a good match has been found.

Furthermore, reputation module should be integrated with other modules to form a more complete system. To clarify, all participating factors (e.g competence, ethical behavior) used for trust calculation, should be validated using reputation module. As an example, the actual value of competence factor for a trustee with higher reputation value would be more than a trustee with less reputation value, even though they claim the same competence value.

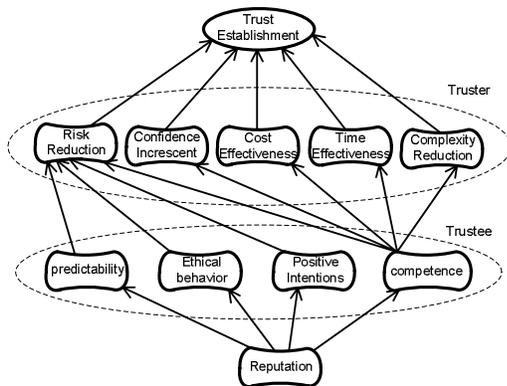


Figure 4. Figure 1: Effects of Trustee's behavior on truster's goals

IV. CONCLUSIONS

Structured methods for studying processes and environments as well as model driven software engineering have gained lots of popularity in the past few years. In this paper, a URN based approach in accordance with model driven software engineering was used to investigate trust related issues. The visual definition of trust that we introduced in Section 3.1 provides a better understanding of trust concept. Moreover, defining truster's and trustee's goals and attributes, and then combining them together (i.e., Figure 4) can help researchers to come up with better formalization and computational solutions. Using this combination, we introduced a model for a new interactive trust management system. Such a system would calculate trust based on what a truster looks for, and therefore would recommend the best trustee according to the user's requirements. We also showed that a trust management system with only one component (e.g., reputation) does not cover all the necessary functions and services. Finally, GRL and UCM were used for modeling trust as a new application area. This demonstrates the usefulness of these notations and opens up the opportunity for researchers to see them in border context.

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