Reasoning about the Role of Information Systems in Trusting Decisions

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Abstract: The interest in the study of trust has grown steadily since 1990 in a wide range of scholarly disciplines. The science of information systems is no exception, since the concepts of information and trust are inseparably intermingled. Meanwhile, there exist numerous applications of trust – most commonly in the areas of security and content filtering - many of which have already successfully been tested in real-world environments. However, with some exceptions, relatively little has been done in laying the conceptual foundations for discussing the relationship between information systems and trust. In this paper we argue that especially in environments, characterized through low presence of institutional mechanisms, availability of information is an important factor in facilitating trusting decisions. Starting from the observations of the confidence building through information in the real world, we identify and classify the potentials of information systems in facilitating trusting decision in virtual environments such as the Internet.

1 Introduction

The interest in the study of trust has grown steadily since 1990 in a wide range of scholarly disciplines [CM96; MC96; Ko99]. The science of information systems is no exception, for – as we shall show later on in this article - the concepts of information and trust are inseparably intermingled. Meanwhile, there exist numerous applications of trust – most commonly in the areas of security [Ch97; Bl96; BB95; Ya93] and content filtering [AH99; YS99] - many of which have already successfully been tested in real-world environments. However, with some exceptions ([Ko94; Ma94; Bl96; Ch97], relatively little has been done in laying the conceptual foundations of the relationship between information systems and trust, especially concerning the role of information systems in supporting trust decisions. In this paper we provide a framework for reasoning about the role of information systems in the context of trusting decisions. We argue that, firstly, the availability of information is an important (albeit not the only) factor in facilitating trusting decisions, especially in environments characterized through a low presence of institutional mechanisms. Secondly, it is our aim to show that by

studying the so-called "confidence-building" processes, which support trusting decisions in real-life, we can identify and classify the potentials of information systems for supporting trusting decisions in virtual environments such as the Internet.

2 Defining Trust

2.1 What is Trust?

Trust is widely recognized as being a major influencing factor in social relationships, including those constituting economic transactions [Re96; Blo97]. Yet, in spite (or rather: because of) its pervasive character, trust is difficult to pin down in terms of a firm, yet still widely accepted definition. For the purpose of this paper we decide to use the definition by Zand, which contains a representative subset of those aspects of trust, being agreed upon in the scientific community. According to Zand trust "consists of actions that: (a) increase one's vulnerability, (b) to another whose behaviour is not under one's control (c) in a situation in which the penalty (disutility) one suffers if the other abuses that vulnerability is greater than the benefit (utility) one gains if the other does not abuse that vulnerability" [Za72].

While we acknowledge that other, equally satisfactory definitions exist (the discussion of which is provided elsewhere, see [Blo97; MC96; Ma94]) there are two aspects of trust, which for the sake of the clarity of the subsequent explanations we shall address explicitly. The first aspect concerns the difference between the terms "confidence" and "trust" (explicitly discussed in [Se97]): in our view, the two are not identical, albeit they are related to each other in as much as the presence of "confidence" encourages risk-taking, immanent in every trusting decision. Cleary, the more confident you are, the greater the readiness to dare the "leap of trust", up to the point where the trusting decision is not even consciously perceived[1]. The second aspect pertains to the dilemma, of whether we can speak of the "target of trust" only with respect to human agents – a question, somewhat related to the former aspect. Although we acknowledge the argument made by some scholars, that the act of trusting presupposes "free will" on the part of the trusted party, for the purpose of this paper we adopt a perspective of Fogg and Tseng: According to their account (see [FT99]), the process of engaging with inanimate objects (e.g. computers) entails similar sense of insecurity as is the case, when dealing with a human agent. Thus, in the remaining of this paper we do not explicitly distinguish between "trusted objects" and "trusted agents". In both cases the term "trusting" denotes a condition in which the trusting party has enough confidence as to get engaged with the object, person or institution in question. Furthermore, we allow such engagements to be purely hypothetical, i.e. the state of trust implies a trusting belief, not necessarily a trusting action.

2.2 Building Confidence to Support Trust

Viewing the phenomenon of trust, the question arises of how does trust come into being? Nearly every piece of literature on trust provides a (more or less explicitly stated) model of, what we shall call a "trust-building process". Usually, such models entail a notion of

[1] This kind of trust is generally termed "system trust" [Lu89] or "institutional based trust" [ZD95] or "impersonal trust" [Sh87]

iterative bilateral exchanges[2], which – if satisfactory for both parties – result in a steady increase in trust on both sides over a period of time [NK99]. An illustrative example of this process in a business-to-business setting is depicted in Figure 1 [Schn01].

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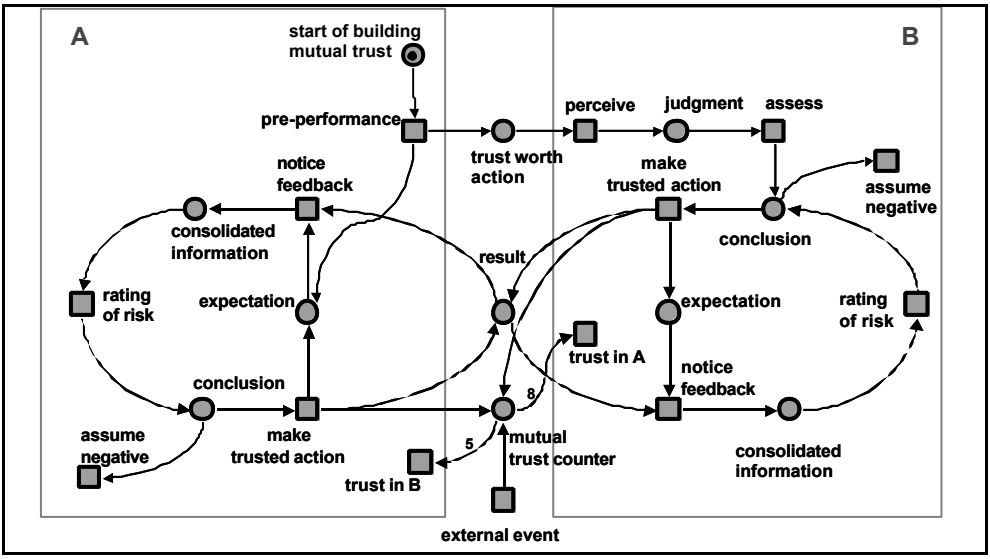

Figure 1: A Petri net model of trust building in a business-to-business context

The class of models such as the one depicted (subsequently termed "basic trust models") pose the assumption, that the degree of (mutual) trust can be seen as a function of the number of experiences perceived as positive by both parties in a given context. However, basic trust models usually do not provide sufficient explanation for situations in which there is no opportunity for such exchanges to take place, for example due to the high risk or lack of time [CM96].

We propose an extension of the basic trust models, which can account for the acceleration of the trust-building process, yet is still "lean" enough (in terms of influence factors being considered) as to be intuitively understandable. The extension consists of four additional factors:

Benefit/risk-ratio: Represents an estimate of the situation-specific risks and benefits as perceived by the trusting agent.

Readiness to trust: Represents a particular configuration of agent-specific variables (e.g. personality traits), which differentiate two particular agents in terms of the "trust threshold", all other factors assumed equal.

Presence of institutions: Represents the presence of social mechanisms by which the potentially negative consequences of a trusting decision can be either foreseen, excluded or remedied in the aftermath. For example, the presence of a (well-functioning) legal system allows for risk reductions through contracts,

[2] These exchanges need not be material, but can also be at the beginning be symbolical as discussed in [HD81].

allowing the trusting agent to demonstrate trust also in situations characterized by a high degree of risk[3].

Availability of information: The last variable represents the information available to the trusting agent prior to coming to a trusting decision. Such information usually entails some form of records of the other party's past performance thereby allowing for estimates about the likely courses of action undertaken by the other party.

In terms of compatibility with the basic trust models the benefit/risk-ratio determines the threshold, which must be reached, before a trusting decision can ensue. This threshold can be reached either through "exchange" activity depicted in the Figure 1 or by means of the aforementioned "extension" -variables – namely readiness to trust, presence of institutions and availability of information.

Three different scenarios in the Figure 2 exemplify the relationship between these three variables. In each of these, the benefit/risk-relationship (which is assumed constant across all three scenarios) is represented by the overall height of the rectangles.

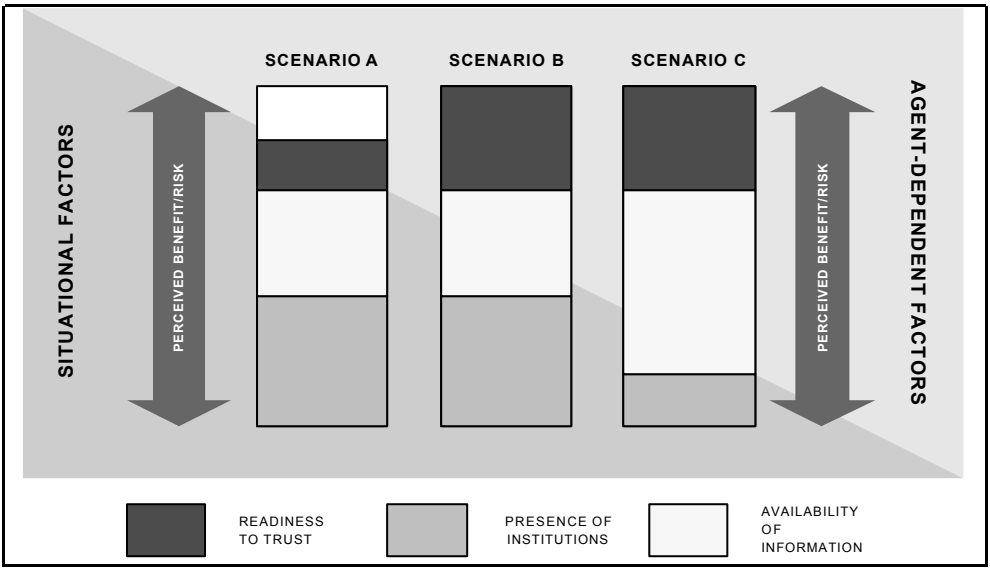

Figure 2: Trust-influencers

Clearly, since this height represents a ratio, more risk (benefit) implies that the height will increase (decrease) assuming the other factor being constant. If we imagine the benefit/risk-rectangle being a reservoir, then the other three variables represent fluids with which the reservoir must be filled, for the trusting decision to be made. Then, the unfilled space of the "reservoir" – symbolized by the white area at the top of the rectangle (only in the left-most scenario) - represents the remaining insecurity on the part of the trusting agent, which, if present, eventually leads to the abandonment of the transaction.

[3] As exemplified in [NK99]: "Trusting an online bank is to a great extent based on user's knowledge (or assumptions) about the laws binding all the business operations of the bank."

One further assumption underlying our model is that the reduction in one factor can be compensated by the other factors. Thus, a person with a relatively low readiness to trust will need either more information or "greater" presence of institutions if the transaction is to be conducted. Similarly, the model states that if a presence of institutions is low, the transaction will only take place if either a) the trusting agent is a trustworthy person (high readiness to trust), b) he is well informed (high availability of information, c) the risk of the situation in question is low or d) the expected benefit of the situation is high.
The model allows us to again restate our understanding of the relationship between confidence and trust: confidence then is the sum of factors, which - alongside one's readiness to trust – promotes trust, up to a point, where the risk perceived is overcome and the trusting decision made[4].

3 Trusting in the context of Internet

3.1 Delineating Internet in Terms of Trust

What exactly is the impact of the Internet in terms of trusting relationships - in particular in terms of the impact of such networks upon the determinants of confidence building described in the previous section?
As far as "presence of institutions" is concerned, the Internet is largely characterized by a relative absence of universally valid institutional arrangements in many spheres of interaction. There are virtually no mechanisms preventing frauds when engaging in an electronic transaction at auction sites, such as EBay, nor are there any obligatory codes of conduct regulating participation in chat rooms. Furthermore, many legal aspects of dealings in Internet remain unclear as the field is still new and the spheres of jurisdiction not clearly demarcated.
Concerning the "readiness to trust", the research findings are somewhat contradictory: while it has been observed that in some cases technical and legal concerns generally lead to lesser participation in electronic transactions (especially in the domain of business-to-business transactions) [Scho00], other researchers point out that the issues of trust are someone taken too lightly on the part of consumers (i.e. the readiness to trust is too high). Uslaner resolves this dilemma by claiming, that the Internet (in fact, technology in general) does not exercise neither positive nor negative influence upon one's decision to trust. Rather, the readiness to trust determines the kind of interactions that a particular user will participate in [Us00]. This is consistent with our model delineated in the previous sections: what actually varies is the "presence of institutions" perceived by a particular agent, while the "readiness to trust" (in terms of agent's personal traits) remains the same.
The findings regarding the third factor – "availability of information" - are ambivalent, too. Compared to the realm of traditional face-to-face interactions, the Internet generally impedes the richness of person-to-person interactions [OO00]. Moreover, the culturally embedded cues that allow us to evaluate trustworthiness in traditional information spaces (e.g. newspapers) are largely absent on the Internet [EC99]. On the other hand, the Internet exhibits an unprecedented potential of collecting, aggregating and disseminating

[4] Buskens calls this phenomenon "Trust with Reason", see [Bu98].

knowledge in a digital form, which - if intelligently exploited through appropriate information systems - can overcompensate the adverse effects mentioned above.
Thus, the working assumption here is, that the actual degree of participation in electronic transactions over the Internet depends on the availability of information, which in turn can greatly be enhanced by appropriate information systems.

3.2 Availability of Information: Issues and Challenges

What does "increasing an availability of information" mean in the context of trusting decisions? Before addressing this issue in the context of the Internet, let us have a look at a real world-situation first. Imagine meeting a person, whom you encountered before in a course of a business event. The person, an employee of a well-known company, is wearing a business outfit; her business card states her as being a holder of a university degree. Furthermore, let us assume that a hypothetical occasion of the meeting is such, that a trusting decision on your part is required - for example lending this person a considerable amount of money. If we leave other factors, such as benefit/risk (amount of money, expected reward) and institutions (enforceability of contracts) aside for the moment and exclude the possibility of stepwise mutual exchanges, then the only confidence-building activity remaining is *increasing the availability of information* as to justify the subsequent trusting decision[5].
We claim, that under circumstances such as these, the decision to trust, will depend on three factors: firstly, the amount of information collected, secondly, the trustworthiness and thirdly, the ways of aggregating information (e.g. the observed attributes) to a single estimate of confidence.

3.3 Collection of Information

The example in the previous section already indicates that there exist various ways of obtaining confidence-building information. In our attempt to construct a meaningful classification, we identify the following ways of collecting information[6]:

> **Derivation**: trustworthy-making qualities can be inferred from any observable property of a person (or object) in question. For example we can derive a person's trustworthiness by observing her outfit as in the above example[7]. We judge a book by its cover. In fact, derivation is a very powerful method for inferring additional cues about a person (or object) in question. In real-life such derivations are often embedded in cultural patterns and therefore performed unconsciously.
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> **Recall**: Often, we obtain statements by remembering previously conducted transactions revealing otherwise non-observable indicators of trustworthiness. In everyday life, the importance of recall is manifested through the notions of *familiarity* and ultimately friendship: as the research in the field of sociology

[5] The abstract notion of "information" in our case consists of observing the previously mentioned attributes: the business outfit, the company-affiliation, the aforementioned degree and the impression acquired on the previous encounter.
[6] A list of examples in the domain of security can be found in [CW96].
[7] This is why media-rich communication as in face-to-face meetings generally promotes a trustworthy atmosphere. Just from seeing people we can observe a multitude of cues such as nationalities, social class, demeanour etc., see [OO00, p. 43].

shows, "people who interact with one another are more likely to be positively disposed toward on another. Even groups of strangers express a preference to work with one another once they interact" [Hi 00, p. 230].

Reputations: Another important indicator of trustworthiness can be obtained by collecting information from other agents (including possibly self-describing statements as for example in advertising), in which case we shall speak of reputation information or - in short - reputations[8]. For the purpose of this article, we use the term "reputations" in the broad sense of the word, incorporating all kind of statements, including for example opinions from friends, certifications and seals of approval. Thus, the university degree in our example can be interpreted as a statement from a third party, which allows for an estimation of trustworthiness. Reputations need not be explicit as is the case with the university degree in our example. There exist also a wide variety of *implicit indicators* that can nevertheless be interpreted as reputations[9].

Trust Transfer: In the case of trust transfer, the confidence-invoking information can be inferred by observing a relationship between the person (or object) in question and another person (or object) already considered trustworthy, whereby the relationship is such that the transfer of trust is reasonable. A ubiquitous example of this phenomenon is *authorship*, i.e. a relationship between a producer (e.g. novelist) and a product (e.g. novel). As Landon and Smith point out: "If consumers face costs of gathering information on product quality, they may rely on the quality reputation of firms to predict current quality" [LS97, p. 290; Ko94, p. 313-345]. Other instances for such relationships include similarity, containment, group membership and affiliation[10]. While the notion of trust transfer has been to some extent examined in marketing, there has been virtually no research on this topic in the area of information systems[11].

3.4 Determining the Quality of Information

Not all confidence-building information is created equal. It is conceivable, that some cues have more "weight" than others, i.e. their contribution to the overall confidence level is comparatively higher. There exist many reasons for this: The most obvious one is that a particular observation might be *more or less indicative of the trustworthiness*. For example, the fact that a certain book is a bestseller might (or might not) be interpreted as a statement of its trustworthiness. Another reason for different "weights" is, that with cues that are definitely strongly indicative of the possession of certain trustworthy-making characteristics, there exists a great incentive for its originator to

[8] Note, that we interpret reputation solely as information collected from others, whereas in the literature the concept of reputation often entails what we term "recall", as well.

[9] On overview of implicit indicators is provided by [Nic97].

[10] We recognize, that the difference between reputation and trust transfer is not necessarily obvious, since a third party's statement describing an object can also be seen as a relationship. The notion described here however also entails "hidden" relationships not necessarily expressing preferences.

[11] One exception is the work of Stewart, who examines the transference of trust through links between various companies on the World Wide Web [St99].

misrepresent the actual state of affairs in order to incur some kind of benefit[12]. Then, relying on a particular cue again presupposes an act of confidence building: For example, we might collect additional information indicating the trustworthiness of a restaurant critic, or honesty of a witness in court. However, in everyday life this kind of recursive relationship is rarely an issue, since in most cases there exist institutional arrangements alleviating such risks and so the trusting decisions can be justified through confidence in institutional mechanisms ("presence of institutions" according to the above model). For example, we rarely question proofs of identity issued by state authorities or product ratings published by reputable magazines. We rely that commercial promotions will be marked as such and that an academic title cannot be forged very easily.

3.5 Aggregation of Information

Finally, the remaining question is how to aggregate the information obtained from different sources in a coherent overall judgement. Note, that firstly, the notion of aggregation can (but need not) entail the question of *selection* of a subset of cues deemed appropriate for consideration in the overall judgement. For example, in the area of marketing, it has been observed, that consumers often determine quality by judging one single, so-called "dominant", attribute (for example, brand name) [Nie94]. Secondly, the cues selected might - but need not - be assigned different weights. Examples of the weighting scenario include the assignment of different weights to information stemming from friends and acquaintances as opposed to anonymous sources. Also, information acquired through own experiences and/or observation is often assigned more weight, than information provided by third parties.

Obviously, the concrete manifestation of the confidence-building process (comprising the rules guiding the selection, derivation as well as the aggregation of information) is to a large degree dependent upon situation- and agent-specific factors. It will be different in a high-risk situation (for example, consulting a doctor in case of a serious disease), as opposed to a low-risk situation (estimating the quality of cinema movies). It will be different in the case of a person with a high readiness to trust, as opposed to a trust-averse person. Nevertheless, we believe, that the information processes underlying confidence-building activities exhibit the same basic structure. In the next section, we shall examine the impact of the Internet upon these information processes and particularly the role of information systems as means of supporting confidence-building activities.

4 Supporting Confidence-Building through Information Systems

4.1 Availability of Information and the Internet

>From the point of view of design of information systems the shift towards the Internet has at least three implications, which must also be taken into consideration when designing information systems in support of trusting decision (see Table 1).

Aspect	Implication
Collection of Information	New means of obtaining confidence-building information

[12] Bacharach and Gambetta use the term "mimicry" (borrowed from the field of biology) to characterize a deliberate attempt to broadcast false statements about one-self [BG99].

	become apparent.
Determining Information Quality	Recursive collection of confidence-building information gains importance.
Aggregation of Information	The rules and activities underlying the confidence building through information can be automated.

Table 1: Issues in building confidence in open electronic networks

Firstly, along with the digital nature of information new means of obtaining confidence-building information become apparent. Secondly, the issue of *quality* of information indicating trustworthiness gains importance. And finally: the myriad of possible ways of obtaining confidence-building information calls for the support of decision makers by structuring and possibly automating confidence-building activities through information systems. We shall analyse these implications in more detail in the following sections.

4.2 New Means of Obtaining Cues

The first implication pertains to the fact, that - as most of the confidence-building cues – are stored as digital information, there exist new ways of obtaining them. These are:

Improved methods of derivation: digital methods of information extraction augment human's observing apparatus and adapt it to the digital world. For example, if we make a plausible assumption, that a syntax error-rate in a written document is a conclusive indicator of its reliability, then performing a spell checking function (as provided by most word processors) is a comparably low-cost way of obtaining an additional conclusive indicator of its trustworthiness.

Enhancement of memories: Human memory can be augmented by the power of information systems. The recording of personal experiences and their presentment in a suitable moment at a later point in time can be a cheap, yet effective confidence-enhancing strategy. For example, bookmarks, implemented by virtually all web-browsers, can be seen as the extension of human memory, recording confidence-enhancing information, which might be lost otherwise.

Collection of reputations: Reputations generated by third parties can increase confidence in a certain person (or object). Clearly, in a context of a networked structure such as the Internet, this method offers a substantial potential. Patterns of past performance, references from past and current users as well as certifications from third parties can all be extracted from existing information sources.

Derivation of relationships: One way of obtaining statements indicating relationships between two entities is by transferring them directly from the real world. For example, an employee can state his affiliation to a company on a vCard. However, information systems also render the derivation of previously undetected relationships. For example, knowing that an otherwise anonymous user exhibits preferences similar to ours makes his opinion preferable to the opinions of other users. Therefore, the derivation of a certain degree of similarity between two persons – an important measure of uncertainty reduction [Hi00, p. 228], can be achieved through computing correlations; it is the case in so-called recommender systems [VR97]. A similar example is the derivation

chains of people who know each other as demonstrated in the ReferralWeb-Project [Ka97].

4.3 Necessity for Determining Information Quality

In the context of Internet, the issue of the quality of information indicating trustworthiness is particularly important. There are two reasons for this: firstly, contrary to the real world, fake proofs of trustworthiness are easy to produce: it costs near to nothing to produce an electronic signature, signalling someone else's identity (even compared to written signatures). The second reason is the absence of institutions (see section 3.1): on the Internet one most often cannot rely on the proper functioning of the institutional mechanisms as a means of protection from false information. As has been observed even organizations considered as being representative examples of "institutions" cannot be trusted unconditionally: For example, Friedmann reports of a breach of trust on the part of Amazon.com, when it was revealed that publishers sometimes purchased spots for their books in the Amazon.com recommendation system [Fr00, p. 36]. Thus, information signalling a trustworthy product proved as a deliberate attempt at influencing consumers' decisions.

Relying on information therefore again necessitates collection of confidence building and brings forth the problem of recursion, already mentioned in the section 3.4. A very figurative example of such a recursive relationship, again from Amazon.com is depicted in the Figure 3, where the books` ratings are also made subject to evaluation.

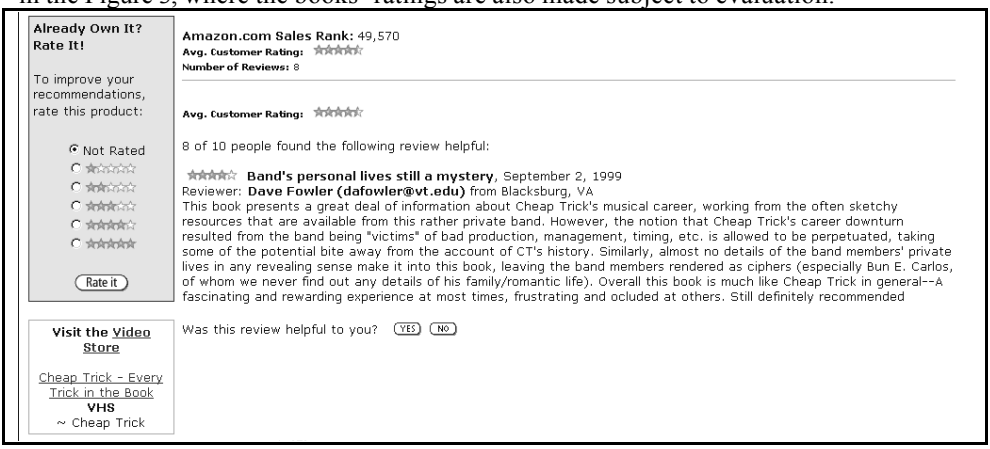

Figure 3: Recursive Ways of Judging Information Quality at www.amazon.com

4.4 Potentials of Automation

With the growing necessity of conducting economic and social transactions over open electronic networks such as the Internet, we can reasonably assume that the need for confidence-building activities will increase also. Information systems pose a chance of supporting decisions involving trust, by automating the rules and activities (collection of confidence-building attributes, verification of their quality), which constitute the confidence building process. We believe, that the potential of such support is especially important in situations, characterized through repeated interactions exhibiting similar

structure but varying parameters. Examples of such situations range from the verification of security credentials, selection of competent project members in virtual teams, search for reliable information or improvement of purchasing decisions in procurement departments.
Among the challenges involved in building such systems it will be especially important to find an appropriate balance between the simplicity and efficiency of support on the one hand and the need for adaptation to varying agent- and situation-dependent factors on the other hand.

5 Summary and Conclusion

In this article we outline a simple framework for reasoning about the potentials of supporting trusting decisions in low-trust environments through information systems. The framework allows us to position availability of information in a broader context of confidence-building factors and to outline the potentials of information systems in improving the availability of information in open electronic networks such as the Internet.
In the course of the future research we plan to refine the concepts delivered in this paper. In particular, we intend to delve deeper into the question, of what requirements must be fulfilled by information systems in support of confidence-building processes, how these requirements can be adequately modelled and finally, how they can be translated into appropriate information systems architectures.

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