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# FILLING GAPS AND RE-CONCEPTUALIZING TRUST IN INFORMATION TECHNOLOGY

*Research in Progress*

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## Abstract

*This article aims to contribute to better understand what trust in information technology (IT) means. Past Management Information Systems (MIS) research has conceptualized trust in IT in a relatively homogeneous way as trust in IT-enabled and IT-mediated products and phenomena, neglecting trust in IT itself, and only marginally differentiate among the different sources of trust. All this make difficult to generalize findings and develop a well structured scientific corpus of knowledge about trust in IT. We re-conceptualize trust in IT and propose an integrative framework of Trust in IT Itself (TITI) to overcome the previous shortcomings. The framework is built on two axes. The first axis refers to the sources of the expectations about the IT, opposing the calculative-based trust and the not calculative-based ones. The second axis is about the attributes of the IT valued by the trustor and includes the trust in functionality of the IT and the trust in the reliability of the IT. The combination of the two axes create the conceptual space for a new definition of trust in IT itself. An empirical application of the framework is in progress. First data analysis show evidences in line with the new theoretical framework. Further research is planned to consolidate the validity of the framework.*

*Keywords: Trust in IT, cognitive attributes, calculative attributes, functionality, reliability.*

## 1 Introduction

This article aims to contribute to better understand what trust in information technology (IT) means. Previous literature exposes that trust is important for complex and uncertain technologies (Lee and See, 2004). Today we face technologies, in general, and IT, in particular, that are more and more complex and ubiquitous (Yoo et al., 2010), which make trust in technology a corner stone of our social constructions and daily lives (Giddens, 1990).

However, past Management Information Systems (MIS) research has conceptualized trust in IT in a relatively homogeneous way as trust in IT-enabled and IT-mediated products and phenomena (Komiak and Benbasat, 2006), while neglecting trust in IT itself, beyond any specific IT-enabled or IT-mediated entity or phenomenon (Mcknight et al., 2011). Moreover, past MIS research has only little differentiated among the different types of trust (Komiak and Benbasat, 2006), which are conceptualized and mobilized outside the MIS field (Luhmann, 1979; Mayer et al., 1995). This leads to confusion and a lack of understanding of both the antecedents and consequences of trust. In fact, there are different types of trust and each type is driven by different antecedents, is built on different grounds, and leads to different consequences. In synthesis, trust in IT has been apprehended, in different traditions, in inconsistent ways.

These differences and inconsistencies around the conceptualizations of trust in IT make difficult to generalize findings and develop a well structured scientific corpus of knowledge about what trust in IT is. A lack of good understanding of what trust in IT means restrains the understanding of what the antecedents and consequences of trust in IT are, like IT adoption and use (Thatcher et al., 2011). As far as the IT is ubiquitous in our society, trust in IT could influence all our daily behaviors. Said otherwise, a weak understanding of trust in IT could lead to the misunderstanding of many behaviors. Indeed, the changes that IT have made in different sectors require building trust in new people, artefacts and institutions. For example, the adoption and use of IT in healthcare to improve patients' care requires building trust in these technologies, based on clear evidence (Duggal et al., 2018). Hence, trust is at core of the development of e-health and telemedicine (Tuckson et al., 2017).

The purpose of this paper is to re-conceptualize trust in IT to propose an integrative framework of Trust in IT Itself (TITI) where all the different and inconsistent previous conceptualizations of trust in IT find their appropriate place in our new integrative framework. Our study will, firstly, expose the diversity of the existing conceptualizations of trust in IT. Then it proposes a theoretical framework to integrate the existing disparate conceptualizations of trust in IT and finally, this research empirically shows the application of the framework.

## 2 Theoretical framework

Our novel theoretical framework is ground on a systematic literature review (Paré et al., 2015). The senior scholars' basket of eight journals in Information Systems and the 50 Journals used in the Financial Times Research Rank for MBA rankings have been our starting set of publication outlets. First, we searched for all articles including the word "Trust" in the title. The EBSCO Business Source Complete database and search engine returned 876 records. To target only articles related to IT, we discarded all the articles without the word "technolog" or "system" in their abstracts. The remaining 153 articles were inspected in full for a thorough analysis. We complemented these 153 articles, borrowing theories (Gkeredakis and Constantinides, 2019) outside MIS and management fields, such as social psychology, for a total of 197 publications. The results of this literature review follow.

### 2.1 Trust in IT-enabled entities and phenomena

A large portion of MIS scholars have investigated trust in IT-enabled and IT-mediated products and phenomena: like virtual teams (Jarvenpaa et al., 2004; Piccoli and Ives, 2003), e-commerce (Kim et al., 2016), digital markets (Du and Mao, 2018), online recommendation agents (Benbasat and Wang, 2005), knowledge management systems (Thatcher et al., 2011), online environments (Riedl et al.,

2010), online vendors and online customers (Fang et al., 2014) or e-government (Venkatesh et al., 2016), among others. They integrated the concept of trust in various behavioural models and mobilized trust as an antecedent of behaviour, confirming its strong effect on intention to use and adopt IT-enabled and IT-mediated entities and phenomena.

## **2.2 Trust in IT itself**

While there are numerous studies in MIS using this concept of trust for IT-enabled and IT-mediated entities and phenomena, literature in the MIS field provides paradoxically very little research on trust in IT itself. There are only three papers whose abstracts include “trust in technology” (Lankton et al., 2015; Teo et al., 2008; Wang and Benbasat, 2008) and one paper whose abstract includes “trust in information technology” (Vance et al., 2008), in senior scholars' basket of eight journals in Information Systems. The IT, required for the existence of the IT-enabled or IT-mediated entities and phenomena, is not investigated separately from the entities and phenomena which support. Hence, the actual measured trust aggregates both aspects: the IT and the supported entity or phenomenon, without distinction. These operationalizations limit the possibilities to understand how and to what extent trust in IT itself is important for the trust in the IT-enabled and IT-mediated entities and phenomena.

## **2.3 The two axes of trust in IT itself**

By extensively reviewing the literature, two main axes emerge to describe trust in IT itself. The first axis is about the sources of the expectations toward the IT. The sources can be calculative and not calculative. The second axis is about the valued attributes of the IT. The valued attributes can be related to functionality of the IT and to reliability of the IT.

### **2.3.1 First Axis on the sources of the expectations toward the IT**

The first axis about the sources of the expectations about the IT includes the calculative-based kinds of trust and the not calculative-based kinds of trust. Several authors have tried to disentangle between two kinds aspects of trust. Calculative and analytic decision making to trust, by one hand, and confidence or faith (Luhmann, 1979; Pratt et al., 2019) aspects on the other.

**Calculative-based kinds of trust:** Generally, authors, i.e. Benbasat et al. (2005), take for granted that trust is a rational belief related to calculus of cost and benefits, which is distinguished from attitude considered as an evaluative reaction to a phenomenon. This epistemic script (Avgerou, 2013; Boxenbaum and Rouleau, 2011) seems to be related to the use of the concept of trust in the Technology Acceptance Model and derived models, which consider trust as an antecedent of intention to use. For instance, Pavlou & Fygenson (2006) considered trust as antecedent to both attitude (consumer's evaluation of the desirability of using a website) and perceived behavioral control. Again, Venkatesh et al. (2016) investigated the trust in e-government considered as an antecedent of the intention to adopt. Overall, the calculative approach for the IT is about the assessment of the benefits and costs, for the IT provider, of cheating. When the benefits, for the IT provider, of cheating do not exceed the costs, for the IT provider, of being caught cheating, the calculative-based kinds of trust in IT emerge.

**Not calculative-based kinds of trust:** To our best knowledge, little is known in MIS about the distinction between calculative-based and confidence-based aspects of the concept of trust in IT (McKnight et al., 2011; McKnight et al., 2002; Rempel et al., 1985). Several authors in management field highlighted that many of the assumptions of rational choice models are empirically unsustainable (Kramer, 1999; March and Olsen, 2010). We know especially from the other disciplines (Pratt et al., 2019) that belief may go beyond the rational paradigm which underlies the mainstream vision of the concept of trust, in MIS literature. Moreover, even when rational processes are pursued, human bounded rationality (Simon, 1991) opens the door for other sources of trust, complementary, to the rationally derived costs and benefits. Several scholars defined trust as a state of positive expectation regarding other people's actions and intentions (Möllering, 2001; Rousseau et al., 1998), that is, an

attitude (Kramer, 1999; Lewis and Weigert, 1985; Robinson, 1996) more than a rational belief made on a calculus of risks and benefits. Accordingly, these scholars argued in favor of a multi-facets concepts of trust (Lewicki and Bunker, 1996; Rousseau et al., 1998; Zucker, 1986). Kramer et al. (1999) for example insisted on the importance to enrich the calculative-based trust by the facet of the relational trust, while other scholars propose to enrich trust with the concepts of faith (Rempel et al., 1985), confidence (Luhmann, 2000), attraction (Li and Fuller, 2017) or values (Ba and Pavlou, 2002). We consider together these different aspects under the umbrella term of not calculative-based kinds of trust. Hence, not calculative-based kinds of trust in the IT are the expectations grounded on natural, moral, and social orders that the IT does not disappoint and does not cheat.

### 2.3.2 Second Axis on the valued attributes of the IT

The second axis is about the valued attributes of the IT. Among the definitions of trust, some scholars defined trust as a state of positive expectation regarding other people's actions and intentions (Möllering, 2001; Rousseau et al., 1998). These definitions point out that trust requires a trustee and a trustor. Some articles, published in MIS outlets, developed the specific concept of Trust in IT, mirroring the conceptualization of trust in humans and considering the IT as a peculiar trustee (Lankton et al., 2015; Teo et al., 2008; Vance et al., 2008; Wang and Benbasat, 2008). Two main human attributes seem better explain trust in other human: competence and integrity. These two valued attributes are translated into functionality and reliability of the IT.

**Trust in the functionality of the IT:** Trust in the functionality of the IT relates to the belief that the specific IT has the capability and the features to do for one what one needs to be done (Mcknight et al., 2011). This attribute of the IT echoes the competence attributed to humans. Competence is mobilized to trust in people as far as competence is considered the belief that the trustee has the ability to do what the trustor needs to have done (Lankton et al., 2015). This logic applied to IT refers to a sort of technical competence of a system measured in terms of system's ability to perform the tasks the system is supposed to perform (Lee and Turban, 2001). Specific to IT among all the technologies, is its capability to deliver information and the veracity attributed to this information. This specificity opens up under-explored conceptions of trust in IT as specific kinds of beliefs. According to many analytic philosophers, we can consider beliefs as "propositional attitudes". Hence, on one side, as a proposition, a belief has a specific meaning that can be expressed in the form of a sentence. On the other side, as an attitude, belief involves a mental stance on the validity of the proposition (Schwitzgebel, 2010). Beliefs thus involve at least two properties: (i) representational content and (ii) assumed veracity (Stephens and Graham, 2004). As a consequence, "beliefs typically describe enduring, unquestioned ontological representations of the world and comprise primary convictions about events, causes, agency, and objects that subjects use and accept as veridical." (Connors and Halligan, 2015). Belief can be defined, hence, as the mental acceptance or conviction in the truth or actuality of some idea (Schwitzgebel, 2010). For this reason, trust in IT would include enduring convictions on the veracity of the propositions coming from the IT. These propositions would be the information output of the IT, hence considered, to some extent, truthful.

**Trust in the reliability of the IT:** Trust in the reliability of the IT relates to the belief that the specific IT will consistently operate properly (Mcknight et al., 2011). This attribute of the IT mirrors the integrity quality attributed to humans. Integrity is the belief that the trustee adheres to a set of principles that the trustor finds acceptable (Benamati et al., 2010). The integrity attribute applied to IT mainly refers to a system which operates continually (i.e., with little or no downtime) and which responds predictably to inputs (i.e. always printing on command) (Mcknight et al., 2011). As far as integrity is measured on the adherence to a set of principles decided by the trustor. We advance that benevolence could be one of this principles. While some studies propose benevolence as a valued human attribute at the same level of integrity and competence attributes (Benamati et al., 2010; McKnight et al., 2002), we conjecture that benevolence is a particular principle among the different principles of the integrity attribute, such as honesty or transparency, hence included in integrity, rather than aside integrity attribute. The translation of the benevolence attribute to IT is labelled with helpfulness of the IT (Glanville and Paxton, 2007; Mcknight et al., 2011). Helpfulness would refer to

the users' beliefs that the technology provides adequate, effective, and responsive help to complete a task (McKnight, 2005).

## 2.4 The definition of Trust in IT Itself

The intersection of the two axes creates the conceptual space for a new definition of Trust in IT Itself (TITI). We advance that Trust in IT Itself (TITI) is any combination of calculative-based and not calculative-based expectations that the IT has desirable functionality and reliability attributes. The calculative and not calculative axes give the bases on which the trustor assesses the IT. The calculative-based trust and the non calculative-based trust form the global expectation that trustor has of the IT itself. To the extent that they form the global trust in IT, they require to be considered formative measures when operationalised in some measurement instruments (Kim et al., 2010). Once the construct is formed via calculative-based and not calculative-based processes, trust in IT would reflect in the appreciation of the functionality and the reliability of the IT, by the trustor. Variations in trust in the IT would cause variations in the appreciation of the functionality and reliability of the same IT. Hence, functionality and reliability have to be considered reflective measures when Trust is operationalised in a measurement instrument (Coltman et al., 2008). Both sides, the formative and the reflective ones, refers to the same concept of Trust in IT itself, but in complementary ways (Figure 1).

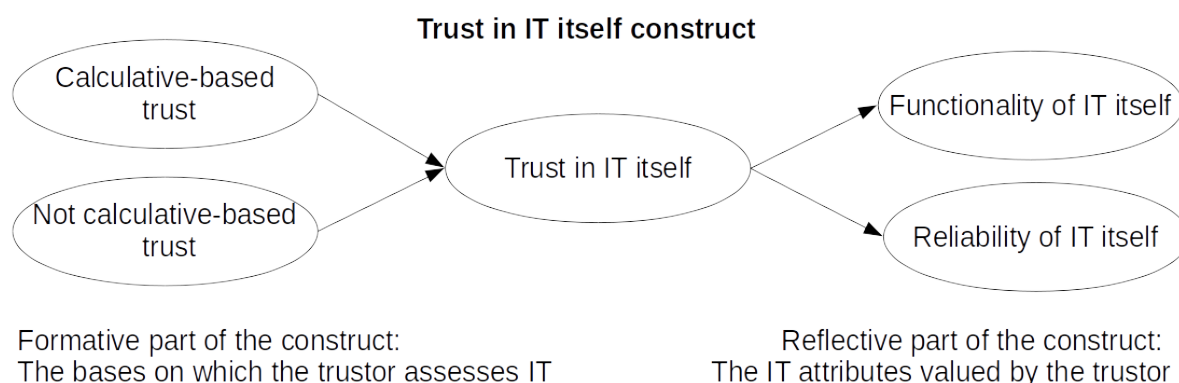


Figure 1: The representation of the Trust in IT itself construct

## 2.5 The four quadrants of Trust in It itself

The intersection of the two axes in a bi-dimensional space creates four quadrants where four different and complementary stances of trust in IT itself emerge.

**First Quadrant: calculative-based trust in the functionality of IT itself.** At the cross-road of the consideration of trust as a rational belief related to calculus of cost and benefits and the capability and the features of the IT, the first quadrant refers to the analytic evaluations of the ability of the IT to perform the tasks the IT is expected to perform. As far as IT integrates features of delivering information, this quadrant includes also the rational judgments about the veracity of the information output from the IT.

**Second Quadrant: calculative-based trust in the reliability of IT itself.** At the cross-road of the consideration of trust as a rational belief related to calculus of cost and benefits and the consistency of the operations of the IT, the second quadrant refers to the analytic evaluations of the ability of the IT to operate continually and predictably to inputs, following a set of principles decided by the trustor. Among these principles, helpfulness of the IT is included, and hence this quadrant includes also the analytic evaluations of the provision by the IT of adequate, effective, and responsive help to complete a task.

**Third Quadrant: not calculative-based trust in the functionality of IT itself.** At the cross-road of the consideration of trust beyond the rational paradigm and the capability and the features of the IT, the third quadrant refers to the natural, moral, and social evaluations of the ability of the IT to perform the tasks the IT is expected to perform. As far as IT integrates features of delivering information, this quadrant includes also the natural, moral, and social judgments about the veracity of the information output from the IT.

**Fourth Quadrant: not calculative-based trust in the reliability of IT itself.** At the cross-road of the consideration of trust beyond the rational paradigm and the consistency of the operations of the IT, the fourth quadrant refers to the natural, moral, and social evaluations of the ability of the IT to operate continually and predictably to inputs, following a set of principles decided by the trustor. Among these principle, helpfulness of the IT is included, and hence this quadrant includes also the natural, moral, and social evaluations of the provision by the IT of adequate, effective, and responsive help to complete a task.

### 3 Methodology

We develop a mixed method approach to empirically proof our conceptual framework on Trust in IT Itself (TITI). An exploratory questionnaire and six focus groups (Klaus et al., 2010) have been already deployed in order to apprehend the assessments and the arguments provided by respondents on TITI. They were operationalised on the Artificial Intelligence (AI) in healthcare to allow respondents to see themselves in a concrete situation requiring TITI. Other questionnaires, focus groups and experiments will follow, to test our framework in different contexts, across heterogeneous technologies, to increase confidence that results are not related to any specific IT-enabled or IT-mediated product or phenomenon (Davis, 1993; Venkatesh and Davis, 1996).

We detail here the already accomplished methodological steps. First, a questionnaire was designed according to the main axes of trust in IT itself and administered in paper format in June 2019. A convenience sample composed of 61 anonymous students in business and engineering, age 20-24, mostly men, from the University of Montpellier. Once the questionnaire collected, in order to better apprehend respondents' answers, we asked them to explain their answers and debate about them via a focus group setting. The objective was to identify, in an exploratory way, the axes of TITI (Gioia et al., 2013).

### 4 Preliminary results

Our first analysis exploits the data collected via the questionnaire and the focus groups. We classified, according to the two axes and the four quadrants, the answers from the questionnaires and the notes taken during the focus groups. For the questionnaire we took into specific consideration the following open-ended question "Do you trust AI to be more competent than doctors to make a diagnosis and "Do you think that, in the future, an AI algorithm will be more reliable than a doctor to indicate the most appropriate treatment?" We report here quotes of its answers. For the focus groups, all the six focus groups were analysed in whole and we report our notes.

#### **First Quadrant: calculative-based trust in the functionality of IT itself.**

The completeness of the "database" is a central theme that makes some students to consider that the amount of data on a disease ("*an almost infinite database, perfect for diagnosing a disease*") allows AI to perform better in diagnosis than a physician; while others considered, on the contrary, that there is a lack of sufficient data for AI to be reliable and precise on rare diseases. Hence they apply calculative cognitive processes to justify their trust in AI or in a physician:

*"Yes [AI is more competent than a physician] because an algorithm can learn infinitely more cases than a doctor."*

*“[I trust AI less than doctors], in the detection of a disease there are many factors to consider, which sometimes go further than the observable symptoms for example to assess the psychological state.”*

*“Doctors are more competent than AI, because they have expertise plus intuition and reflection: the medical diagnosis is not a raw analysis.”*

Moreover, some students expressed their wish that a "fight" between the AIs can take place in order to retain the most competent algorithm.

#### **Second Quadrant: calculative-based trust in the reliability of IT itself.**

Students expressed concerns about the transparency of the algorithms, the diffusion of the code in open source, as well as the indication of the probability of reliability of the results, which are for them the conditions to trust AI. They also said that AI is made by humans, so it can have orientations and biases like humans: for example, as doctors who may be influenced by others such as the pharmaceutical industry.

One student answers that the AI is more reliable than a physician *“because the AI would be totally objective, neutral, unruffled. Nor does it have any economic interest to see the patient again.”*

One of the students stated that the only way to be sure that health data is not hacked or resold is to use paper files. In addition, some students expressed the fear that AI will favour the big majors of Internet, which would have the AI monopoly.

One student expressed the idea that majors in the pharmaceutical industry might try to hack the AI to give results that benefit their products. Four focus groups raised the risk of mutual insurers' use of AI for profiling patients.

In addition, the question of data confidentiality challenged with the data process involving the use of AI contrasts with privacy which is at the core of the doctor-patient relationship. The assessment of doctors' and algorithms reliability leads students to trust more

*“ [I trust AI more than doctors] because the AI would be totally objective, neutral, unruffled. Nor does it have any economic interest to see the patient again.”*

*“It depends on who coded the algorithm and why he did it => health = caution. Conflict of interest = mistrust. The pharma sector is not very transparent = lobbying.”*

#### **Third Quadrant: not calculative-based trust in the functionality of IT itself.**

Most students considered that AI will progress in the future and its results will be more and more accurate and trustful.

*“An AI has a calculus power which is superior to a doctor's one, but it does not have the distance of the doctor, medicine is not an exact science. In the future AI will be more competent than the physician, the AI will make progress.”*

At the same time, we find the presence of a certain degree of confidence in the AI functionalities and in the physician's competences:

*“The doctor has a more personalized approach, he combines logic and feelings, he has flair and common sense.”*

*“An AI has a calculus power which is superior to a doctor's one, but it does not have the distance of the doctor, medicine is not an exact science. In the future AI will be more competent than the physician, the AI will make progress.”*

#### **Fourth Quadrant: not calculative-based trust in the reliability of IT itself.**

Students also said they did not trust any third party to secure data that, by definition; given the use of the Internet, carries risks. This raises the question of the reliability not so much of the algorithms as such but of third parties (i.e. insurances, key players of Internet) involved in the relationship with the AI.

One of the students stated that the only way to be sure that health data is not hacked or resold is to use paper files. In addition, some students expressed the fear that AI will favour the big majors of Internet,



which would have the AI monopoly. Here appears the theme of the dependence of technology, which assumes that the individual can no longer choose.

One student expressed the idea that majors in the pharmaceutical industry might try to hack the AI to give results that benefit their products. The four groups raised the risk of mutual insurers' use of AI for profiling patients. Here appears the theme of benevolence, which may be classified also in the relational-related vision of trust.

Thus, collective guidance, reliability and benevolence are challenged for third parties involved in the patient-physician relationship mediated by technology: software vendors and data hosts.

In addition, the question of data confidentiality challenged with the data process involving the use of AI contrasts with secrecy which is at the core of the doctor-patient relationship. The relational trust, i.e. trust in a trustee, in doctors seems to be more important than the relational trust in third parties involved in this data process (i.e. insurers, pharmaceutical companies, key players of Internet).

*“It depends on who coded the algorithm and why he did it => health = caution. Conflict of interest = mistrust. The pharma sector is not very transparent = lobbying.”*

*“No, in the detection of a disease there are many factors to consider, which sometimes go further than the observable symptoms for example to assess the psychological state.”*

## 5 Expected Contributions, Future Research and Conclusions

Our contribution aims to better understand what trust in IT means. We advance toward a more comprehensive and inclusive definition of trust in IT itself. We overcome the main stream, but narrow focused, conceptualizations of trust mainly as calculative-based kind of trust. The advanced framework for Trust in IT Itself (TITI) would offer a larger and more solid ground to build up conceptual and empirical articles on trust in IT in all its diversity.

Directly, we plan to pursue our empirical investigations to consolidate our first preliminary results. As far as we explore the subject of trust leveraging artificial intelligence as an example of an IT still rare and in the making, the next technology would be the web search engine, a largely diffused and well established IT. We will investigate using the same methods of questionnaires and focus groups. We will replicate on other technologies till we will be confident that the results are technology independent and hence related to IT itself and not dependent to the specific IT levered in our empirical explorations (Davis, 1993; Venkatesh and Davis, 1996). Once this exploration phase will be over, we will move to the confirmatory phase, through experiments operationalized through vignettes presenting different scenarios in a survey. At the end, we would have tested our framework in different contexts, across heterogeneous technologies.

This mainly theoretical paper re-conceptualized trust in IT, via the proposition of an integrative framework of Trust in IT Itself (TITI). The framework is built on two axes. The first axis refers to the sources of the expectations about the IT, opposing the calculative-based trust and the not calculative-based trust. The second axis is about the attributes of trust in IT that are valued by the trustor. They include functionality and reliability of the IT. This framework has found its first empirical validation in the context of artificial intelligence, but other empirical tests will follow.

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