Use of Technological Tools for Supporting Interpersonal Trust: From Modelling to Fostering Trust Through Design

by

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AUTHOR'S DECLARATION

This thesis consists of material all of which I authored or co-authored: see Statement of Contributions included in the thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

Statement of Contributions

Papers included in this thesis

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Abstract

Trust is a core construct of our social lives, influencing how we interact with other individuals that are part of our social circle. Whether at work, in teams, or with friends and family, trust influences how much information we exchange with the other individuals and how we interact as a dyad. Defined as risk acceptance behaviour in situations where there is dependency between the parties, trusting another person means accepting some risks to benefit from the social integration of tasks and knowledge. In an institutional environment, trust is a core component of teamwork dynamics, having a strong influence on team effectiveness and performance.

Teams are the backbone of current industry, research, healthcare, and business domains. Teams have the power to increase the momentum of projects and tasks, and may also benefit from the collective body of knowledge brought by experts from different fields. Teamwork also brings new constraints to the interpersonal dynamic; for instance, a lack of interpersonal trust can deeply impact the performance and effectiveness of a team. Without trust, communication and interaction between team members can be significantly impaired, limiting the ability of a team to perform and to become effective.

As teams move to non-collocated work, the development of trust is restricted by the limited media richness of communication channels. The perceptual mechanisms that compose the major part of the trust development process become constrained, as behavioural cues are not readily available through Computer Mediated Communication Systems (CMCSs). For this reason, virtual teams can suffer from low, fragile, and delayed trust, impairing team effectiveness and performance.

Given the increasing prevalence of non-collocated teams, there is a need for the development of a toolset for understanding, measuring, and fostering trust in distributed teamwork environments. The existing literature provides only a partial understanding of the trust formation process and does not encompass a detailed description of the perceptual mechanisms that would help explain trust formation and allow the design of interventions tailored at targeting trust.

I started by developing a model that explains trust formation and the perceptual mechanisms involved in this process, in which I also incorporate the distinction between intuitive trust and calculative confidence. The Human Factors Interpersonal Trust State Formation Model developed in this thesis helps explain the situational variability of interpersonal trust, a very important characteristic to consider when using the knowledge about trust formation to inform design. This

model explains how researchers and practitioners can develop designs and interventions to foster trust based on increasing the perception of trust-building cues.

Similarly, good trust metrics must capture both a measurement of trust between two people and provide information about how each trust cue influences the formation of the trust state. With the intent of incorporating situational sensitivity to a trust metric, I designed the Quick Trust Assessment Scale (QTAS), based on the NASA-TLX structure, using a combination of direct rating of subjective subscales of trust, with a pairwise comparison of each pair of subscales. I evaluated the QTAS using Crombach's Alpha and Factor Analysis. The results showed high internal validity and identified one component for extraction from the metric, since this component focused on measuring a construct outside the interest of the QTAS. The QTAS is the first trust metric to be developed that includes a component to measure the situational variability of trust.

The next component of this thesis focuses on identifying and testing ways to foster trust in a specific other through electronic communication. To achieve this objective, I initially conducted an ethnographic study to identify how team members foster trust in face-to-face collaborations and which trust cues are most often exchanged. In this study, I identified the effect of a third party on fostering trust (liaison) and five behaviours, or trust building cues, that were most used: recommendation, validation, expertise, social network, and benevolence/willingness to help. These five behaviours were later converted into interface design objects (trust tokens), in the form of badges, to be used in CMCSs and social network environments, acting as surrogates for the missing trust cues. The trust tokens were tested on simulated social network interfaces to identify the effects of multiple latent factors. Results showed that the use of the trust tokens is independent of gender, age, education level, and personality type. However, use was dependent on the type of risk the participants were facing and their cultural background. Although trust tokens are effective in fostering trust behaviour, there was not a unified solution for every type of situation.

In order to further validate the situational dependence of trust decisions, I have evaluated two major variables of interest. Through experimental manipulation, I demonstrated the influence of (1) situational risk and (2) cultural background on the use of trust cues. These findings are of relevance for the design of systems that support the development of interpersonal trust as they raise the awareness of the highly variable nature of trust. In order for designers, researchers, and practitioners to successfully influence trust behaviour in teamwork environments, they need to include interpersonal trust as a variable of interest in the design requirements of systems that support teamwork, as well as carefully consider the impact of their interventions, as their interventions will influence variably, depending on the situation and target population.

Ultimately, this research program demonstrates the importance of including interpersonal trust as a variable of interest in and as a requirement for the design of systems that support teamwork and collaboration.

Acknowledgements

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The support and guidance provided by Prof. Catherine M. Burns were vital for the development of this research program and for my own personal growth as a researcher. Her passion for research, her supervision style, and her experience in human factors have deeply contributed to my perspective on teaching, supervision and research: that learning is a journey in which people need to find their passion and pursue their interests. Without passion for our research, we can never succeed. Prof. Burns has further reinforced my approach to challenges: "*The only impossible things are the ones that we haven't tried hard enough*".

I would like to thank my PhD committee for all the support and constructive feedback during the development of this work: Dr. Jonathan Histon, Dr. Renee Chow, Dr. Troy Glover, Dr. Aimee Morrison, and Dr. Philip Smith. Thank you for all the support and time devoted to improving my research and thesis.

The ethnographic observations that were part of this thesis were conducted at the University of Waterloo Student Design Centre. I would like to thank all the teams that were part of my observations and volunteered their time for the development of this research program.

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Dedication

Obtaining a PhD degree is a journey, an exploration of the unknown and of yourself. With constant challenges and learning opportunities, it has definitely been one of the most amazing experiences of my life. Learning about what drives and motivates me has changed my perspective on how I approach learning and research. This entire learning process would not have been possible without the support, care, and lessons from friends and family.

First and foremost, I dedicate my dissertation and PhD work to my loving wife, Priscila Carrara, who has accompanied me in my amazing journey through my PhD in Canada. She has always provided a safe port me during the hard moments, cheering me on, and celebrating the successful ones. I have only gotten where I am because I had you by my side, always encouraging me to reach higher and to never stop. Thank you for your love and patience over these amazing years.

I dedicate this work to my supervisor and friend, Prof. Catherine Burns, who has guided me through the years of my PhD, always pushing and encouraging me to succeed, be a better researcher, and teaching me how to become an academic. Beyond being an amazing supervisor, Cathy has always been a friend. Without your support, this work would never have been possible.

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"The only impossible things are the ones that we haven't tried hard enough"

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Chapter 1
Introduction

Teamwork has become one of the keystones of organizational environments, leading to improved work capabilities and capitalizing on the collective knowledge of the team. The social dynamic inside a team highly influences team performance and team effectiveness, regulating how individuals collaborate and exchange information. Interpersonal trust is an important factor that influences these social constraints due to its impact in team communication and willingness to collaborate.

Teams must constantly cope with low levels of trust and with social conflicts that limit their performance in order to achieve proper performing stages (Rickards & Moger, 2000; Tuckman & Jensen, 1977) and team effectiveness (Kiffin-Petersen, 2004). For this reason, trust has been of interest to researchers in the field of teamwork and organizational studies, with a focus on identifying effective ways to foster trust and, consequently, improve team dynamics. To date, focus has been on managerial interventions to foster trust, selection of team members and team design, and team-building activities to increase ones awareness of the other parties in the team and identifying commonalities between individuals that can trigger the development of trust.

As teams move into non-collocated work, trust issues become more significant. Individuals lose the ability to perceive simple cues that would normally be provided during interaction with other team members (Rockmann & Northcraft, 2008) as interpersonal interaction becomes constrained by the communication systems used by these teams. The availability of experiential cues in face-to-face contact and casual bonding are often lost in such cases (Fiol & O'Connor, 2005; Peters & Manz, 2007). For this reason, virtual teams can suffer from low, fragile, and delayed trust, impairing team effectiveness and performance (Bos, Olson, Gergle, Olson, & Wright, 2002).

Although interpersonal trust in team environments is an important problem to be addressed in organizational and human factors research, most of the attention in these areas has been on the evaluation of problems generated by trust as a new team condition (M.J. Ashleigh & Stanton, 2001; N. S. Stanton, Ragsdale, & Bustamante, 2009) and on managerial interventions to target low trust issues (Coppola, Hiltz, & Rotter, 2004; Holton, 2001). Additionally, little has been done in the area of designing communication systems to facilitate the development of interpersonal trust between team members to improve team performance and effectiveness. Some work in this area by Greenspan et al.

(2000) focuses on increasing the media richness of the channel by providing richer information to the trust parties.

The research herein looks to fill this gap by presenting the development of a research program targeted at developing tools that can help designers better understand trust in the context of teamwork and the perception mechanisms behind trust formation, identify effective ways to foster trust development, and design communication systems that can bridge the gap that is created by this shift to virtual teams. The tools proposed in the following chapters provide the necessary support for designers to incorporate interpersonal trust as a requirement in their interventions and new designs, positively influencing team interaction and team dynamics.

1.1 Structure of the Thesis

This dissertation was organized as a collection of papers presenting the development of tools for understanding, measuring, and fostering trust in teamwork. It follows a novel thesis structure based on guidelines from multiple research universities in Canada, US, and Australia.

In Chapter 1, I present the introduction of this dissertation, where I also cover the structure of the thesis, the motivation, and the literature that served as a foundation for the papers that ensue.

In Chapter 2, I discuss the research objectives that framed this entire research program, also providing details about how each paper is used to answer the research questions that guide the development of my research deliverables.

In Chapter 3, I provide a summary of the research questions that guided each of the chapters of this thesis, along with a brief description of each chapter and the relevant findings.

Each of the chapters, from Chapter 4 to Chapter 8, corresponds to one part of the development of tools to support trust-fostering design for teams. They include a trust modelling tool, a trust measurement tool, and a trust fostering tool. Each component was published in the form of an independent paper before being integrated as chapters of this dissertation. Papers are presented as they were submitted for publication, but with all the references integrated in a single bibliography section. In each chapter, a foreword connecting that publication to the content presented in the previous chapters will help transition from the previous chapter and fit the paper in the body of this thesis. Following the foreword, I present the paper in its entirety, exactly as it was submitted for publication. In the end of each chapter, a supplemental section will allow me to provide complementary materials that were not included in the papers due to space constraints, with samples presented in the appendix section.

In Chapter 9, I present a discussion section and conclusions, connecting all the stages of this research program and discussing implications for different research domains. In Chapter 9, I provide an overview of the deliverables and how they fit the objectives of this research program.

Each paper presented herein informed the development of the subsequent chapters. The relationship between the chapters can be found in Figure 1, with the foreword of each chapter also covering dependency of that chapter on the previous ones.

1.2 Motivation

The development of the trust modeling, trust measuring, and trust fostering components of this thesis were motivated by work in three major areas of research:

1. Teamwork research on the influence of trust on team development.
2. Applications of trust research in different fields, such as teamwork, automation, or design.
3. Designing for trust (interpersonal, automation, websites).

The objective of this thesis is to connect these three research areas by providing tools to design systems tailored to foster interpersonal trust between individuals working in virtual team environments. Next, I present the literature that guided each component of this thesis.

1.2.1 Teamwork Research in Technology Permeated Societies

As society evolves into networked and globalized communities, we are more dependent on technologies to support our daily, leisure, and professional activities. From complex computational tasks that allow us to develop advanced technologies and solve unimaginable problems, to simple everyday tasks like finding our way to a new friend's house; technology has significantly changed how we interact with the world and with individuals around us.

However, technology also has a dark side (Kaku, 2012, 2013) which not only impacts us as individuals by creating high levels of technological dependence (Mesman, Kuo, Carroll, & Ward, 2013; Shu, Tu, & Wang, 2011), but also as a society by reducing social interactions (R. Kraut et al., 1998). Consequently, both positive and negative impacts of technology must also be considered when analysing the interaction of individuals in a team.

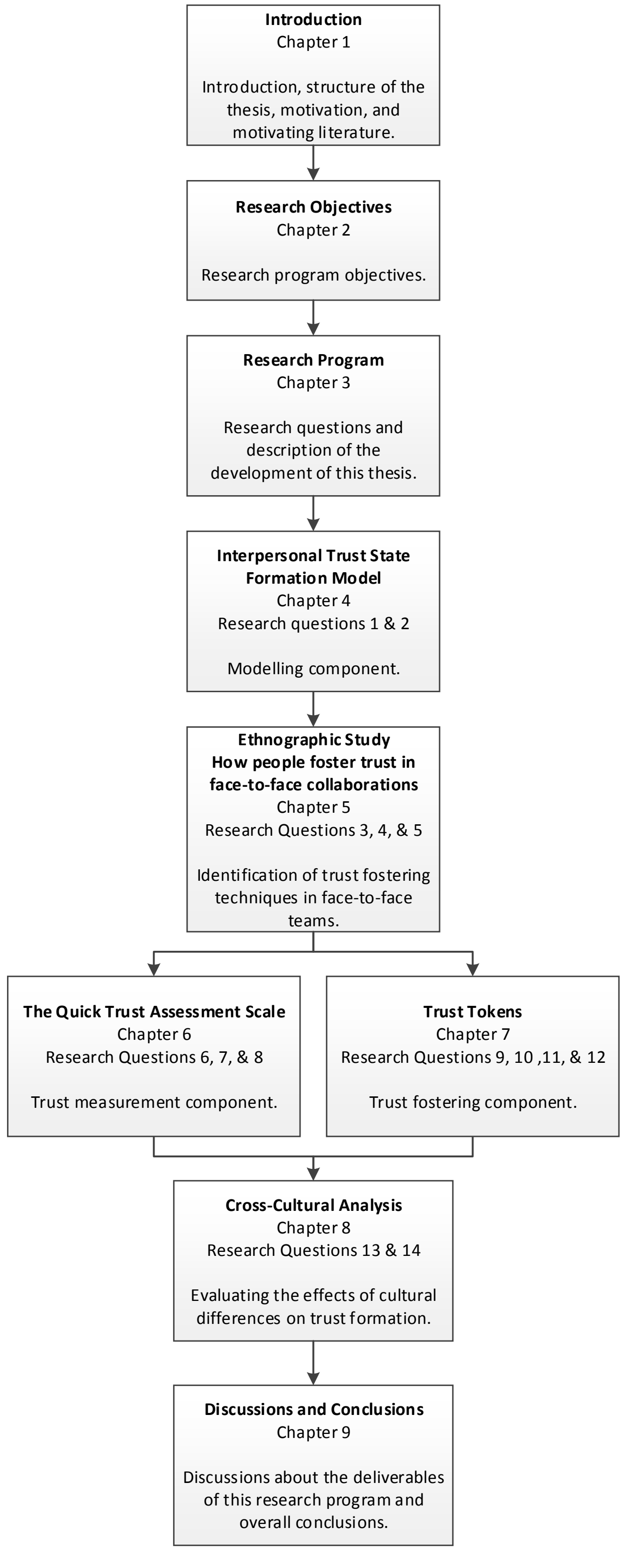


Figure 1: Organization of the chapters of this thesis.

Information technology has created the opportunity to expand the collaboration beyond a single physical location, now being possible to integrate expertise from members that are across the globe. However, this same technology has also brought constraints to teamwork, since team dynamics have changed significantly since the start of this technological integration (Henttonen & Blomqvist, 2005; Maruping & Agarwal, 2004; Potter, Balthazard, & Cooke, 2000; Rhoads, 2010).

Team members now often collaborate through computer mediated communication systems (CMCSs) — communication and collaboration tools that mediate this electronic information exchange (Bos et al., 2002; Majchrzak, Rice, King, Malhotra, & Ba, 2000). Team members may not see each other face-to-face, working for the entire length of the project without having any direct contact (pure virtual teams) (Fiol & O'Connor, 2005). An important study in this area is that of Zolin, Hinds, Fruchter, & Levitt (2002), in which they evaluated trust in global virtual teams on 167 dyads. The team, from this perspective, has to be interpreted through a different lens, as important social components of teamwork are no longer readily available (Fiol & O'Connor, 2005; Gibson & Cohen, 2003; Peters & Manz, 2007). For example, casual bonding is described as a vital part of the development of social ties that define teams (Newell, Tansley, & Huang, 2004). However, in virtual teamwork, due to stronger focus on task oriented communications (Rhoads, 2010), such casual bonding has a tendency to be minimal (Hinds & Weisband, 2003; Holton, 2001; Suchan & Hayzak, 2001).

The limited availability of cues that individuals normally use to assess another party when deciding whether to trust and that have traditionally been part of the team development process (Dennis, Fuller, & Valacich, 2008; Rockmann & Northcraft, 2008; Workman, Kahnweiler, & Bommer, 2003) may mean a "less efficient connective tissue" to hold the team together, resulting in teams with reduced effectiveness and compromised team structures. Constraints like interpersonal trust, conflict dynamic, cultural diversity, and lack of social ties and dependency, may have an exacerbated influence on team dynamic due to the limited contact between the team members.

1.2.2 Team Development

Teams are unique entities formed by the active integration of team members, leading to an enhanced state that capitalizes on the skills of each team member. In order to reach this state, however, team members have to go through social development processes that shift a group of people into a performing and effective team (Janz, Colquitt, & Noe, 1997; Johnson, Suriya, Yoon, Berrett, & Fleur, 2002).

Multiple authors have presented models describing the development of groups into teams. For example, Tuckman (Tuckman & Jensen, 1977; Tuckman, 1965) describes team formation as occurring through five stages that they name forming, storming, norming, performing, and adjourning. These stages describe team formation through the categorization of the social dynamic of the group into linear stages. More recently, Bonebright (2010) presented a review of Tuckman's model, presenting an overview of the use of this model in the past 40 years, some of its applications, and the impact it has had on teamwork research. A representation of Tuckman's model of team formation can be found in Figure 2, adapted from Langton and Robins (2007), and will be further explored in Chapter 5.

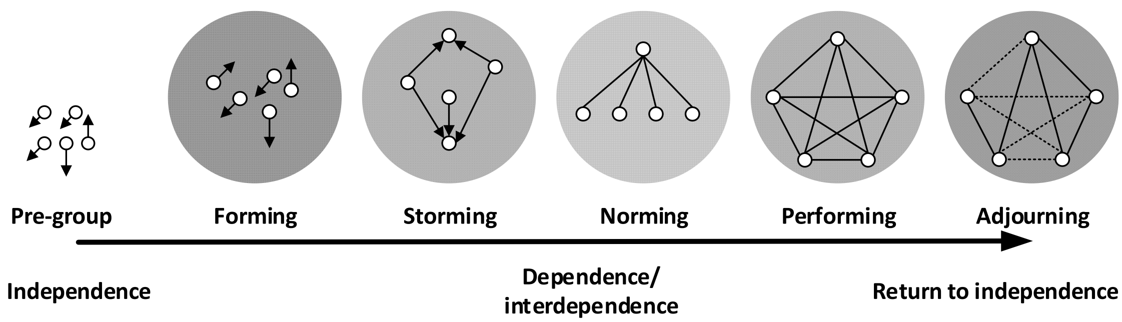


Figure 2: Representation of Tuckman's (1977) model of team development. Image adapted from Langton and Robbins (2007).

Another model for team development was presented by Gersick (1988), wherein team formation is described by the punctuated equilibrium model. As described by Furst et al. (1999),

> *Gersick found that the timing of group formation and the way group work efforts change over time were consistent regardless of the group, the nature of the group's task or the deadline for completing the task. More specifically, Gersick's research suggests that groups experience what might be called a `mid-life crisis.' For the first half of their allotted time together, groups tend to operate from inertia with little actual focus on the work to be accomplished. Nevertheless and regardless of the amount of time allocated to a group task, at about the halfway point in their schedule*

groups begin to focus more energy on task accomplishment. These renewed efforts carry the group forward to task completion. (Furst et al., 1999, p. 264)

A representation of Gersick's model of punctuated equilibrium can be found in Figure 3.

Team development has been demonstrated to be highly connected to team effectiveness and team performance (Furst et al., 1999; Gersick, 1988; Hackman, 1987; Kozlowski & Ilgen, 2006; Neuman & Wright, 1999; Sundstrom, De Meuse, & Futrell, 1990; Tekleab, Quigley, & Tesluk, 2009; Tuckman & Jensen, 1977; Tuckman, 1965), having interpersonal trust as a facilitator of team evolution (Barrick, Stewart, Neubert, & Mount, 1998; Costa, 2003; Kiffin-Petersen, 2004; P. Lee, Gillespie, Mann, & Wearing, 2010; Zaheer, McEvily, & Perrone, 1998). The development of teams is also influenced by the technological level of the team and its members, as it will define:

- How team members are able to interact (Townsend, Demarie, & Hendrickson, 1998),
- What the supporting and communication tools for team development are (Alnuaimi, Robert, & Maruping, 2010; Desanctis & Jackson, 1994; Kiesler, Siegel, & McGuire, 1984; O'Connor, Friedrich, Scales, & Adhikari, 2009), and
- How management and leadership can influence and regulate the team (Rickards, Chen, & Moger, 2001; N. A. Stanton & Ashleigh, 2000; Webber, 2002).

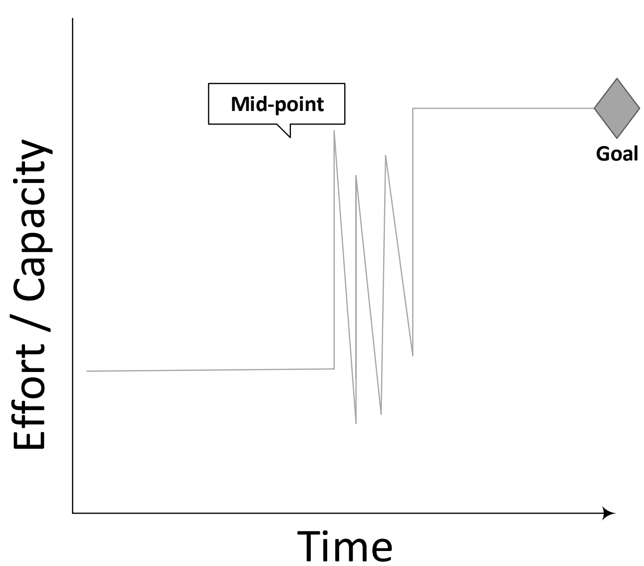


Figure 3: Representation of Gersick's (1988) punctuated equilibrium model.

The influence of trust on the development of proper team structures in virtual or technology dominated teams has motivated the development of tools for understanding, measuring, and fostering trust in virtual team environments. Facilitation of the development of interpersonal trust through understanding and creating mechanisms to enhance it will be discussed in Chapter 4 and Chapter 5.

1.2.3 Trust Research

The term has taken many definitions over the years and been used in a wide variety of domains. Excellent reviews of the concept have been conducted by Rousseau, Sitkin, Burt, and Camerer (1998), McKnight and Chervany (1996), and Lewicki McAllister, and Bies (1998). In order to situate this research program in the wider area of trust research, I will begin by conceptualizing trust in everyday usage, followed by more specific research-based definitions of interpersonal trust.

The online version of Merrian-Webster defines trust as the "belief that someone or something is reliable, good, honest, effective, etc." (Trust [Def. 1], 2014a), the "assured reliance on the character, ability, strength, or truth of someone or something." This everyday definition of trust focuses on the belief in or assurance of a certain behaviour. Going a little bit deeper into the definition, trust is defined as a risk acceptance process in which the person trusting has a certain expectation of the behaviour of the other party (Gambetta, 1988; Luhmann, 1979). Similarly, the online Oxford dictionary defines trust as the "firm belief in the reliability, truth, or ability of someone or something." (Trust [Def. 1], 2014b).

These two dictionary definitions share the word reliability. The act of trusting closely relates to the evaluation of the risks of engaging in collaboration and depending on the other agent, where the evaluation of these risks and the expected behaviour of the other, is the basis for making a decision to trust or not. Another common thread is the reference in both definitions to the ability of the other team member, where trust refers to interpersonal relations. Trust is deeply connected with the knowledge of the other parties' abilities and skills, since trusting is usually related to a task in which we expect the other party to be able to perform (Gill, Boies, Finegan, & McNally, 2005; Mayer, Davis, & Schoorman, 1995; Ridings, Gefen, & Arinze, 2002).

Trust is theorized to be unable to exist if there is no risk involved in the interaction between the parties (Das & Teng, 2004; Lewicki, 2006; Rotter, 1967). These authors relate trust to risk acceptance behaviours, wherein trust relates to the risk one accepts in order to benefit from collaboration with the other party. In order for a trusting behaviour to occur, one must have accepted the probability of loss or uncertainty in the behaviour of the other party (B. D. Adams, Flear, Taylor, Hall, & Karthaus, 2010; Gillespie, 2003; Ratnasingam, 2005). As described by Gillespie, "…trust begins where rational prediction ends … and risk actually creates an opportunity for trust"(Gillespie, 2003, p. 5).

Risk alone does not characterize trust, however. There is a strong need for interdependence between the parties before risk acceptance behaviours can be characterized as trusting (D. M. Rousseau et al., 1998; Wieselquist, Rusbult, Foster, & Agnew, 1999). The two parties need to be involved in a mutual relationship in which one must rely on the other party.

There are important terms that will be used throughout this document and must be defined here. These are the words trustor and trustee. A *trustor* is the individual that accepts the risks when trusting, the one that places trust on another person. The *trustee* is on the other side of this relationship and is the one being trusted by the trustor (Beccerra & Gupta, 1999). This nomenclature has been widely used in the literature to represent the roles involved in a trusting relationship. A visual representation can be found in Figure 4.

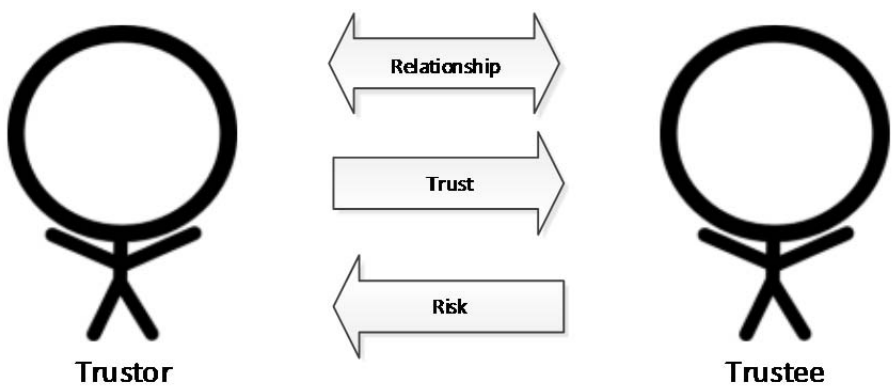


Figure 4: Visual representation of trustor/trustee relationships.

1.2.3.1 Trust Research Areas

Trust has been investigated as a construct influencing social behaviours in multiple research fields, but each has applied field-specific boundaries to their studies. As described by Rousseau et al. (1998), there is significant overlap in research that has been done within the different research areas, demonstrating some similarity of trust research.

A good example of the uniqueness of each research area is the case of trust in automation (J. D. Lee & See, 2004; Seong, Bisantz, & Gattie, 2006), shown by the limitation on the extrapolation of trust in automation to interpersonal trust, as there is no reciprocity between the automated agent and the trusting individual. Therefore, in order to situate my research I will present an overview of the different areas of research that have contributed to the development of this thesis.

1.2.3.1.1 Trust in Close Relationships

One of the seminal areas of trust research is that of trust in close relationships. For many years, trust research focused on understanding the dynamics behind interpersonal trust in close relationships and how it influenced social life (Larzelere & Huston, 1980; Marková & Gillespie, 2008; Rempel, Holmes, & Zanna, 1985; Sorrentino, Holmes, Hanna, & Sharp, 1995). Close relationships are indeed the ideal type of relationship for studying trust and its evolutionary components as long term and tight bonds are integral part of these relationships (Lerner & Mikula, 1994).

Trust is a concept we develop as part of our lives from the moment we are born (where we trust the person we identify as our mother) and evolves throughout our social development. At different stages of our life, trust will distinctly influence our social formation and our interpretation of others' behaviours, influencing not only how we interpret the world and live our lives, but also how we socialize with others (B. Barber, 1983).

In close relationships, interpersonal trust is described as having a strong evolutionary component (Rempel et al., 1985), combined with a signalling component (Rempel, Ross, & Holmes, 2001). Authors like Wieselquist et al. (1999) have developed models to describe the trust formation process within close relationships. Their model, presented in Figure 5, identifies the effects of dependence and commitment to the formation of trust. Their model focuses on describing two very important aspects of trust behaviour that define the social relationship between individuals:

1. The interdependence of trust, where the trust formation process of one agent is directly linked to the trust formation process of the other.
2. The evolutionary process of trust, where trust has a feedback loop in which attitudes and trust behaviour feedback into the cognitive process and influence future behaviour between the parties.

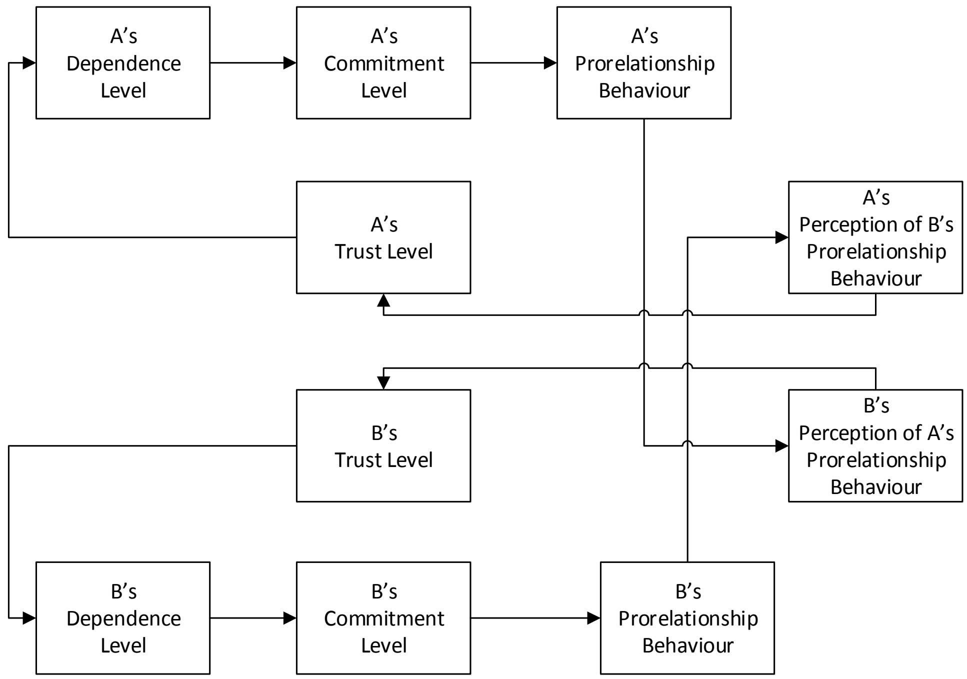


Figure 5: Wieselquist et al. (1999) model of trust in close relationships.

Simpson (2007) moves away from an evolutionary interpretation of trust behaviour. Simpson's trust model focuses on predispositions to trust and how they influence the dynamic between the parties. In his description, the trust decision is presented as heavily influenced by both parties, highlighting the interdependence of trust (Figure 6).

No matter the field, measuring variables of interest (trust in this case) has always been an important part of trust research. Such measurement allows for the identification of trust problems and the correlation of trust with other social constructs that are part of social life (Frost, Stimpson, & Maughan, 1978). In one of the first developments in measuring trust, Rotter (1967) developing what was called "*A new metric for the measurement of interpersonal trust,*" a title which can be a little misleading. This metric actually focuses on measuring propensity to trust, one of the dispositions that leads to trust behaviour (as described by Simpson (2007), serving as a foundation for the development of most of the trust metrics described elsewhere in this thesis.

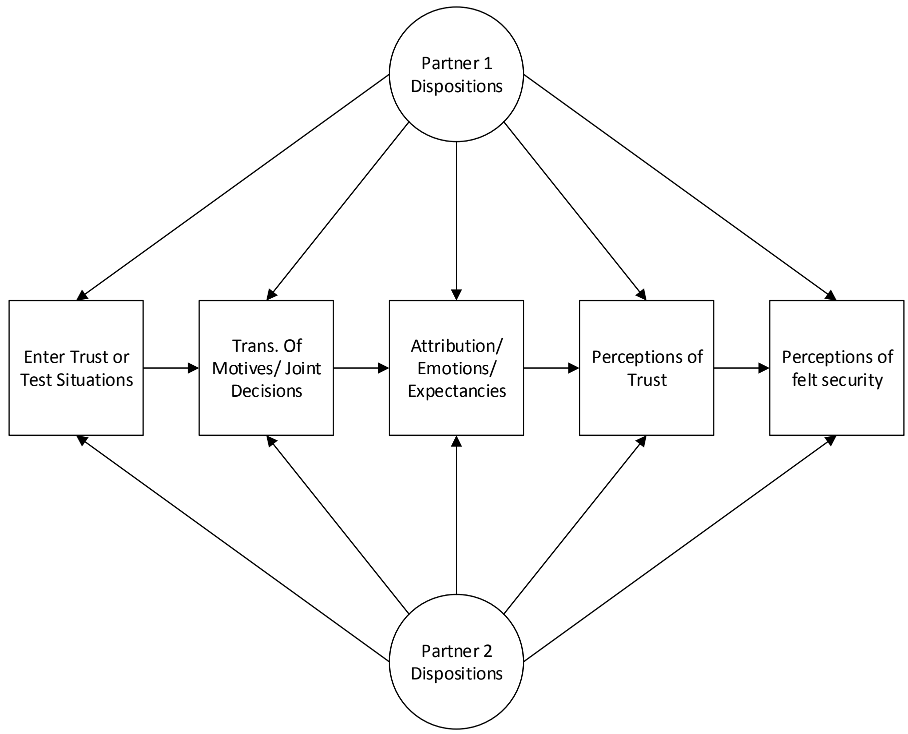


Figure 6: Simpson's (2007) trust model with a linear description of trust.

Metrics focusing on the measurement of interpersonal trust in close relationships tend to focus on antecedents to trust that are part of close relationships, using questions focused on behaviours, such as coping with conflict, embarrassment, welfare, promises, fidelity, or being together after some years (Larzelere & Huston, 1980; Rempel et al., 1985). The focus on partner behaviour is directly related to mutual sharing and is quite specific to this type of trusting behaviour. Samples of the trust questionnaires developed by Larzelere and Huston (1980) and Rempel et al. (1985) can be found in Appendix M and Appendix N respectively.

Moving towards organizational settings, trust shifts in its meaning and effects, requiring a new interpretation of which factors influence trust and the balance between the signaling and evolutionary components of trust.

1.2.3.1.2 Trust in Organizational Settings

Research on trust in organizational settings is one of the most developed areas of trust research, as trust has a significant impact on performance and consequently, on profits. This impact on profits has created a strong interest from organizations and funding agencies on improving the understanding of trust behaviour to implement measures to improve team dynamics and consequently positively influence team performance (Dirks & Ferrin, 2001; Kramer, 1999).

When expanding the understanding of trust to relationships developed outside close relationships, the array and influence of antecedents of trust change significantly (Knoll & Gill, 2011; Morrow, Hansen, & Pearson, 2004). However, the cognitive processes involved in the formation of the trust state remain similar (Das & Teng, 2004; Mayer et al., 1995; McKnight, Cummings, & Chervany, 1998; Morita & Burns, 2014b). Significant changes when considering interpersonal trust in an organizational environment include:

- Individuals now rely on a different set of antecedents and trust influencing factors (Das & Teng, 2004; Gill et al., 2005; Jarvenpaa, Knoll, & Leidner, 1998; Knoll & Gill, 2011; Mayer et al., 1995; McKnight et al., 1998; Morrow et al., 2004; Ridings et al., 2002).
- A shift in emphasis from the affective or evolutionary components of trust to the calculative or signaling-related components (Lewicki et al., 1998; Lewicki, Tomlinson, & Gillespie, 2006; McAllister, 1995; Morita & Burns, 2014b; Six, Nooteboom, & Hoogendoorn, 2010; N. A. Stanton, 2011).
- The relevance of each antecedent on the formation of trust behaviours changes, as the same cues available in close relationships will have different impact on trust (Lewicki et al., 2006; Morita & Burns, 2014b; D. M. Rousseau et al., 1998).

There are a wide variety of trust models that consider organizational trust, allowing researchers to better understand and predict trust behaviour, including the model presented in Chapter 4 of this thesis. All these trust models describe the overall cognitive processes that lead to a trust state, as well the inputs and outcomes of trust.

Mayer et al. (1995) break the large array of antecedents of trust into three major categories, that they define as ability, benevolence, and integrity. These encompass the majority of the antecedents of trust within organizational environments (Jarvenpaa et al., 1998; Lewicki et al., 2006). This simplification is useful for modeling purposes as it allows antecedents to be more easily understood by non-experts through creation of a simplified and condensed model. However, this approach can also oversimplify the large array of antecedents and personality factors that are described in the literature as influencing trust (Gill et al., 2005; Jarvenpaa et al., 1998; Knoll & Gill, 2011; Mayer et al., 1995; McKnight et al., 1998; Morrow et al., 2004; Ridings et al., 2002) in striving for a clean and easy to understand model. The Mayer et al. (1995) model, however, does not include the influences of institutional, cultural, and environmental constraints that can impact trust, resulting in an interpretation of trust behaviours focused solely on the characteristics of the two parties involved in the interaction. Consequently, the model cannot explain, for example, the situational variability of trust in a trusting situation in which individuals are exposed to distinct institutional constraints (such as individuals from different institutions). Explaining such variability is key when evaluating models to inform the design of trust-fostering interventions that will be used across distinct environments, as described later in this thesis. There is a strong emphasis on the evolutionary component of trust, as well as the description of the effects of trust propensity on the perceived factors and the incorporation of a risk assessment stage. More details about Mayer et al. (1995) trust model can be found in Figure 7.

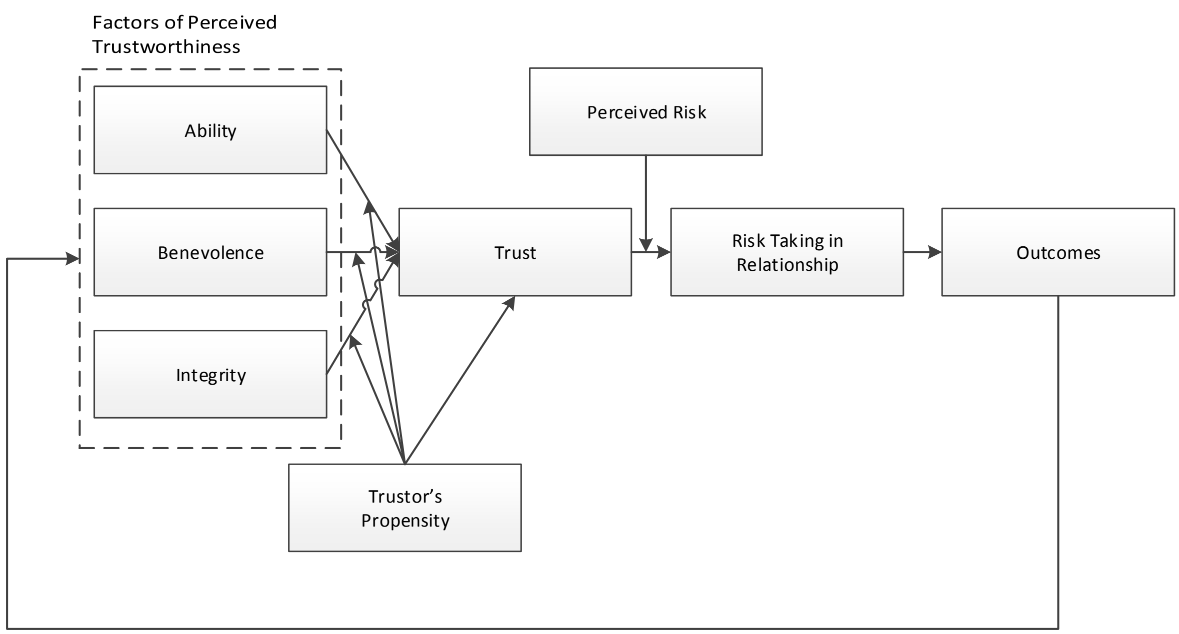


Figure 7: Mayer et al (1995) organizational trust model.

McKnight et al. (1998) shifted the focus to initial trust formation in organizational environments by incorporating the effects of institutional and cultural variables on trust formation, filling part of the gap left by Mayer et al. (1995). Through the evaluation and modeling of the social dynamics of an initial contact, they modeled the variables that influence the development of newly formed relationships. Trust is described by these authors as highly influenced by disposition to trust (also described by Rotter (1967) as propensity to trust), as well as institution-based trust. Institution-based trust corresponds to the norms and assurances that are in place within an organization and that regulate the behaviour of the other party (Crisp & Jarvenpaa, 2013; Knight, 2001). McKnight et al. (1998) created a model that further explores the components of disposition to trust and institution-based trust, but partially neglects the evolutionary aspect of trust formation. Their model lacks a feedback link to feed the effects of a trusting intention on the inputs to trust, but excels at providing a detailed description of institutional factors that influence trust (Figure 8). The importance of the evaluative component described by a feedback loop cannot be underestimated as it describes how trust between the parties can change over time and corresponds to one of the core processes of trust formation (Colombo & Merzoni, 2006; G. R. Jones & George, 1998), even for initial trust (Jonker & Treur, 1999).

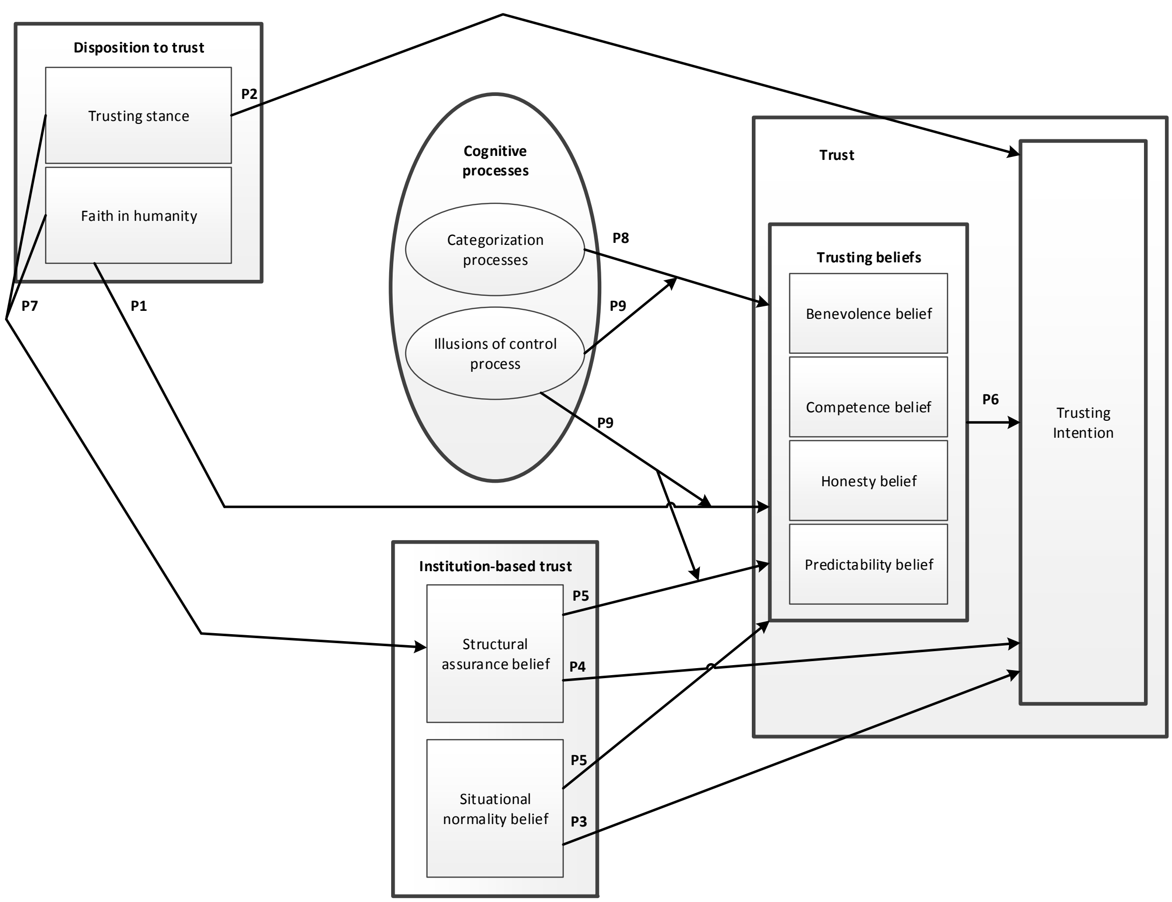


Figure 8: McKnight et al. (1998) initial trust formation model.

Furthering the development of trust models, some authors have opted for the development of mathematical models that could predict trust behaviour based on a set of inputs and history of collaboration (Luna-reyes, Cresswell, & Richardson, 2004; Y. Wang & Singh, 1998). Although a very important approach to trust modeling, this process relies on a simplified set of inputs to create a manageable trust model. An example of such a model, the model developed by Bhattacharya, Devinney, and Pillutla (1998) can be found in Figure 9.

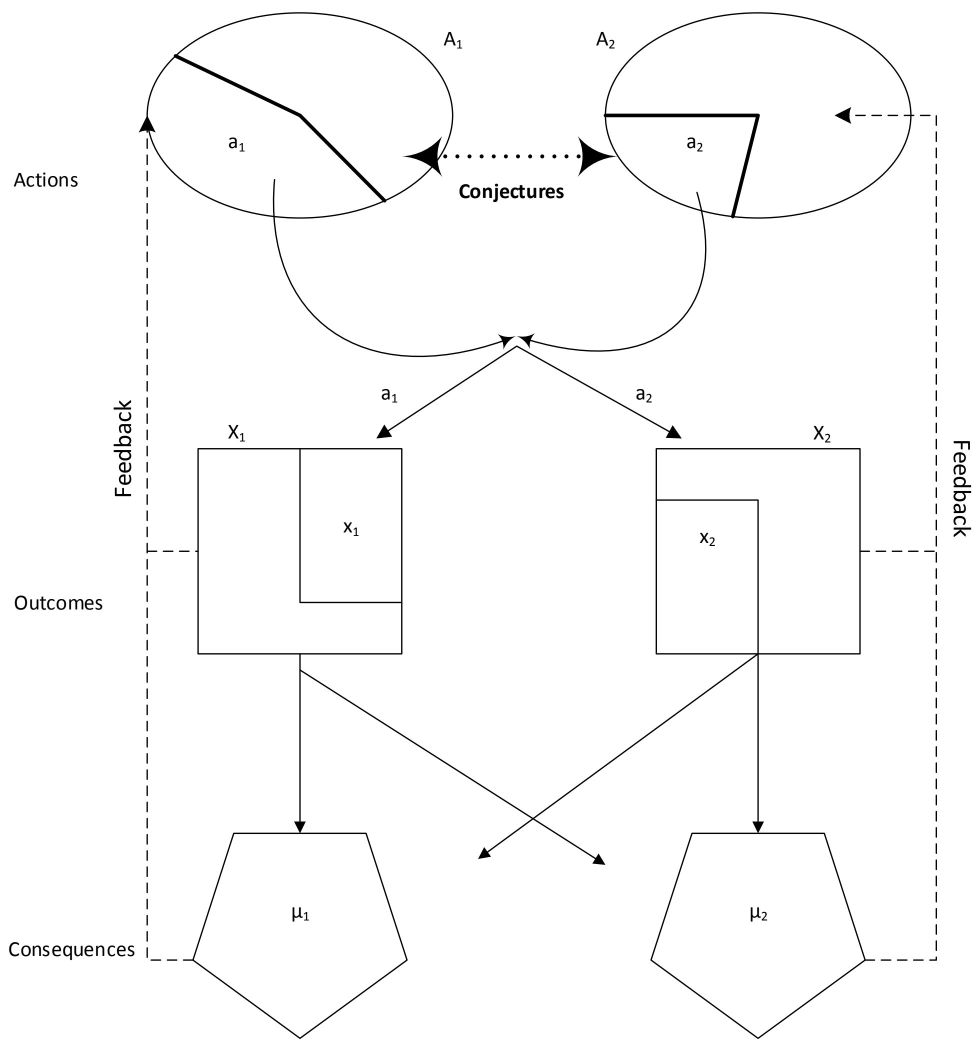


Figure 9: Mathematical trust model by Bhattacharya, Devinney, and Pillutla (1998).

These mathematical models prove limited in describing how cues are perceived by individuals, how cues convey information about antecedents and personality traits, and how cues are used to develop a trust state. They lack, for example, the ability to explain how situational variability can influence the perception of trust factors (Dirks, 1999; Jarvenpaa, Shaw, & Staples, 2004; La Guardia & Ryan, 2007; Morita & Burns, 2014b; Payne & Clark, 2003; Schlenker, Helm, & Tedeschi, 1973). Situational variability needs to be accounted for in these models to allow the interpretation of how trust is formed in different work environments by incorporating situational constraints on the trust state formation process.

Similar to other areas of trust research, some authors have developed trust metrics to measure and interpret trust within an organizational context. However, these metrics also fail to incorporate the situational variability of trust formation.

Several existing metrics focus on measuring trust atmosphere or trust climate within institutions or teams. Cummings and Bromiley (1996) developed the Organizational Trust Inventory (Appendix O), a metric tailored to measuring group trust atmosphere and inter-group trust. Costa and Anderson (2011) developed metrics for measuring global team trust, looking at team level trust but not trust levels between specific team member dyads. Cook and Wall (1980) and Farris, Senner, and Butterfield (1973) have developed similar metrics for evaluating the trust atmosphere in an institution as a whole. All these metrics are tailored at evaluating the existing supporting norms, leadership, and team-wide antecedents that influence the trust propensity of the team members (Mayer et al., 1995).

Focusing on the dyadic evaluation of trust, McAllister (1995) developed a metric wherein trust is divided into affective-based and cognitive-based components (Appendix P). This distinction is important for separating the signalling component (Six et al., 2010) from the evolutionary component (Colombo & Merzoni, 2006), and can also be seen in the trust model developed in this research program, presented in Chapter 4. However, similarly to the Mayer et al. (1995) trust model, the trust scale developed by McAllister (1995) suffers from oversimplification. Although it is an effective way to calculate an overall trust score using only 11 questions, it is difficult to identity which antecedents are more important to the trust scores, as they are reduced to cognitive-based and affect-based trust clusters.

To avoid such oversimplification in the measurement of trust, Butler (1991) developed the Conditions of Trust Inventory (CTI - Appendix Q). Using a more detailed and complex metric, Butler creates the opportunity for looking at the distinct components of trust, allowing for a dissection of which factors are indeed influencing the trust score. However, the ease of using the metric is complicated due to increased size, as the CTI relies on 44 questions. The CTI presents trust as a composition of 11 factors that are each measured through 4 redundant questions evaluating the same construct.

The need to incorporate situational dependency on trust models described in the previous paragraphs motivated the development of the Interpersonal Trust State Formation Model presented in Chapter 4 and the Quick Trust Assessment Scale presented in Chapter 6. These components of this research program aimed to fill this existing gap by incorporating the situational variability in a trust model and in the calculation of a trust score, providing the potential to help identify existing trust issues within collaborative teams.

Expanding on the concept of organizational trust, researchers have now applied the interpretations developed for institutional trust into the evaluation of trust between institutions. Although very different in context, trust in such situations can still be described by signalling and evolutionary components between two agents.

1.2.3.1.3 Trust Between Institutions

Another area of institutional trust research is that of trust between institutions or between organizations (B. D. Adams et al., 2010; Ratnasingam, 2005; Zaheer et al., 1998). This research field is of high importance for inter-institutional cooperation, as it highly defines how organizations interact with each other (Parkhe, 1998; Zaheer & Venkatraman, 1995), how business relationships evolve (Lane & Bachmann, 1998), and how trust can impact the success of a business (Bos et al., 2007).

Trust between organizations has been defined by Ring and van de Ven as:

> Reliance on trust by organizations can be expected to emerge between business partners only when they have successfully completed transactions in the past and they perceive one another as complying with norms of equity. The more frequently the parties have successfully transacted, the more likely they will bring higher levels of trust to subsequent transactions. (Ring & Van de Ven, 1992)

From their perspective, trust between institutions in highly focused on (1) the possibility of future transactions, (2) the behavioural expectation of future transactions, (3) the evolutionary interpretation of trust, and (4) compliance with norms.

Since international cooperation has become a very important part of business research, the importance of inter-institutional trust has become even more salient as organizations interacting with each other can be bound by different cultural backgrounds (Koeszegi, 2004; Marchington & Vincent, 2004), organizational rules and constraints (Bachmann & Inkpen, 2011), local laws and regulation (Koeszegi, 2004), and business policies (Davenport, Davies, & Grimes, 1999). All of these factors can influence how businesses interact with the other party. Therefore, for business interactions to be successful, representatives of each company need to be aware of such differences and be sensitive to how their behaviour can influence how another business may perceive their actions.

The importance of international collaborations in current teamwork literature and the widespread use of virtual teams for international collaboration have motivated the evaluation of the influence of cultural constraints on trust behaviour, explored in the Chapter 8 of this thesis. Designers need to be aware of the existence of cultural constraints when designing for international teams since their interventions might have different impacts on different parts of the team.

Building from the existing knowledge on organizational trust and trust in close relationships, authors in human factors have expanded the interpretation of trust behaviour to the interaction between a human agent and an automated agent, as discussed below.

1.2.3.1.4 Trust in Automation

Moving towards a design-centered approach to trust research, researchers have described human behaviours towards automated systems in a similar way as they have approached trust in an interpersonal relationship. Some authors claim that there are significant similarities between interpersonal and trust in automation and have attempted to extend interpersonal trust concepts into research on trust in automation (Dzindolet, Peterson, Pomranky, Pierce, & Beck, 2003; Muir, 1994). Others have been stricter in claiming a need for separate investigations and modelling (J. D. Lee & See, 2004; Madhavan & Wiegmann, 2007).

It is important to define trust in automation. Many authors have discussed it without going in detail into on the semantic definition of trust in automation. Muir (1994) for example, follows the definition by Barber (1983) to state that trust in automation is:

> Trust (T) is the expectation (E), held by a member of a system (i), of persistence (P) of the natural (n) and moral social (m) orders, and of technically competent performance (TCP), and of fiduciary responsibility (FR), from a member (j) of the

system, and is related to, but is not necessarily isomorphic with, objective measures of these properties. (B. Barber, 1983)

Other authors, like Lee and See (2004), define trust in automation as "the attitude that an agent will help achieve an individual's goals in a situation characterized by uncertainty and vulnerability" (p. 54). This definition of trust follows a more automation-centered approach to identifying the meaning of trust between an operator and an automated system.

Initial developments in trust in automation occurred in the 1990s, with important works by Muir (1994); Muir and Moray (1996); Parasuraman and Riley (1997); Cohen, Parasuraman, and Freeman (1998); and Lee and Moray (1992, 1994). Later, important works by Lee and See (2004); Dzindolet, Peterson, and Pomranky (2003); and Jian, Bisantz, and Drury (2000), added modelling, measurement, and design methods to the toolkit available to human factors specialists.

The most influential model of trust in automated systems was developed by Lee and See (2004). Lee and See approached trust formation from an information processing perspective, developing a detailed descriptive model. Their model incorporates a combination of situational and institutional variables into an information processing model with a single feedback loop, and is shown in Figure 10.

Metrics for trust in automation were developed by Jian, Bisantz, and Drury (2000). Such metrics are extremely important for the evaluation of newly designed systems (Gupta, Bisantz, & Singh, 2002; Seong & Bisantz, 2001), the identification of issues with existing systems (Lees & Lee, 2007; Rajaonah, Anceaux, & Vienne, 2006), and as a technology evaluation or redesign opportunity.

More recently, following the developments in robotics and multimedia technology, authors like Sanders, Oleson, Billings, Chen, and Hancock (2011); Freedy, DeVisser, Weltman, and Coyeman (2007); and Hancock, Billings, Schaefer, Chen, DeVisser, and Parasuraman (Hancock et al., 2011) have evolved trust models, metrics, and associated automation literature to account for the interaction between humans and robots (J. A. Adams, 2005; Kosuge & Hirata, 2004) and for the anthropomorphization of automated agents (Bass et al., 2011; Pak, Fink, Price, Bass, & Sturre, 2012). Through the use of human-like features on automated systems, designers have reinterpreted interactions with the automation, making them more closely resemble interpersonal interactions.

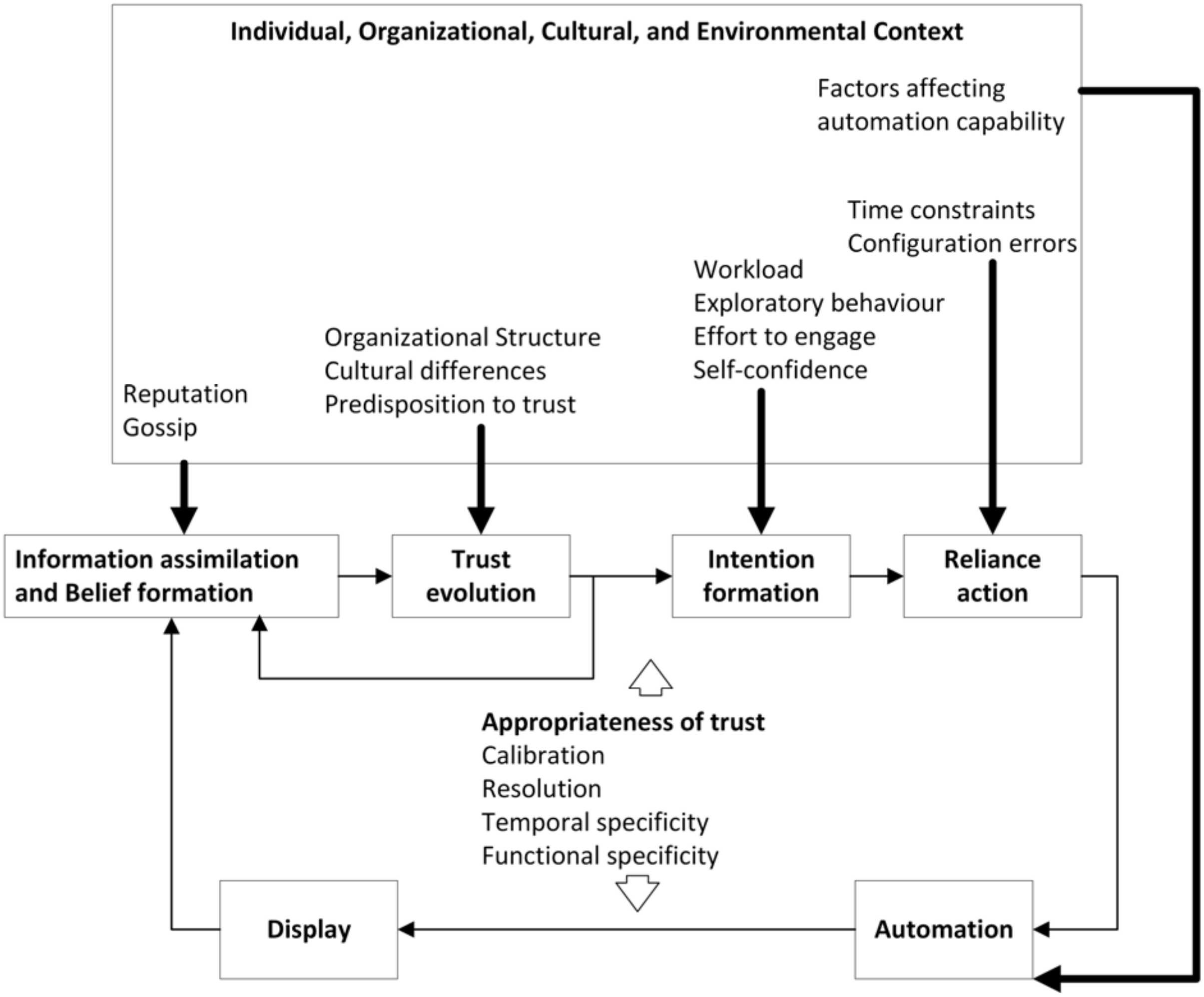


Figure 10: Trust in automation model presented by Lee and See (2004).

Similar developments have taken place in the online trust field, where the interaction between humans and websites has been studied to identify design features that can lead to increased trust.

1.2.3.1.5 Trust in Websites

Trust in websites is a branch of the "design for trust" approach. As a very important component of marketing (Urban, Amyx, & Lorenzon, 2009), sales (Gefen, Karahanna, & Straub, 2003), and user engagement (Fogg, 2002; Sillence, Briggs, Harris, & Fishwick, 2006), the development of website interfaces that can demonstrate or elicit a feeling of trustworthiness has been widely discussed in the literature. This area is of extreme importance for banking websites (Mukherjee & Nath, 2003), e-commerce (Walczuch & Lundgren, 2004), health-related sites (Luo & Najdawi, 2004) and financial and trading websites (M. C. Lee, 2009); all applications with strong competition for a market share and significant risks for the users. Risks in trusting websites plays an important role in defining user behaviour, as it is possible to see in interpersonal trust (Chapter 7) as described by Morita and Burns (submitted).

Corritore et al. (2003), for example, discuss the effects of several design aspects on the formation of trust. Their model presents three major perceptual factors that are described to influence trust in on-line environments: perception of credibility, ease of use, and risk (Figure 11).

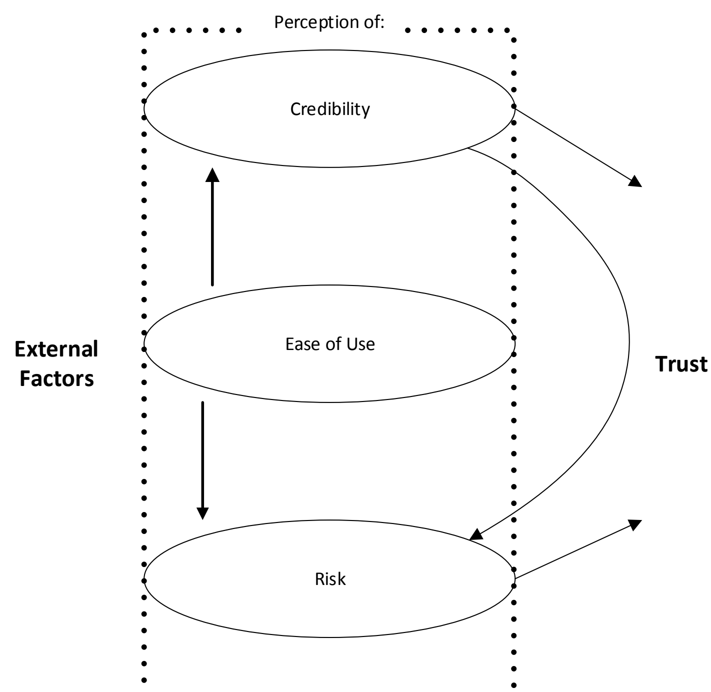


Figure 11: Model of on-line trust described by Corritore et al. (2003).

1.2.4 Designing for Trust

Most of the areas of trust research explored above have provided some guidelines on how to use the information extracted from models and metrics to develop design or managerial interventions to foster trust. Trust fostering interventions create an opportunity for human factors, ergonomics, and organizational research specialists to identify and test possible ways to foster trust. Since trust is described as linked to team performance, team effectiveness, and solid communication, the importance of facilitating the development of trust on a team perspective cannot be overstated.

Two major approaches have been taken with the intention of fostering trust. In the first, interventions target increasing trust propensity, by creating conditions in which individuals have a higher tendency toward trusting (Pak et al., 2012; R. Phillips & Madhavan, 2013). In the second, interventions are targeted at providing more information to the agents to promote an informed trust decision (Morita & Burns, submitted, 2013; Rusman, Bruggen, Sloep, & Koper, 2010).

1.2.4.1 Designing Trustworthy Automation

Authors, over the years, have evaluated the effect of several design techniques on the trust process between humans and automated agents, identifying simple but effective ways of calibrating trust to system requirements (McGuirl & Sarter, 2006; Muir, 1987; Yeh & Wickens, 2001).

Trust in automation is a very delicate balance. The dangers of improper levels of trust on the automated agent go beyond low levels of trust. Overtrusting a system can result in expectations beyond the capabilities of what the system can deliver (Muir & Moray, 1996), also resulting in complacency (Parasuraman & Manzey, 2010). In this case, there is a significant risk of accidents caused by the disconnect between the real capacity of the system and operator expectations (Parasuraman & Riley, 1997).

Sheridan (1988) presented design guidelines for trust in automation, which were later explored by Seong and Bisantz (2002, 2008). Sheridan describes seven characteristics of automated systems that have the potential to influence operators to trust the automation: *reliability*, *robustness, transparency, familiarity, explication of intentions, dependence, usefulness, validity, and understandability.* In line with this, Cofta (2009) presents features of a trustworthy system (not necessarily an automation) that are used by operators and users to create their trust state on the system. These features are extracted from the interpersonal trust literature and provide a good list of important considerations in designing trustworthy automations: *competence/ability, privacy, usability, reliability, safety, security, and maintainability*.

In addition to their model, Lee and See (2004) present an overview of techniques and considerations for the development of appropriate trustable automation. Their guidelines are divided in three major categories, defined as: "*Make the Automation Trustable*", "*Relate Context to*

Capability of the Automation", and "*Consider Cultural, Organizational, and Team Interactions.*" I will highlight a few of their design guidelines that are relevant when designing for interpersonal trust:

- Design for appropriate trust, not greater trust,
- How past performance depends on situations,
- Consider individual and cultural differences in evaluations because they may influence reliance in ways that are not directly related to the characteristics of the automation.

Lee and See reinforce the importance of situational differences on trust (J. D. Lee & See, 2004), the influence of cultural constraints on trust (Atoyan, Duquet, & Robert, 2006; Ho, Wheatley, & Scialfa, 2005), and the importance of designing for an appropriate level of trust. These guidelines also motivated the investigation of situational and cultural variability on trust presented in Chapter 7 and Chapter 8 of this thesis and the development of the trust metrics in Chapter 6.

Many of the trustworthy features described by Cofta (2009) span into the field of design of websites, as there is some overlapping between techniques in these two fields. In both types of trust, interactions are between a human and a system with limited responsiveness and reciprocity in the interactions.

1.2.4.2 Designing Trustworthy Websites

Over the years researchers have identified features of websites that convey an image of trustworthiness and reliability, both important features to be conveyed by a website. Since most of our trust actions are based on perception of trust cues, most of these features consist of designing websites following a set of standards and guidelines.

Urban, Amyx, and Lorenzon (2009) cover design features that lead to trust. They work from the perspective that trust is more than "proper privacy and security," that trust is an evolutionary process and is influenced by situational variability. Another well accepted review of website features that influence trust behaviour has been developed by Fogg et al. (2003); using over 2500 participants, they evaluated the credibility of two different website designs. After compiling the comments given by the participants for each website, they have identified some themes that are influential for the design of trustworthy websites: design look (46.1%), information design/structure (28.5%), information focus (25.1%), company motive (15.5%), usefulness of information (14.8%), accuracy of information (14.3%), name recognition & reputation (14.1%), advertising (13.8%), bias of information (11.6%), tone of the writing (9.0%), identity of site sponsor (8.8%), functionality of site (8.6%), customer service (6.4%), past experience with site (4.6%), information clarity (3.7%), performance on a test (3.6%), readability (3.6%), and affiliations (3.4%).

There are other studies in the literature that present similar results. Corritore et al. (2003) have explored specific design components and their power on fostering trust, as for example the use of human images on websites (Cyr, Head, Larios, & Pan, 2009; Riegelsberger, Sasse, & Mccarthy, 2003; Steinbrück, Schaumburg, Duda, & Krüger, 2002) or accounting for cultural and demographic variability for the design of websites (Cyr, Bonanni, Bowes, & Ilsever, 2005; Cyr & Bonanni, 2004, 2005).

The design of trustworthy automations and trustworthy websites has served as a primer for how it is possible to convey trust supporting information through components of CMCs used by virtual teams. The exploration of this approach can be found in Chapter 7.

1.2.4.3 Designing for Interpersonal Trust

Although teamwork has become the norm in current organizational settings and trust has been on the short-list of teamwork-related constructs that are of relevance for effective teams, there is not a significant amount of resources on how to design teamwork supporting systems that promote the development of interpersonal trust.

The design of social artifacts for teamwork makes up one of the major approaches to facilitating the development of team structures and to foster trust behaviour. One specific group of artefacts of interest for this research program are what are called "cognitive artefacts" (Hutchins, 1996). Cognitive artefacts, as described by Norman (1991) are "artificial devices that maintain, display, or operate upon information in order to serve a representational function and that affect human cognitive performance." Such artefacts can range from command and control task coordination displays (M.J. Ashleigh & Stanton, 2001; Houghton et al., 2006; Jenkins, Salmon, Stanton, & Walker, 2010) to Computer Mediated Communication Systems (CMCSs) (Jarvenpaa & Leidner, 1998; Riva, 2002) that interface the collaboration of virtual teams.

CMCSs present a viable artefact to incorporate design features targeted at improving trust. Some authors, such as Rusman (Rusman, Bruggen, Cörvers, Sloep, & Koper, 2009; Rusman et al., 2010) have used personal profiles in CMCSs to attempt to increase the availability of information and allow team members to make more informed trust decisions. Types of cues explored by Rusman et al.

(2010) range from pictures, assessment rates by other peers, professional interests, interaction frequency, and ratings. Such an array of information would be available to team members on a profile-like page, similar to LinkedIn. Although the availability of information is greatly increased, team members are required to actively search for information that could be used to influence their trust on the other team members.

As an alternative to improving trust in teams, there are resources available that give instructions on the process of designing teams (Mohrman, Cohen, & Morhman, 1995; Reagans, Zuckerman, & McEvily, 2004). Through the identification of characteristics, compositions, constraints, and resources available to effective teams, researchers have written guidelines for creating conditions for optimal team effectiveness. A team formed by the ideal individuals, might not operate to maximum effectives if the necessary resources are not available (M.J. Ashleigh & Stanton, 2001; N. A. Stanton, 2011). Similarly, a team cannot operate properly with even the most advanced resources if team members do not function well in a collective environment (Burke, Salas, Wilson-Donnelly, & Priest, 2004; Salas, Cannon-Bowers, & Johnston, 1997).

The focus of interpersonal trust research has been on managerial interventions. Since trust is described as a signalling process (Six et al., 2010; Six, 2007) combined with an evolutionary process (Colombo & Merzoni, 2006), some alternatives to improving trust in teams include the use of trust building activities (Holton, 2001; Six, 2005), the use of casual social chat (Zheng, Bos, Olson, & Olson, 2001), and the development of social activities (Rocco, 1998; Zheng, Veinott, Bos, Olson, & Olson, 2002), among others. The key aspect that permeates all these techniques is that individuals are given an opportunity to better know each other and develop a relationship that goes beyond the workplace; this is accomplished through the discovery of hidden cues such as value and interest similarities, past history, and rapport development (Bachmann & Zaheer, 2006; Morrow et al., 2004). However, these activities require time and resources that might not be available in all situations, especially for virtual teams.

The investigation of trust in organizational environments has motivated the development of trust tokens presented in Chapter 7 of this thesis. In Chapter 7, I attempt to use interface design objects as cues to convey trust-supporting information that is lost when teams shift from face-to-face to virtual environments.

Chapter 2
Research Objectives

Considering the constraints that are imposed on communication by virtual teams or hybrid teams and the potential for communication technology to convey trust supporting information (in addition to the verbal communications), I present the development of tools to inform the design of systems that cater for the development of interpersonal trust.

The objective of this research program is to provide researchers, designers, team members, and team managers mechanisms to *gain insights into*, *measure*, and *foster* trust behavior through the development of team interventions and redesign of communication systems that can capitalize on the power of high levels of trust within a team.

Therefore, the three major objectives of this dissertation are:

- *To contribute to the knowledge* of how cues from the environment are perceived and integrated into a trust state, as well as the effects of environmental, task, experiential, and cultural constraints on the formation of a trust state.
- *To contribute to the methodology on how to measure* trust, capturing not only the current state of the trust relationships within a team, but also identifying which cues play a predominant role within a specific team. This information can be used to create tailored interventions to foster trust behaviour.
- *To contribute to design methodologies on how to foster* interpersonal trust through the development of interventions and design approaches that can help individuals make informed trust decisions by presenting supporting information or increasing the propensity to trust of these individuals.

Existing trust models, as discussed in Chapter 1, provide simplistic descriptions of the perceptual mechanisms involved in acquiring information from trust cues to inform a trust state. Existing models have good descriptions of possible factors that can influence trust, but lack a proper description of how they become integrated. Consequently, they cannot explain the effects of multiple constraints (cultural, environmental, task, etc.) on the perception and use of trust-supporting information. Additionally, current models do not incorporate separate cognitive components for affect-based and cognition-based trust, which makes it harder to explain the differentiation on trust behaviour of individuals that just met versus individuals that have prior knowledge of each other. The model presented in this dissertation was developed to fill these two gaps in the available literature, which will help researchers, designers, and practitioners better understand the effects of their interventions as they can now explain how the information provided to team members is perceived.

In addition, the trust metrics currently available do not capture the subtleties of trust perception. For example, they cannot differentiate the relative importance of various cues on the overall formation of the trust state. Consequently, they cannot explain the situational variability of trust, which is an important aspect to consider when designing tools to facilitate the development of interpersonal trust. This thesis tackles this issue by developing a trust metric that combines the simple direct trust evaluation of trust with the relative importance of each of the sub-dimensions of trust as evaluated by the Quick Trust Assessment Scale presented in Chapter 6. This richness not only helps identify targets for interventions, but also creates a more balanced trust score that now includes the effects of situational dependency of trust.

Lastly, as discussed in Chapter 1, the available literature on designing supporting systems for teams does not hold interpersonal trust as a variable of interest. Consequently, design methodologies targeted at fostering trust are scarce, with most available methodologies focusing on improving communication between the team members. Considering the importance of trust as a precursor to team performance and effectiveness, as well as the potential of using CMCSs to transfer supplemental information beyond the verbal communication in the form of interface design components, there is a need to develop mechanisms for transferring trust cues that are not usually available in non-collocated work. In this dissertation, I target this problem by creating and testing surrogates to carry such trust-supporting information using trust tokens.

The objectives outlined above are broken down into its multiple research questions that have driven my research. These research questions are outlined in the next chapter and define the subsequent chapters of this thesis.

Chapter 3
Research Program

In this chapter, I will provide a brief overview of the development process followed in this research program and describe the high-level research questions that led to each of the papers and framed the development of that particular component of the thesis. Each individual paper presented in the following chapters will investigate a research question in greater depth.

3.1 Contributing to the Knowledge of Trust Perception and Formation

The available literature lacked a model that properly described the perceptual mechanisms used by an individual to form a trust state, preventing the identification of effective ways to foster trust behaviour through design. Existing trust models, such as those of Mayer et al. (1995), McKnight et al. (1998), Lee and See (2004), Bhattacharya et al. (1998), and Wieselquist et al. (1999), do not fully describe the perceptual mechanisms involved in the perception of trust cues. These trust cues compose the main source of information for informed trust decisions and are highly regulated by the task, environmental, individual, experiential, and cultural constraints that influence the formation of a trust state. The knowledge of how the trust state is formed is vital to the design of communication interfaces and interventions that can foster trust behaviour, as it can provide insights into the most efficient ways to target trust. Therefore, to take this research program forward, I realized that a novel model accounting for these perceptual components needed to be devised. To do so, I identified the following as research questions:

Research Question 1: Can the integration of human factors literature and trust models help us to better understand the process of trust perception and formation?

Research Question 2: Can this same integration inform how cultural, environmental, situational, and task characteristics influence and constrain the perception of trust cues?

These two research questions are answered in the paper entitled *"Understanding 'interpersonal trust' from a human factors perspective: Insights from situation awareness and the lens model*" by Morita and Burns (2014b), which can be found in Chapter 4. In this paper, I present the Human

Factors Interpersonal Trust State Formation Model, which integrates multiple human factors frameworks from the trust literature to help better describe the trust state formation process, the constraints that influence trust behaviour, and possible perceptual mechanisms involved in the acquisition of trust-supporting information. Through an extensive and systematic review of the literature, I integrated the knowledge and overall structure from existing trust models with the cognitive modeling of Situation Awareness (Endsley, Bolte, & Jones, 2003; Endsley, 1995) and the lens model (Brunswik, 1939, 1952) to explain how the information acquired from the individuals' surroundings is integrated into a trust state. This model differentiates itself from others in the literature by presenting (a) separate cognitive pathways for the formation of calculative confidence (cognition-based trust) and intuitive trust (affect-based trust) and (b) a description of a possible perceptual mechanism to explain the situational variability of trust (Figure 12).

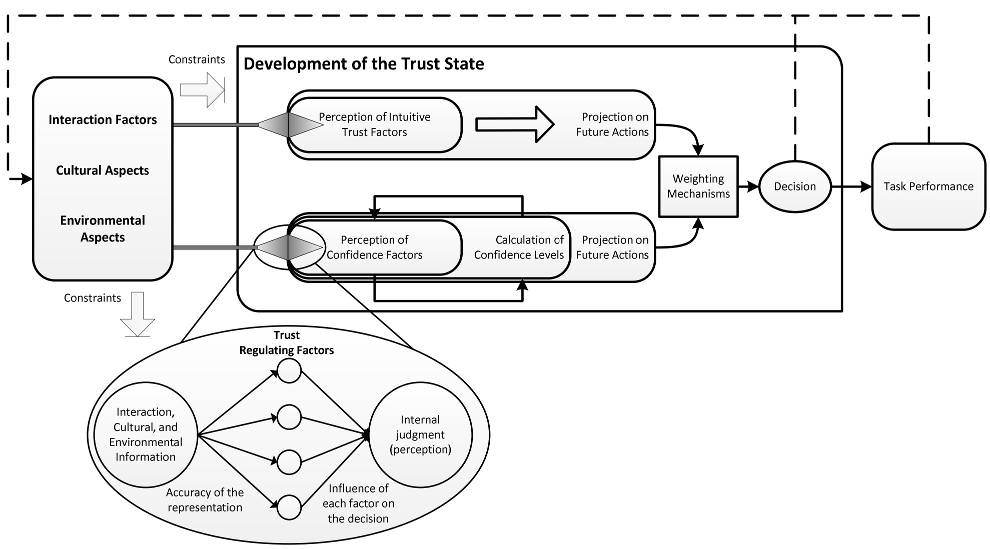


Figure 12: The Human Factors Interpersonal Trust State Formation Model.

The next step in the development of this research program was to identify how individuals that are part of a collaborative environment used the team structures and mechanisms available to (a) build their trust mental models about others and (b) foster the development of a trust state in other individuals. In order to identify these mechanisms, it was necessary to be immersed in a collaborative environment that would allow for observation of this process. The data from the observations would later be used to mimic the trust-supporting information transfer process normally done through face-to-face contact by using interface design components to carry similar information. Therefore, my next research questions were:

Research Question 3: How do individuals working as a team use team social dynamics to perceive information about others and form a trust state (trust formation)?

Research Question 4: How do individuals working as a team use team social dynamics to help others develop a trust state (fostering trust)?

Research Question 5: What are the most common and efficient cues transmitted during this information exchange process to develop a trust state?

Research questions 3 to 5 were answered in my next published paper entitled "*Trust tokens in team development*" by Morita and Burns (2014a) presented in Chapter 5 of this thesis. For this research, I conducted an ethnographic study at the University of Waterloo in which, for the length of one year, I observed two competition-related student teams from the Student Design Centre to identify how trust-supporting information flowed between the team members. I followed ethnographic methods described by Fetterman (2010) and Spradley (1979) to perform my data collection. During this period, I acquired data from in-situ observations, as well as from electronic communications. In this paper, I identify five behaviours that are most influential in fostering trust and two mechanisms used by individuals to transfer this information. These five behaviours are: expertise, recommendation, social capital, benevolence, and willingness to help. These five behaviours were later converted into trust tokens presented in Chapter 7 and used in the attempt to foster trust through interface design.

3.2 Contributing to the Methodology on How to Measure Trust

After creating a model to help understand how cues are perceived and used in the formation of a trust state, I pursued the next step in the progression of this thesis. In order to develop tools to support the design of interventions and interface components tailored at fostering trust in systems that mediate communications in virtual teams, I had to develop a novel metric for measuring trust that provided the insights necessary to inform design and that included the situational variability of trust on a trust score.

In addition to measuring the trust level between two people, it was important for this metric to capture the subtleties of trust formation and how each perceived trust cue influenced the formation of a trust state to account for situational variability. Existing metrics have done a great job measuring trust, but lack the ability to capture these nuances of trust formation. The ability to do so would inform the development of interventions to target trust behaviour. Therefore, in order to add a new resource to the tools developed in this thesis, I had to answer the following research questions:

Research Question 6: How can we develop a trust metric that, in addition to measuring trust, can capture information to inform design and explain the situational variability of trust?

Research Question 7: What is the necessary format for a trust metric to be able to capture these nuances on the trust state formation, while remaining compact and reliable?

Research Question 8: How can we use the information collected by this new trust metric to inform the designs of communication systems and the development of interventions to foster trust behaviour?

These research questions are answered in my third paper entitled "*Towards a Quick Trust Assessment Scale (QTAS) – Measuring trust in collaborative environments*" by Morita and Burns (submitted, in revision) presented in Chapter 6. Using the knowledge already gained about the perception process that leads to a trust state, I could include on my trust metric, cues representing some components of teamwork and collaboration that were identified as important in the previous studies presented in this thesis. The development of the QTAS satisfies these research questions and was divided into three main tasks: choosing the format of the trust metric, choosing the dimensions to be included in the metric, and evaluating the newly developed trust metric.

To develop the metric presented herein, it was necessary to identify a measurement tool that could replicate the perceptual components from the models presented in Chapter 4, in order to incorporate the situational variability in the calculation of the trust score and to collect information to support design. This was accomplished by incorporating a measurement component (pair selection) to capture the direct perception of each cue, as well as the internal relevance of that cue on the formation of the trust state. This information is relevant because it identifies which variables are most influential on the formation of the trust state, identifying variables that were particularly important to fostering trust.

The selection of an appropriate format was performed through a systematic literature review in which I identified the NASA-TLX (S. G. Hart & Staveland, 1988) as an ideal format. The NASA-TLX was chosen as it matches some of the characteristics of the perceptual mechanism of the trust formation model described in Chapter 4.

In order to select the appropriate dimensions and evaluate the trust metric developed in this thesis, I conducted three separate studies. The first narrowed 90 possible dimensions initially identified through a literature review into clusters of 15 trust antecedents and 9 personality factors. These were then used as an input to the second study, in which the 24 factors were further reduced to 9 dimensions that were included in a test version for my trust metric. This test version was then used in my third study to evaluate the reliability of the trust metric, which can be found in Figure 13. Through cross-comparison with other metrics, as well as the verification of internal reliability through use of Crombach's Alpha tests, I have demonstrated the validity and reliability of the QTAS.

3.3 Contributing to Design Methodologies on Fostering Interpersonal Trust

The third and final step in the development of trust supporting tools for use in virtual teams consisted of applying what was learned in the previous studies to designing interface components with the potential to foster trust when used as part of communication systems in social network environments and CMCSs. It was necessary to develop techniques to actively foster trust through the inclusion of tailored interface design objects in virtual communication interfaces, with the objective of conveying cues that are normally transmitted and perceived through face-to-face contact. Therefore, the following questions needed to be answered for the development of the trust-fostering tools presented in this thesis:

Research Question 9: How can we use the knowledge acquired in answering the previous research questions about trust fostering behaviours to design interface design components that have the potential to carry trust-supporting information?

Research Question 10: How are such interface design components used by individuals when developing a trust state?

Research Question 11: What is the predominant information used when deciding whether to trust in an electronic environment?

Research Question 12: What are the effects of constraining factors, as for example situational risk, in the use of trust supporting information?

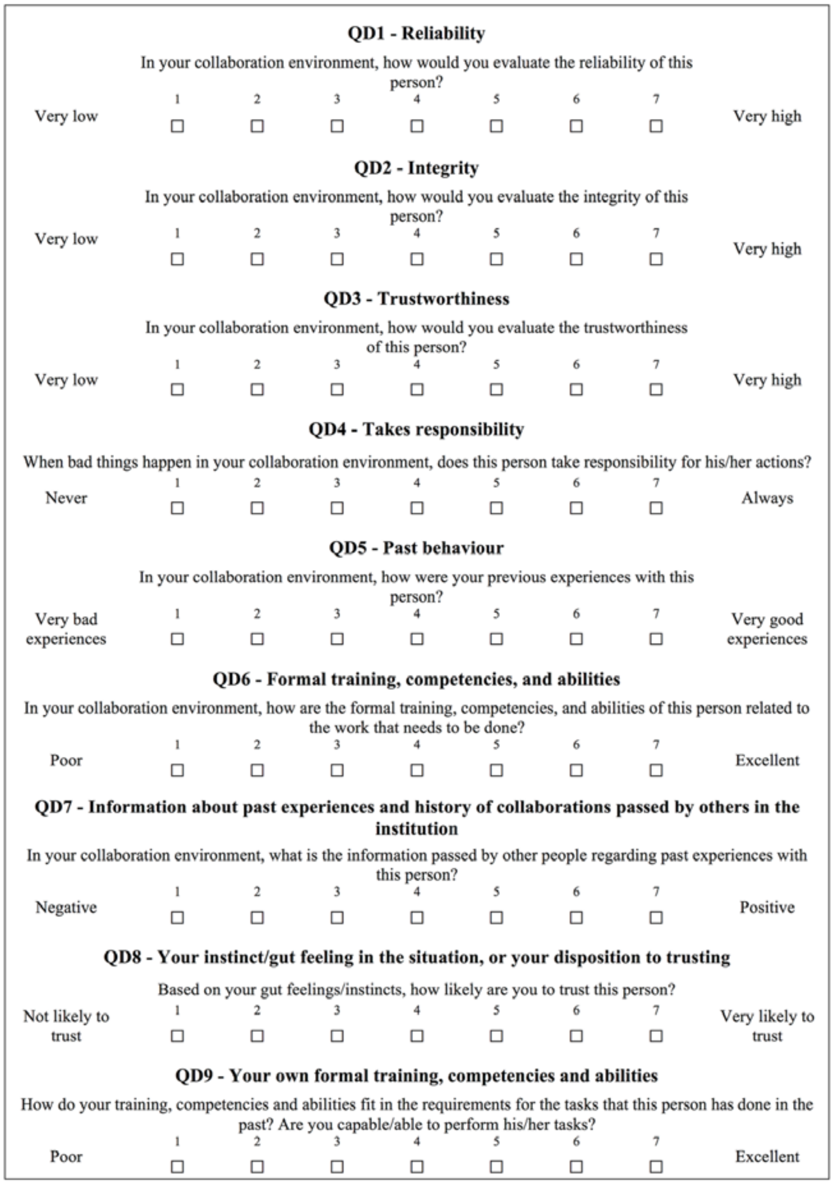
These research questions are answered in the paper entitled "*Trust Tokens: Insights for fostering interpersonal trust through interface design*" by Morita and Burns (in preparation), in preparation for submission to IEEE Transactions on Human-Machine Systems and covered in Chapter 7 of this thesis. In this paper, I propose that interface design objects have the potential to act as surrogates for cues usually acquired in the interpersonal interaction that happens in face-to-face collaborations and that, through the provision of these supplemental cues, I could help individuals make informed trust decisions in virtual collaborations.

In this paper, I use the results of the ethnographic study in Chapter 5 to inform the creation of interface design objects in the form of badges, called trust tokens, to convey the necessary missing information. Through simulated social network interfaces, I was able to test the trust tokens and validate part of the perception mechanism from the Human Factors Interpersonal Trust State Formation Model (Chapter 4) by demonstrating that certain types of risk do indeed influence the use of trust-supporting cues. These results support the presence of internal weights in the model, as well as the components in the QTAS, to capture these nuances in trust perception.

The final analysis of this thesis focuses on further evaluating the effects of constraining factors on the trust decision, such as is presented in Chapter 8 with its investigation of situational risks. In this section, I explore the effects of cultural constraints on the trust decision process, as highlighted in the motivation section. In order to achieve these objectives, I used the following research questions to frame my analysis:

Research Question 13: What are the effects of cultural constraints on the relevance of different trust cues for the formation of a trust state?

Research Question 14: Are there significant differences on which variables or cues two groups of culturally distinct individuals use to compose their trust state about the person being trusted?



QD1 - Reliability

In your collaboration environment, how would you evaluate the reliability of this person?

	1	2	3	4	5	6	7	
Very low	☐	☐	☐	☐	☐	☐	☐	Very high

QD2 - Integrity

In your collaboration environment, how would you evaluate the integrity of this person?

	1	2	3	4	5	6	7	
Very low	☐	☐	☐	☐	☐	☐	☐	Very high

QD3 - Trustworthiness

In your collaboration environment, how would you evaluate the trustworthiness of this person?

	1	2	3	4	5	6	7	
Very low	☐	☐	☐	☐	☐	☐	☐	Very high

QD4 - Takes responsibility

When bad things happen in your collaboration environment, does this person take responsibility for his/her actions?

	1	2	3	4	5	6	7	
Never	☐	☐	☐	☐	☐	☐	☐	Always

QD5 - Past behaviour

In your collaboration environment, how were your previous experiences with this person?

	1	2	3	4	5	6	7	
Very bad experiences	☐	☐	☐	☐	☐	☐	☐	Very good experiences

QD6 - Formal training, competencies, and abilities

In your collaboration environment, how are the formal training, competencies, and abilities of this person related to the work that needs to be done?

	1	2	3	4	5	6	7	
Poor	☐	☐	☐	☐	☐	☐	☐	Excellent

QD7 - Information about past experiences and history of collaborations passed by others in the institution

In your collaboration environment, what is the information passed by other people regarding past experiences with this person?

	1	2	3	4	5	6	7	
Negative	☐	☐	☐	☐	☐	☐	☐	Positive

QD8 - Your instinct/gut feeling in the situation, or your disposition to trusting

Based on your gut feelings/instincts, how likely are you to trust this person?

	1	2	3	4	5	6	7	
Not likely to trust	☐	☐	☐	☐	☐	☐	☐	Very likely to trust

QD9 - Your own formal training, competencies and abilities

How do your training, competencies and abilities fit in the requirements for the tasks that this person has done in the past? Are you capable/able to perform his/her tasks?

	1	2	3	4	5	6	7	
Poor	☐	☐	☐	☐	☐	☐	☐	Excellent

Figure 13: Sample of the test version of the QTAS.

These research questions were answered in the paper entitled "*Cultural differences in the perception of trust: A comparison between western and eastern populations"* by Morita, Horiguchi, Sawaragi, and Burns (in preparation) in preparation for submission to Computers in Human Behaviour and also presented in Chapter 8. In order to further evaluate the effects of cultural constraints on the formation of a trust state, I conducted cross-cultural comparisons between populations in Canada and Japan. This allowed me to test the effect of cultural differences on the use of trust cues. In order to collect this data, I replicated three of my studies using a Japanese sample, allowing for comparable datasets. I replicated studies 2 and 3 (described in Chapter 6 as part of the development of the QTAS) as I was interested in evaluating how individuals in a Japanese population considered each of the factors and their relative importance for the formation of a trust state. I also replicated the trust token study to look at variations in the use of trust supporting information in electronic environments, such as social networking websites. The results presented in Chapter 8 demonstrate the need to carefully consider culture as an important constraint when designing for cross-cultural virtual teams.

The integration of these research questions and the research areas presented in this chapter are a primer to the contents of this thesis. The different areas of trust and teamwork research explored in this thesis provide a comprehensive presentation of how to better understand, measure, and design for trust. In the next chapters, I will present the development of each of the stages of this research program, as described in Figure 1.

Chapter 4
Development of the Human Factors Interpersonal Trust State Formation Model

4.1 Foreword

I initially identified the need to better understand how environmental cues are perceived during the trust formation process and the perceptual mechanisms involved in this process, so that these could inform the development of trust-fostering techniques. Even considering the existing body of knowledge on trust modeling (Lewicki et al., 2006; Sutcliffe, 2006), there remained a need to more accurately describe the perceptual mechanisms involved in trust formation.

Existing trust models include a component to describe the input of perceived cues, as they correspond to the signalling component of trust (J. D. Lee & See, 2004; Mayer et al., 1995). However, current models do not effectively describe the effect of situational variability on the perception of trust cues (Dirks, 1999; Jarvenpaa et al., 2004; La Guardia & Ryan, 2007; McKnight et al., 1998; Payne & Clark, 2003; Schlenker et al., 1973). These models lack components to describe why the same cue might have different effects in different trusting situations. Situational variability is of core importance for design of interventions intended to foster trust as, without understanding how such variability can impact the perception of trust cues, designers might spend their time and effort targeting interventions that may have little effect on trust.

The second important aspect to describe in my model was the separation between affective- and cognitive-based trust as described by McAllister (1995). Each of these two types of trust has different cognitive shortcuts that influence how cues are perceived and integrated into a trust state (Erdem & Ozen, 2003; Morrow et al., 2004). It is important to consider this differentiation when designing for teams at different stages of development (newly formed teams versus mature teams), as different levels of team development will create different paths for trust formation (Goel & Karri, 2006; Langfred, 2004; Welter & Smallbone, 2006).

The perception mechanisms and the description of separate pathways for calculative confidence and intuitive trust are two of the most important components for the development of a trust model targeted at helping identify effective ways to foster trust behaviour though design, as they provide mechanisms for interpreting how changes in the system can influence trust behaviour.

4.2 Understanding 'Interpersonal Trust' from a Human Factors Perspective: Insights from Situation Awareness and the Lens Model

Morita, P. P., & Burns, C. M. (2014). Understanding "interpersonal trust" from a human factors perspective: Insights from situation awareness and the lens model. *Theoretical Issues in Ergonomics Science*, 15 (1), 88-110.

4.2.1 Overview

Trust has become a hot topic in the academic world in the past few decades. Authors from a variety of fields, especially human factors, have developed field-specific approaches to understanding trust. However, in the field of human factors, researchers usually take the approach of modelling how trust is formed between humans and automation. There is still a gap in the human factors literature with regard to frameworks for supporting the development of sociotechnical systems where interpersonal trust is a desired design output. Through the combination of mainstream trust literature with human factors frameworks such as situation awareness and the lens model, we have developed a model that not only supports the understanding of interpersonal trust formation and the design of systems that foster the development of interpersonal trust, but also fills an existing gap in the trust modelling literature concerning the detailed description of the interpersonal trust state formation process.

4.2.2 Introduction

Interpersonal trust is a vital component of personal and work relationships as trust provides the foundations for accepting the unknown and coping with complexities that are beyond our control, leading to new opportunities to acquire new knowledge and experience (Luhmann, 1979). Trust also plays a vital role in workplace collaborations since it creates an opportunity for different individuals and teams to work together, increasing both their physical and intellectual capability (Dirks & Ferrin, 2001; West, Tjosvold, & Smith, 2003, p. 113). However, understanding what trust really means from the perspective of human factors and the design of user-centred systems that support interpersonal trust is still somewhat undefined even considering the recurrent use of the word 'trust' in our social and personal lives. In this article, we argue that current human factors perspectives, such as Endsley's situation awareness (SA) framework (Endsley et al., 2003) and Brunswik's lens model (Brunswik, 1939, 1952), can offer useful insights into the understanding of trust. Because of their applied goals, human factors perspectives may provide guidance for the design of socio-technical systems where interpersonal trust is a design output.

Workplace environments have become very dynamic, always evolving with changes in work requirements and supporting technology (Brown, Bryson, Forth, & Whitfield, 2012; J. D. Lee & See, 2004; Parasuraman & Riley, 1997). Literature about teamwork and collaboration demonstrates that positive trust behaviour is a strong requirement for successful collaboration and team activities (Axelrod, 1984; Mayer et al., 1995; Reina & Reina, 2007). Trust deeply influences team dynamics and the information flow between individuals, acting as a constraint in team communication, and consequently, representing the bandwidth of the existing channel (Jarvenpaa & Leidner, 1997; Kramer & Tyler, 1996). After reviewing the existing interpersonal trust literature and trust in automation literature, we noticed that the existing body of knowledge is extremely strong when defining which factors influence trust, but still weak when describing how this trust state is built. The majority of the literature focuses on the surrounding constraints that influence trust behaviour, and how the trust levels result in a reliance action. Evidence of this condition can be seen in publications by Lee and See (2004), Mayer et al. (1995) and McKnight et al. (1998), where the trust state formation component is present, but only described by a box in their model.

The importance of the trust formation process comes from the ability to explain the different ways available information about the other party, task, environment or culture can impact trust. This creates an opportunity to develop communication or collaborative systems that can better support the development and maintenance of interpersonal trust. This is an area in which human factors frameworks can offer a substantial contribution.

The trust model we are presenting in this article was designed to explain the development of the state of trust through the integration of the available trust literature with existing human factors frameworks. In particular, we have focused on models of institutional or organisational trust (Section 4.2.3.1), also using contributions from models of trust in automation (Section 4.2.3.4) as these are more relevant to trust in the context of workplace collaborations. We present the rationale behind the development of our trust model as part of Section 4.2.3. In Section 4.2.5, we discuss the development of our model structure by reviewing and incorporating Brunswik's lens model (Brunswik, 1939, 1952) and Endsley's SA framework (Endsley, 1995) into the development of a design-relevant human factors model of interpersonal trust. As a means to showing applicability, a case study is presented with the development of the model.

4.2.3 Existing Approaches to Trust Research

Trust is a well-defined and commonly used construct that permeates the general population's vocabulary and their daily experiences. However, as researchers, we must not be fooled by the deceptive simplicity of the topic. Trust roots go much deeper. Its influence has strong connections with collaboration (Hunter & Pierce, 2010; Reina & Reina, 2007), risk management (Earle, 2010), use of automation (J. D. Lee & See, 2004; Parasuraman & Riley, 1997; Seong et al., 2006), and quite critically, team performance (Costa, Roe, & Taillieu, 2001; Davis, Schoorman, Mayer, & Tan, 2000; Jarvenpaa et al., 2004; Paul & McDaniel, 2004). Throughout the literature, there is a common conclusion: trust is crucial for proper interaction between two entities; including two people, systems, teams or institutions (Bachmann & Zaheer, 2006; Parasuraman & Riley, 1997).

In this study of trust state formation, a few streams of trust research are particularly relevant. Workplace collaborations have some peculiarities, like the dynamic shift from affective to analytic trust as described by Lee and See (2004), which set them apart from the mainstream trust research in close relationships and trust in automation, requiring a different approach to how trust state is formed. In this scenario, we identified four key perspectives on trust that are most relevant: trait and characteristics-based models of trust (Section 4.2.3.1), trust as intuitive or calculative (Section 4.2.3.2), trust as risk (Section 4.2.3.3) and trust in automation (Section 4.2.3.4). Each of these perspectives will contribute to the development of certain components of the model.

4.2.3.1 Trait and Characteristic-Based Models of Trust

Authors like Gambetta (1988), Mayer et al. (1995), McKnight et al. (1998), Knoll and Gill (2011), among several others, describe interpersonal trust as the composition of a range of traits and characteristics that define the trusting individual (trustor), the individual being trusted (trustee) and the situation. These trust influencing factors are situational and actor specific. Different combinations of these factors, when combined and integrated, compose specific trust scenarios with many possible outcomes. Some are representative of the actors and can move laterally to other trust interactions that they are involved with, like trustor's tendency or propensity to trust for example (Mayer et al., 1995); others are situation specific and will change according to the type of trust interaction and actors involved, like trustee's characteristics like benevolence or competence (McKnight et al., 1998). Some examples of traits and characteristics of the person being trusted include, but are not limited to: benevolence, integrity, abilities, trusting propensity, risk perception, honesty, predictability, etc. Numerous publications list the several factors that influence trust (Bachmann & Zaheer, 2006;

Jarvenpaa & Leidner, 1997; J. D. Lee & See, 2004; Mayer et al., 1995; McKnight et al., 1998; Nooteboom, 2002; Six, 2005; Spector & Jones, 2004), which are generally called antecedents or regulating factors.

Mayer et al. (1995) present an evolutionary model for trust focusing on antecedent signalling and trust evolution. Following their work, we find that of McKnight et al. (1998) where they present a non-evolutionary model for initial trust formation also focused on a signalling perspective. Later, Wildman et al. (2009) expands both approaches into a model that explains the formation of swift trust. However, in this available literature, there are no formal models about the steps used to integrate these variables into a trust state, nor regarding the different influences that each stage of trust development can have on trust (Kramer & Tyler, 1996; Nooteboom, 2002; Six, 2005). The question that remains is: 'How is that trust state formed?' The model we are presenting in this article will help answer that question.

4.2.3.2 Trust as Intuitive or Calculative

Other trust research differentiates between types of trust. In some, trust is defined as intuitive, guttural and is said to rely little on regulating factors and instead depends highly on previous experiences (Guth & Kliemt, 1994; Lahno, 1995; Six, 2005). This approach to trust is mainly affective based (J. D. Lee & See, 2004) and requires the development of a relationship between the parties, being signalled by the evolution of the experiences as well described by Lahno in his mathematical model (Lahno, 1995). Such evolutionary trust is dominant in long relationships where the parties are well acquainted and frequent trust exchange exists between them.

The other stream describes trust as a calculative process in which an individual evaluates a series of traits and characteristics to build his opinion about the other as presented in Section 4.2.3.1. This analytical view of trust is well described by numerous authors as a cognitive–integrative process where a large range of factors act on the development of the trust formation and the trust decision. This differentiation is mostly clear in McAllister's (1995), in which he presents these two approaches as affect-based trust and cognition-based trust, respectively.

Lee and See (2004) also describe this difference, presenting it as analytical and analogical components of trust. Analytical and analogical trust processes explain trusting by analysing the antecedents, integrating into a mental model and composing a decision. Analogical processes occur specifically when trust is determined by association rather than by direct experience or direct perception of a certain trait or characteristic of the trustee. However, despite indicating these different types of trust, Lee and See did not differentiate between these processes in their model of trust. We understand that these two processes of trust come from significantly different cognitive processes and therefore should be distinguished in a model of interpersonal trust. In our model, we are proposing two distinct streams of trust development, one for calculative confidence and other for intuitive trust. From Lee and See's article, we are integrating both the analytical and the analogical processes of trust into one and referring to them as calculative confidence as we believe these to be similar cognitive processes. In contrast, affective trust is a significantly different process. Calculative confidence and intuitive trust are both involved in all trust decisions with varying degrees of influence, and over time, calculative confidence can evolve to intuitive trust (J. D. Lee & See, 2004). In our own research, a study we conducted on a pool of 200 university students and industry representatives found that 46% of the participants considered trust in workplace as a guttural process while the remaining 54% of the participants considered it calculative. Consequently, including the two streams of calculative confidence and intuitive trust is clearly important in any model of interpersonal trust.

4.2.3.3 Trust as Risk

One of the most accepted perspectives on trust is that trust is related to risk acceptance where someone accepts risks by trusting in exchange for some benefit. The most used definitions of trust include that of Luhmann in which he describes trust as a gamble, 'a risky investment', a tool whose objective is to reduce the 'uncontrollable complexity' of the system or the interaction by the acceptance of a certain level of risk in exchange for the benefits of the interaction (Luhmann, 1979). Another similar definition is that of Rousseau et al. (1998), in which they interpret trust as risk taking in a social interaction or accepting vulnerability based on expectations of the outcome of the relation. Similar approaches can be seen from Gambetta (1988), Jøsang and Presti (Jøsang & Presti, 2004), and Das and Teng (2004). This approach is considered one of the bases for trusting, and consequently, need to be added into our model through the incorporation of a risk projection component in which the resulting mental model (Castelfranchi & Falcone, 2000) will be used to project risks and benefits to form a trust state or trust level.

4.2.3.4 Trust in Automation

Traditionally, human factors research on trust has focused on the trust of automated agents. Publications go back to Lee and Moray (1992), Muir (1994) and Parasuraman and Riley (1997), in which trust in automation is described from different perspectives. Parasuraman and Riley (1997) approach trust in automation as one of the factors that can influence use, misuse and abuse of automated systems. Bisantz and Seong (2001) presented a study showing how different faults in the automation system can impact trust in the automation. In a similar approach, Seong and Bisantz (2008) have used the lens model to evaluate how meta-information about automation, when presented to the operator, can influence trust by increasing their understanding of the system. Seong et al. (Seong et al., 2006) used the lens model again, now as tool to create a framework that helps understand and measure the user's reliance on an automated system. Other approaches to trust in automation include that of Madhavan et al. (2006), where they evaluate the different impacts of failures and errors on trust in automation for tasks of different levels of complexity for the operator.

Although not in the interpersonal trust field, one of the most influential models of trust in automation comes from Lee and See (2004). They present the behavioural process involved in trusting an automated system with a model based on an evolutionary perspective in which more experience leads to more reliance on the automation. Furthermore, they describe how trust can be calibrated or tuned over time, showing how trust can evolve to be well calibrated with reliability. One could argue at this point that their model could be directly ported over to interpersonal trust. However, Lee and See (2004) also discuss the differences between the processes and why a direct transfer is not possible. Some examples are cited several times in this article and include: lack of social exchange (Deutsch, 1960a) and intentionality in trust in automation, and differences of cognitive processes, just to cite a few. Gao et al. (2006) present a quantitative model of cooperation with an evolutionary approach where they discuss how reliance on automation influences inter-human cooperation. However, through their model we are unable to differentiate between affective, analytic and analogic processes and also lack description of how the 'stimulus' or antecedents can differently influence trust.

In interpersonal situations, where the underlying reliability may be variable or unknown, a more detailed model of how trust can be formed is certainly useful. As well, we believe that the processes of calculative and intuitive trust are distinctly different and should be included in a model of interpersonal trust formation. In particular, intuitive trust plays a strong role in interpersonal trust state formation.

4.2.4 Human Factors Frameworks Relevant for Model Development

Two human factors frameworks were identified as potentially good foundations for developing a human factors model of interpersonal trust: Endsley's SA framework (Endsley et al., 2003; Endsley, 1995) and Brunswik's lens model (Brunswik, 1939, 1952). The SA model provides an explanation of how trust can be formed in a new situation by helping to explain the steps of the trust state formation process. Brunswik's lens model has already been extensively used for the study and modelling of trust in automation, as described in the previous section (Seong et al., 2006; Seong & Bisantz, 2001, 2008) and we see this model as providing a good basis for understanding how the antecedents of trust are perceived and evaluated.

Brunswik's lens model yields strong cue sets as well as correlations between perception and reality. The SA framework explains awareness in terms of requirements for perception, understanding and projection: three levels of requirements that also have relevance in explaining trust. These models are explained in more detail below.

4.2.4.1 Situation Awareness

The SA framework, developed by Endsley (Endsley et al., 2003; Endsley, 1995), is a framework that describes the process by which an individual develops a full awareness of their situation. This awareness is built as the individual perceives, comprehends and projects knowledge of the environment into future actions and decisions. Similarly, trust is commonly represented by the integration of information that is available for the formation of a decision in a specific situation.

Endsley breaks down the SA process into three distinct levels, each with different functions and effects on the overall awareness:

- **Level 1 – perception:** This level describes how people perceive goal-relevant elements of the environment within the restrictions of known space and period of time. This stage encompasses the perception mechanisms used by the individuals as well as the limitations and difficulties with the perception of elements, representing the data acquisition component of the model. Perception mechanisms also play an important role on the trait and characteristic-based models of trust presented in Section 4.2.3.1. The information about the person being assessed is only relevant and will only influence the development of a trust state if properly perceived.
- **Level 2 – comprehension:** This level describes how people process the information collected in Level 1 to gain an awareness of the current situation. With Level 2 SA, people understand

how the current situation will impact their goals and objectives. At this stage, individuals integrate the information collected in the previous SA level into a mental model (Rouse & Morris, 1986) of the task that includes the perceived information from the environment and the regulatory variables. In the formation of the trust state, the information provided by the perceived traits and characteristics also result in the composition of a mental model (Castelfranchi & Falcone, 2000).

- **Level 3 – projection:** This level focuses on how people can predict future events and actions in their environment. To achieve this performance, people must already have appropriate Levels 1 and 2 SA, and, through knowledge of the dynamics of their world, they can extrapolate from the existing information to predict future states and future courses of action. The trust frameworks presented in Section 4.2.3.3 describe trust as highly reliant in the assessment of risks in order to form a trust decision. One of the approaches in risk assessment that is used by these authors is that of a projection of risks of a certain decision into future action to properly assess the balance between risks and benefits in a trust decision.

When people have good and appropriate SA, they operate effectively in their environments, properly interpreting information and taking necessary actions to prevent future problems. When people have inadequate SA, they may misunderstand the state of the system or inappropriately predict future events (Endsley et al., 2003; Endsley, 1995; Morita & Burns, 2011).

The SA model includes inputs as regulating variables such as mental models, goals, objectives, expectations and knowledge about the system. These internal and external factors are important when analysing a task since they provide input points that allow differentiation between situations, tasks and actors. Trust is also a state that relies on the assessment of various antecedents and regulating factors, and in this way, the development of trust has analogues to the development of SA. According to how the perception of trust is shaped and the pieces of information that are available, a certain level of trust about the person being trusted will be formed.

This framework seemed well suited to understanding trust since trust is also a state. Similar to SA, trust can be high or low, appropriate or inappropriate. Trust is formed by perceptions of the social environment, understanding of risks and an expectation or projection of another's future actions. In this sense, operationally, trust has some similarities to SA. When people trust, they are working in a world of uncertainty. They may have perceptions that are well calibrated with reality, or misperceptions of trust. Due to this uncertainty, there is no perfect representation of the factors that represent trust, and consequently, no level of trust exactly adjusted to the reality. While the SA framework discusses a similar approach regarding the formation of a SA state in Chapter 7 of Endsley's book (Endsley et al., 2003), given that each antecedent will have different levels of associated uncertainty, it seemed that additional concepts in this area that support different levels of uncertainty for different cues would be useful. For this reason, we have supplemented the SA framework by using another theoretical model, the lens model by Egon Brunswik (Brunswik, 1939, 1952).

4.2.4.2 Lens Model

The lens model, first developed by Egon Brunswik (Brunswik, 1939, 1952), and further developed by the work of Kenneth Hammond (Connolly, Arkes, & Hammond, 2000), presents a descriptive model in which an individual perceives the world through a series of cues representing the environment surrounding him. Each cue is followed by a pair of weights: one weighting the internal state and other weighting the external state. Through the integration of the several cues, one creates a representation of the world based on the information perceived through these 'lenses'.

The internal weightings of each cue represent the extent to which those cues are used in the composition of the individual's representation of the world, how important they are for that particular actor, and how they influence the decision. Internal weights are dependent on the individual's cognition, representing the influence of each particular cue in the trust state formation process, as well as the individuality of each actor on the representation of the environment. Different individuals can apply different internal weights to a same cue.

On the other side, the external weights provide information about how accurately those cues represent the task being performed or one particular characteristic of the environment. External weights characterise the uncertainty behind each one of the cues, when ideally they should provide a perfect representation. These are hardwired to the environment and can impact the perception of multiple actors simultaneously. This model is shown in Figure 14.

In each perceptual situation, the cues are integrated into a mental representation of the uncertain world being presented. Each of the cues is integrated into an overall model that provides perceptual information (Connolly et al., 2000). A strong connection with SA Level 1 and SA Level 2 can be seen at this point, in which both frameworks present similar ways of approaching environment perception and integration into an internal representation that will shape the decision, while constrained by the uncertainty in the perception and the formation of the mental model (Endsley et al., 2003, Chapter 7).

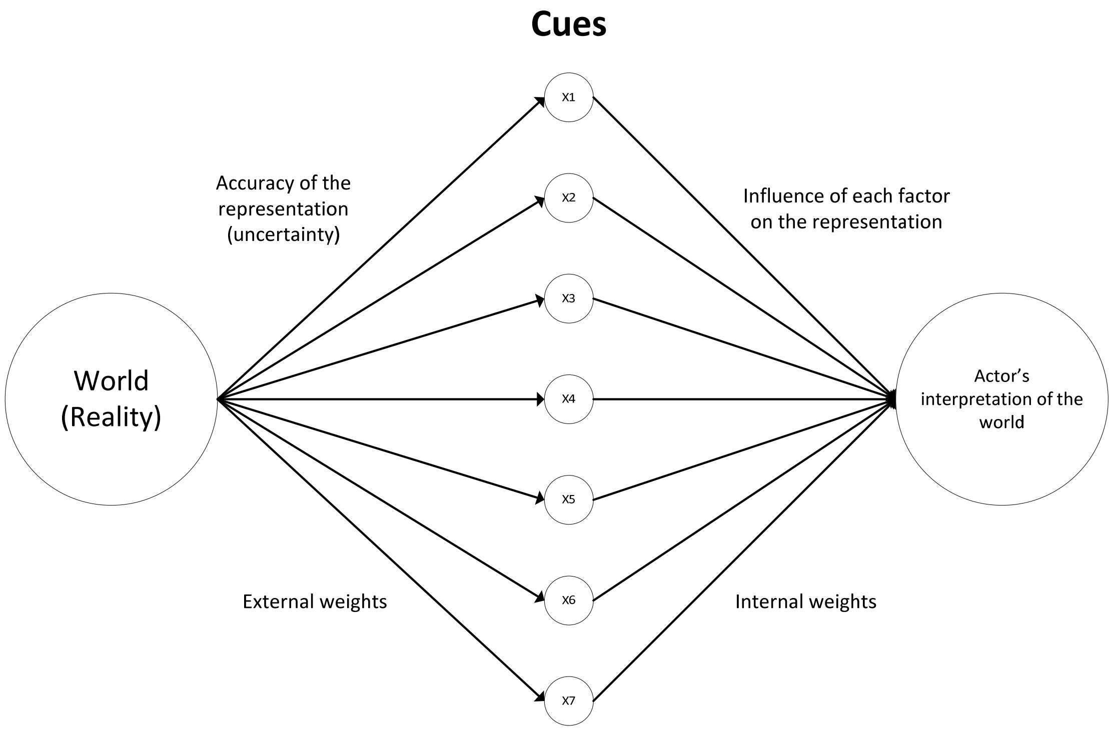


Figure 14: Lens model representation showing the influence of both internal and external weighting mechanisms on the interpretation of the world.

Similarly to the lens model, each trust regulating factor is influenced by two constraints: how accurately each of the trust regulating factors represents the situation and the other actors, as well as the level of influence of that particular factor on the development of a representation of the trustee on the mental model. The first constraint is external to the trust cognition and is not actor dependent, while the second is specific to each actor's cognitive process.

The strength of the lens model over the SA framework for the development of our interpersonal trust model lies on the 'multi-variable' or 'multi-cue' approach, in which the lens model allows the differentiation on the perception mechanism of the two trust streams, allowing the same cue to have separate effects on the different streams and to explain the different effects a regulating factor can have. Through the availability of internal and the external weights, it will be possible to explain how multiple factors are integrated and present the ability to explicitly look at the mismatch between cues and the environment. Another great advantage is the ability to calibrate the levels of trust on an individual level (through the internal weights) and a global level (through the external weights).

4.2.5 The Human Factors Interpersonal Trust State Formation Model

After reviewing the necessary trust literature and providing evidence of the need for the development of a trust model that describes the formation process of a trust state in Section 4.2.3, we now present the development of our human factors interpersonal trust state formation model.

A comprehensive approach to interpersonal trust allows a distributed analysis of the trust factors and the trust state development process via a detailed representation of the trust cognitive processes that allows each of the regulating variables to be weighted differently for intuitive trust or calculative confidence. Our model is composed of three main sections: a cognitive component that describes the formation of the trust state, the decision mechanisms that lead to the trust decision and subsequent performance and the extraneous influences to the trust process that are mainly composed of the large array of antecedents extensively described in the literature.

In order to facilitate the understanding and increase the validity of our model, we will present a sample scenario along the development of our model. This scenario will serve as an opportunity to exemplify the usage and benefits of our publication. In this scenario, we will use a student competition team as an example, in which we will evaluate a condition of over trusting that can lead to catastrophic consequences (Langfred, 2004). This scenario represents a real situation; however, names and type of project have been changed to maintain the anonymity of the groups. These data were collected through approximately 60 h of observation of multiple student teams, where we observed trust-related interactions. During the development of our model, we will discuss how each component plays into the development of this new team's trust. The letters within parentheses represent the antecedents or influencing factors and are also highlighted in Table 1.

Scenario – Introduction

Universities often support student teams, which can range from simple design teams with pure academic objectives like a final year graduation project, to more organised and complex competition teams. For our example, we will consider a recently formed team taking part in an annual competition for the development of an autonomous vehicle that can drive miles without *any human input. In the previous editions of the competition, a different group of people represented the university and only a single member has continued on the team. The relevant characteristics of the new group that will influence trust formation include:*

(a) The new team lead and most of the technical sub-team leads are new to the group.

(b) There was no support to the new members informing them of their roles, responsibilities, required knowledge and general instructions of team functionality.

(c) They already had a prototype underway that was developed in the previous year and it was their responsibility to complete that prototype and succeed in the competition.

(d) Technical leads (individuals who manage the work of each technical sub-teams – controls, engine, power, visual system) were mostly selected based on their personal friendship with the team leader.

(e) The only past member that continued with the group after the transition was assigned a critical sub-team based on his existing experience with the team.

(f) Previous years of the competition were extremely successful, with numerous awards and recognitions to the team.

(g) The team lead cannot micromanage all the technical sub-teams, consequently requiring him to trust each technical lead in the successful development of their component.

This example was prepared from the perspective of the team lead and all diagrams are based on his perception of other team members. Table 1 contains the factors that influence each type of trust decision described in this scenario.

4.2.5.1 Trust Formation Component

The representation of the trust state formation process as a component or a box in the models presented in Section 4.2.3 is offset by descriptive authors like Lahno (2001), Kramer and Tyler (Kramer & Tyler, 1996), Bachmann and Zaheer (2006) and Nooteboom (2002). These last authors provide detailed written descriptions of the trust process, as well as how different types of trust play into the overall decision. The contributions from these authors have an important role in the design of our model, serving as a validation for the structures that we developed. A model of trust state formation will elevate the existing trust literature by providing a detailed formative process that can actually explain the steps that lead to the formation of a trust state. In alignment with what was presented in Section 4.2.3.2, the cognitive component of our model consists of two paths that allow the differentiation between the two types of trust: the intuitive path and the calculative path. This distinction is necessary because not only is each stream regulated by different antecedents at different levels of influence on the trust state formation, but also due to the fact that the formation process is distinct for each path. Lee and See (2004, p. 74) also argue in favour of this separation as '*Recent neurological evidence suggests the existence of structurally separate pathways for affective and analytic responses…*'.

In both cases, we used the SA framework to create the overall structure that develops into the trust state. Essentially, in the case of intuitive trust, people move directly from perception of characteristics and traits to projection of the risks of the interaction. The absence of a calculative state in intuitive trust is in accordance with results found by Rempel et al. (1985) in which trust is defined as a very guttural process, with low cognitive demand, since the trust decision in this case is mostly defined by the relationship building process. Such a type of trust is commonly described as affective trust (Morrow et al., 2004) and composes the larger number of trust processes in close relationships (Rotter, 1967).

In contrast, for calculative confidence, there is an intermediate assessment step in which perceived antecedents and trust regulating factors are integrated in the context of the situation to build a deeper understanding about the person being trusted and the situation in which both actors are inserted into. Numerous authors have discussed that the integration of the available information towards a trust decision is cognitively demanding: Lee and See (2004) for trust in automation, McKnight et al. (1998) and Mayer et al. (1995) for organisational trust and Nooteboom (2002) for generic trust relationships. The acquired information is compiled into a mental model (Castelfranchi & Falcone, 2000) that is used as a basis to perform comparisons between reality and the trustor's expectation. This mental model also supports the projection of the future of the interpersonal interaction and the evaluation of the risks that will be accepted when trusting. The flow of the model can be seen in Figure 15.

Each separate stream has to include perception mechanisms to account for the information acquisition process that will allow antecedents and information to feed into the trust state formation. Perception mechanisms represent one of the main components of the model and a strong opportunity to contribute to the design of systems that properly support the necessary interpersonal trust for the performance of a collaborative task. Perception has been deemed a key component in interpersonal trust as shown by Six et al. (2010), Rempel et al. (1985), Jarvenpaa et al. (1997) and Lee and See (2004), since information will only influence the decision if properly perceived (Six et al., 2010).

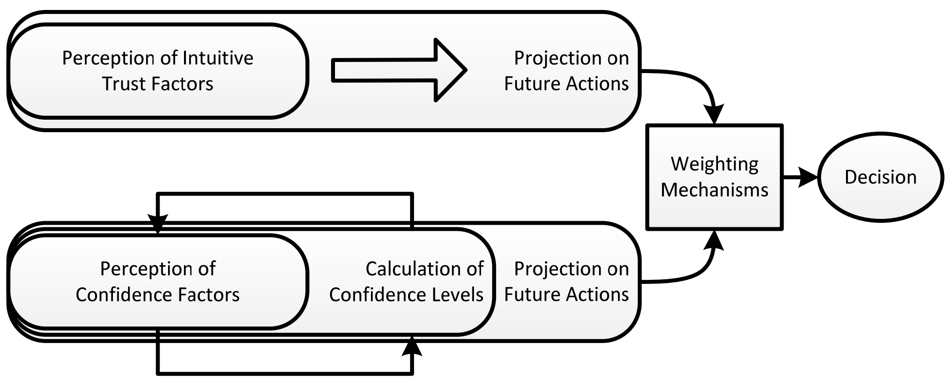


Figure 15: Trust state formation component of the human factors model of interpersonal trust.

Endsley's SA model was built for complex dynamic environments where interpreting the situation and making a decision is the top priority. In environments where trust is critical, however, there can be complexities that arise from incomplete information or perhaps misinformation. Brunswik's lens model (Brunswik, 1939, 1952) provides a way of understanding this aspect of trust and how each piece of information will influence the trust decision, allowing a balanced integration of antecedents that fit the characteristics of the type of trust being assessed.

Each of the trust factors is perceived as a cue representing part of the environment or situation, and, similar to the lens model, will help construct a mental model or internal representation of the situation (Brunswik, 1939, 1952; Castelfranchi & Falcone, 2000). Cues will be seen through a lens that has a limited representativeness of reality, which greatly fits into the uncertainty of trust. Each of the factors will be evaluated internally by the trustor based on two sets of constraints: how well the factors actually represent the trustee and the situation, which are the external weights of the lens model and the internal constraints that define the importance of that cue in the composition of the mental model of trust (Castelfranchi & Falcone, 2000), which are the internal weights of the lens model.

The external component of the weighing mechanism is influenced by how the information is conveyed and how it is available for perception in the institution or environment. Sutcliffe (2006), Lee and See (2004), Nooteboom (2002) and Six et al. (2010) discuss how the availability of information will impact the trust formation process and how they can be misrepresented according to characteristics of the environment or systems being used, which is similar to the uncertainty in Endsley's SA model (Endsley et al., 2003, Chapter 7).

Internal constraints, on the other hand, will influence the importance of a factor when making a decision to trust. The importance of each variable will be shaped by constraints, such as previous experiences, the environment and the institutional culture. However, the constraints are limited to each person's trust cognition. This approach has been demonstrated by Sutcliffe (2006) in the mathematical component of his article and discussed by Lee and See (2004) and Doney et al. (Doney, Cannon, & Mullen, 1998).

A graphical visualisation of the perception mechanisms described above can be seen in Figure 16. Information available will play in the perception stage, serving either as perceived information that will be analysed through the aforementioned lenses, or as a constraint on how much relevance is given to that piece of information.

Previous negative experiences with other team members might reduce the relevance of specific pieces of information if, in the past, a trust decision based on that information did not result in positive outcomes. For example, one may have trusted based on a colleague's recommendation and it resulted in a bad experience. In a similar future situation, the person trusting will carefully consider if he/she should trust someone based on recommendations by team members. The negative past experience resulted in a reduction of the internal weight applied to all recommendations coming from team members.

Scenario – Perception

The first type of trust (Type 1 – intuitive trust) is demonstrated by the team lead and one of his friends that is in the role of the engine technical lead (d). For this type of trust, the existing relationship (d) and previous technical experiences in other situations (h) are the main influencing factors (constraints) on the trust decision. The team lead assumed that the performance of his friend would be similar to what he had seen in the past in other tasks and projects (h) using existing the mental models he already has formed in his mind. Since the team *lead was not informed of the required skills for the technical lead positions (b), he trusted his friend to be a competent technical lead without knowing if he had the necessary skills. In this example, this lack of proper information about the technical lead job requirements (b) (Table 1) is acting as an influencing factor.*

The second type of trust is formed between the team lead and the controls technical lead. The trust in this situation (Type 2 – calculative confidence) is governed by analytic and analogical components. Since there is no previous relationship between the team lead and the controls technical lead, the team lead does not have a mental model of this relationship already formed. In this case, he assumes that since his controls technical lead already has experience with the team (e), he will be capable of properly delivering his component (analogical processes). This was reinforced by the past successes of the team (f), and existing power differences between the two individuals (j) generated by the team lead being less experienced than the controls technical lead (past team member) in regards to the team's project and dynamics. The risk in this situation is that the team lead is assuming capability based on the technical lead's previous associations using analogic processes. The team lead may be overlooking the controls technical lead's real skills and capabilities. Trust by association, or analogical processes, have high levels of uncertainty associated with them since decisions are merely based on assumptions. For the purpose of this example, we are presenting the existing association with the group (e) as a perceived antecedent; and the inexperience (a), lack of knowledge transfer (b), past successes (f), and the power differences (j) as constraints that drove the internal weighting of the 'existing association' to higher levels even considering the existing risks (c)(g). This is a case of calculative confidence strongly constrained by a large number of factors. As previously discussed, analogical processes are included in the calculative confidence stream due to their cognitive demand required to process the existing association. It is still a comparative process that results in a highly uncertain mental model of the individual.

This information is presented in Table 1, with factors organised by relationship type (intuitive trust and calculative confidence) and type of influence (perceived factor or constraint).

After the perception stage, the cognitive process for confidence would go through the calculation phase. Factors that were perceived and weighted are integrated into a mental model that will be used in the risk projection stage (Castelfranchi & Falcone, 2000). Each factor can have different levels of control on the mental model based on how well that information is presented and how much influence that information will have on the cognitive process. Such influence will be defined by the weights of each cue on the perception process (Sutcliffe, 2006) and will compose a weighted score that corresponds to the trust levels. Integrative approaches are also described by Mayer et al. (1995), where antecedents are integrated to compose a trust decision.

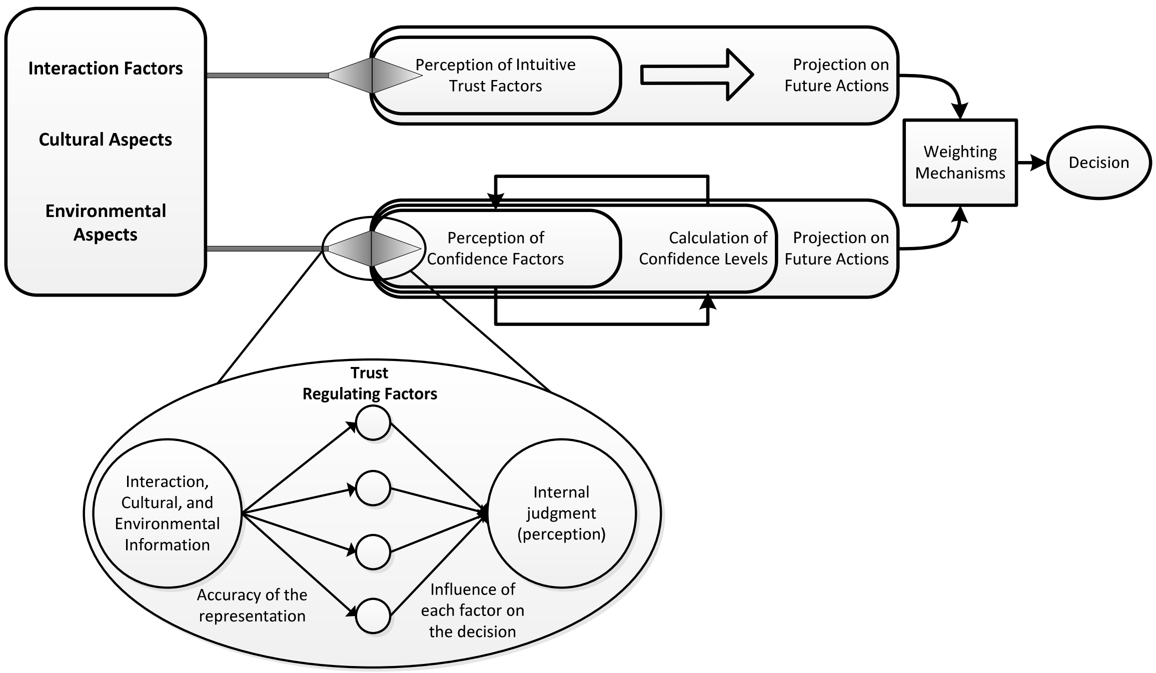


Figure 16: Breakdown of the perception mechanisms. The mechanisms provided above are the same for intuitive trust and calculative confidence. We are only showing one of them in the diagram to reduce cluttering.

Lee and See's (2004) article describes the higher cognitive load of analytic processes in comparison to analogic processes in trust development. We argue here that the affective processes, which are present in the intuitive trust stream, are even lower in cognitive load for being represented by trust formed over time, using a smaller number of perceived antecedents, and an already formed mental model of the person being trusted. As well described by Lee and See (2004, p. 62): 'Knowledge-based or analytic processes are probably complemented by less cognitively demanding processes. A less cognitively demanding process is for trust to develop according to analogical judgments that link levels of trust to characteristics of the agent and environmental context'. This argument is in alignment with our expectations and development of the streams of trust in our model. Here we acknowledge the insertion of analogical trust in the calculative component alongside analytical processes and argue that analogical processes are still more cognitively demanding than affective processes since analogical processes will still require some assessment and integration of information.

Table 1: Organization of antecedents or regulating factors by type of trust and type of influence on the trust state formation.

	Trust type	
Influence type	**Intuitive trust (Type 1)**	**Calculative confidence (Type 2)**
Perceived factors (externally weighted)		(e) Existing team member skills are expected to be high considering his past involvement with the team
Constraints (influencing factors of internal weights)	(b) Absence of knowledge transfer about the team and required skills from previous years (c) Responsibility for team's success (d) Past history (friendship) between team lead and his friends (g) Each sub-team must deliver to achieve team's success (h) Past performance of team lead's friends in distinct tasks (i) A certain level of skills is assumed from previous experiences with his friends	(a) Team lead is aware of his inexperience (b) Absence of knowledge transfer from previous years about the team and required skills (c) Responsibility for team's success (f) Past success from previous university team in this competition (g) Each sub-team must deliver to achieve team's success (j) Power differences between team lead and existing team member

Due to the low cognitive demand of the affective trust processes, intuitive trust does not require a calculation stage. Since we are developing an integrated model with two streams, and that trust evolves from being analytical and analogical (calculative confidence) to being affective (intuitive trust) with the development of relationships (Kramer & Tyler, 1996; J. D. Lee & See, 2004); at the stage in which intuitive trust processes are activated, the mental models developed in the calculative processes can be directly used to base one's judgement of trust. At this point, antecedents and factors that were perceived will be compared against the mental model to project the future of the relationship (Castelfranchi & Falcone, 2000).

This combination of the two trust streams shown in Figure 15 and Figure 16 allows the integration of distinct kinds of trust into one single model, which is highly relevant for workplace collaborations considering that both play important roles in the trust decision process (Nooteboom, 2002). We can assume, based on the literature, that calculative confidence is more situational than intuitive trust. We also argue that the calculation stage, as represented by Sutcliffe (2006), is where an integration of the antecedents through the cues allows a mental model to be formed through an integrative approach. We acknowledge that the process might be too simplistic, but it is a starting point for the development of more advanced integrative descriptions of mental model formation in trust.

Scenario – Calculation

At this point in the evolution of the trust state, the team lead will have distinct processes for each of the types of trust. Intuitive trust (Type 1) will be mainly regulated by the existing mental model that the team lead has of his friends. This mental model was constructed over the years of experience they have had together and the team lead is assuming that their performance would be similar. Had he had access to some information about the requirements for each position in the team, he would have been able to recalibrate the mental models through the calculative confidence processes. The formation of calculative confidence (Type 2) will follow a different path considering that there is no existing mental model formed. The cues available for the team lead provide a limited representation of the reality which consequently resulted in biased mental model of the controls technical lead in which there is a high level of trust, with total unawareness of capabilities and skills.

Figure 17 integrates the information from Table 1 into a visual representation of the perception mechanisms. We will only present the diagrams for calculative confidence (Type 2) for this scenario since it will provide a more detailed representation of the perception mechanisms.

The last step in the cognitive pathway is the projection stage, in which the mental model is used to create a representation of future actions and expected behaviour that are compared to the benefits of trusting the individual. This approach was derived from many of the studies presented in Section

4.2.3.3 of this article where trust is described as a risk assessment process, in which the trustor uses the available information in the form of a mental model to project the risks of the trusting behaviour (Castelfranchi & Falcone, 2000). This approach is in accordance to arguments from Jøsang and Presti (Jøsang & Presti, 2004), Das and Teng (2004) and Lee and See (2004) that trusting is evaluating and accepting risks in exchange for some benefit (Deutsch, 1960a). This approach represents the uncertainty of behaviour or projection as described by Endsley et al. (2003, Chapter 7). In order to properly evaluate their trust levels, individuals need to be aware of the uncertainty of their projections (how accurate they can be) and the high uncertainty of human behaviour.

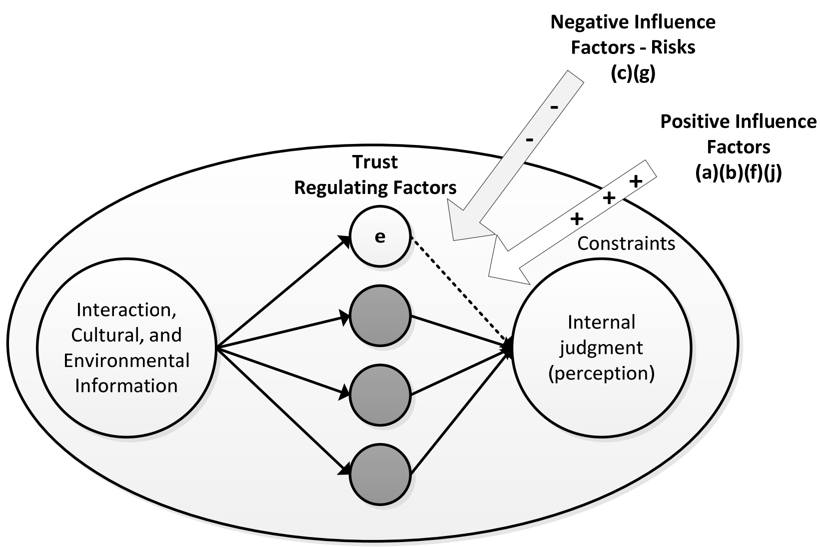


Figure 17: Description of the perception process in the simulated scenario. Each factor number corresponds to those presented in Table 1.

Risk projection will be the component of our model which can explain, for example, why even in situations where one person considers generally trusting another person, their risk assessment of the situation can lead them into not trusting that individual at that specific event (Kramer, 1999). This characteristic showcases the situational aspect of trust and the relationship that trust has with dependence, where the risk can be mapped to the uncertainty of the other individual to perform as expected and the dependability of the trustor in that situation (Kramer, 1999).

The projection stage acts as the output of the trust state formation process. The risk evaluation at this point can be either a decision based on a threshold where the decision to trust is achieved if the benefits surpass the consequences (Jøsang & Presti, 2004); or a second process argued in this article where a pattern matching process (similar to pattern matching schemas) would allow that the risk assessment be compared to other experiences of the trustor to formulate a trust state (a more analogic process). This risk assessment approach encompasses the opportunity to explain why the same mental model representing the same individual can be applied for different tasks and results in different trusting behaviours. Task, environmental and cultural factors can constrain the risk projection, changing the trust outcome for different situations.

Each of the intuitive trust and calculative confidence will feed their influences into the weighting mechanisms, which integrates both types of trust into the decision. This component plays an important role in our model because it explains why one stream of trust might surpass the other. For example, situations where the confidence evaluation led to a low level of confidence might be overcome by a strong bond or relationship with the trusted individual. The consequences to such events might be catastrophic if the trusted individual does not have the proper qualifications for the task.

Scenario – Projection

In the last stage of the trust state formation, the mental model is already formed. The team lead has now integrated the antecedents and been constrained by some regulating factors to form a mental model of the controls technical lead. Although the trust in his friends (Type 1) and in the controls technical lead (Type 2) followed a different stream until now, the projection processes will be similar. In both cases, the mental model was driven towards the formation of a representation of a capable team member, one that would be able to lead the sub-team towards the completion of the deliverables. In the case of trust in his friends (Type 1), the team lead uses analogic processes to project the performance, mirroring on what he has seen in the past regarding his friends' performance. In trusting the controls technical lead, the lack of information available and the power differences drive the trust threshold to lower levels, which result in the team lead trusting even without proper information about the controls technical lead.

In both these cases, the team lead is at risk of having made poor decisions in assigning roles, as he was influenced by affective responses with friends or on power differences with the existing *member. No proper information regarding skills and capabilities that are needed for the task were used in the process, resulting in cases of overtrust and under-evaluation of technical skills.*

The final step in the development of the model is the addition of regulating factors as well as a pathway from decision-making to task performance. Regulating factors will act simultaneously as perceptual variables and constraints to the cognitive process. The complete model can be seen in Figure 18.

There is an underlying similarity with existing models for trust in automation by Lee and See (2004), with the addition of the trust state formation process for the more dynamic interpersonal trust. The presence of intuitive trust and calculative confidence, similar to affect-based trust and cognition-based trust by McAllister (1995) and Chowdhury (2005), led the development into a more perceptual domain that could explain the differences between these two types of trust formation.

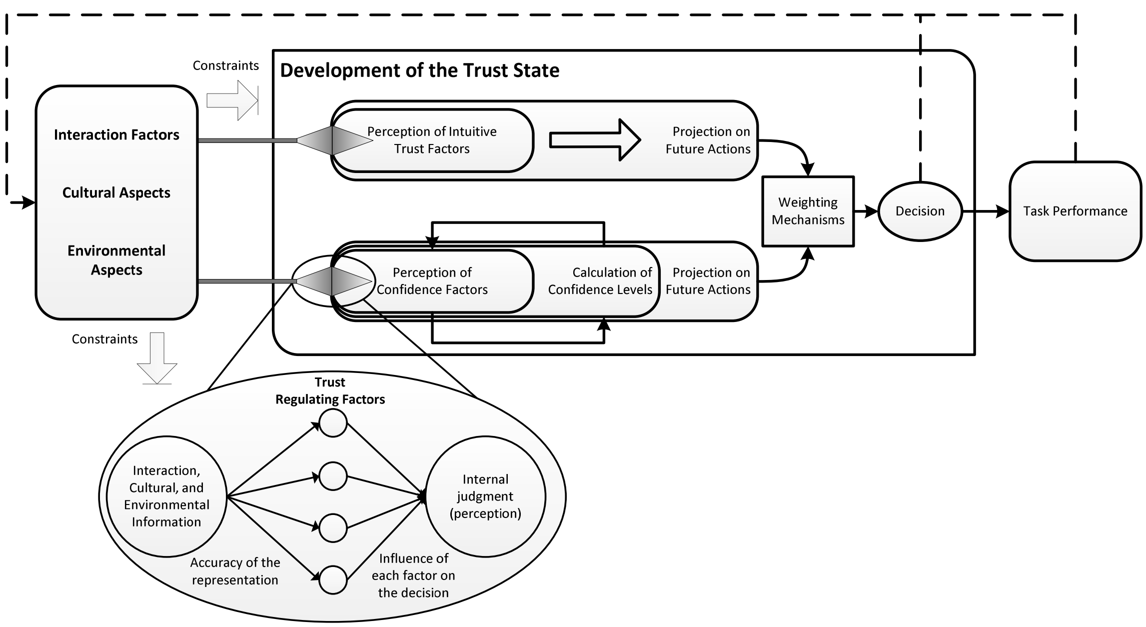


Figure 18: Complete human factors model of interpersonal trust including trust state formation component, performance component and regulating factors component.

4.2.5.2 Performance Component

The trust decision will result in one of two behaviours in the interaction: individual performance in the task without trusting the other party, or acceptance of imposed risks which will result in positive collaboration between the parties. Our model does not place significant emphasis on this component considering that it is already extensively presented by Mayer et al. (1995) and Lee and See (2004).

Trust can assume one of many levels but the decision is based on a threshold in which the one individual will make a binary decision of trusting another. One important clarification here is that although the decision is binary, we must remember that the trust levels are not. Considering that the trust process is described as a cycle (J. D. Lee & See, 2004; Mayer et al., 1995; Sutcliffe, 2006), a lower level of trust today will impact how trust is processed in the future.

4.2.5.3 Regulating Factors Component

Trust is strongly regulated by a large array of factors that will shape the decision, as presented by the numerous models covered in Section 4.2.3.1. Every trust publication covered in this study refers to factors that can influence the cognitive process and the trust decision. We will not explicitly list all the possible factors, but instead aggregate them into three main groups that represent the types of influence that can be present in workplace collaborations:

- **Interaction factors –** all regulating factors grouped here represent the person being trusted and the experiences of the trusting individual. These are the traits covered by authors in Section 4.2.3.1 that showcase characteristics and antecedents of the person being trusted and representing one of the main targets for trust fostering. Examples of these factors include, but are not limited to: benevolence, integrity, training and expertise (Knoll & Gill, 2011; Kramer & Tyler, 1996; Mayer et al., 1995; McKnight et al., 1998; Moorman, Deshpande, & Zaltman, 1993; Nooteboom, 2002; Six, 2005).

- **Environmental aspects –** factors that represent the physical environment as well as task characteristics. Influences from these factors go beyond perception since most will play important roles acting as constraints to the cognitive process. An example would be a teaching environment which is not consciously perceived as a trust fostering environment, but deeply influences how certain pieces of information will affect the decision. Even in cases where the confidence calculation would not reach the threshold for deciding to trust, one might still accept the risk for teaching purposes (Bachmann & Zaheer, 2006; J. D. Lee & See, 2004).

- **Cultural aspects –** factors in this group represent all the underlying cultural factors that can affect trust (Kramer & Tyler, 1996; J. D. Lee & See, 2004). Cultural differences between countries, religions or trust and safety principles will all define how tasks are performed and how collaborations evolve. The strongest emphasis of these factors will be their influence as constraints on the cognitive process.

The three groups above are the inputs and constraints of the trust formation process, which create an opportunity to adjust trust to proper levels, and whenever necessary, foster trust behaviour (Mayer et al., 1995; Six et al., 2010). Information in each of these groups does not always provide a good representativeness of the actual characteristic of the situation or the actor (Connolly et al., 2000; Endsley et al., 2003), leading to conditions in which perception of the trust regulating factors differs from reality. Through the provision of proper and accurate information, the external weighting on the perception mechanisms could be improved, creating a better fit between the cues and the reality (Seong & Bisantz, 2008). A much more drastic approach would be to change the relevance given to each factor on the trust cognitive process by changing the environment, task or culture (Schein, 1990; Schuman, 2006); a challenging and complex task.

The complete model described above presents a tool for evaluating issues such as lack of trust and improper representation of trust regulating variables and antecedents; as well as assessing how trust fostering initiatives can influence the individual's trusting behaviour. The model itself, in combination with existing literature by Mayer et al. (1995), McKnight et al. (1998) and Lee and See (2004), provides an excellent foundation for the development of a human factors framework for the design of trust-relevant systems that support the proper levels of interpersonal trust.

Scenario – Results and trust calibration

Over the course of the year, each sub-team developed one component of the project, just waiting for the control system to be incorporated. A few months before the competition, all components were working together properly, but the control system showed to be unstable and not properly calibrated. Lack of leadership in this sub-team resulted in components that would not communicate properly, resulting in the inability of the team to make the whole vehicle work even a few weeks before the competition. This event resulted in the last minute replacement of the controls sub-team lead by a graduate student that managed to fix part of the system. The success of the team in the competition was not the same as the previous years, since the graduate student only managed to bring part of the system online. This example clearly shows that pressures and *assumptions (high level of uncertainty) led to poorly informed decisions that underestimated skills and capabilities.*

Figure 19 shows the final representation of trust in the controls technical lead in our trust formation model, where constraints, perceived factors, and the formation process are highlighted. This example shows a clear case that more trust does not necessarily mean a better collaboration (Langfred 2004). We have shown by this scenario that there might be cases in which the regulating factors drive the trust formation process towards trust levels that are not appropriate for the situation, or are not based on proper information for that particular task. In this scenario, proper knowledge transfer from the previous team and some extra support from supervising professor would have deeply influenced the outcome, considering that more informed trust decisions could have been made.

4.2.6 Conclusion

Human factors frameworks like cognitive work analysis (Vicente, 1999) and SA (Endsley, 1995) are currently being expanded towards designs of systems that cater for team requirements (Ashoori & Burns, 2013; Bolstad, Cuevas, Gonzalez, & Schneider, 2005). This expansion shows the importance that teamwork has on the design of complex systems, since as systems grow in size and reach; more people are required to interact and cooperate. Consequently, trust in these environments has only become more important for successful collaboration (Axelrod, 1984; Mayer et al., 1995; Reina & Reina, 2007).

The strong link between trust and successful collaboration presents an opportunity for improving systems and team performance, considering that trust is a constraint to information flow and proper interaction between team members. Our framework provides mechanisms for understanding existing trust issues inside teams and analysing how trust fostering initiatives are influencing the trust states by explaining how such state is formed. On a macro level, our framework provides mechanisms for designers to understand the trust requirements inside work environments and the constraints that are limiting the calibration of trust to the proper levels. It allows them to develop systems that can maximise collaboration and information flow between team members through the support of interpersonal trust.

Existing trust literature in institutional trust present models which have one strong deficiency that limits their usage for the design of trust-centred systems: the lack of detailed description of the trust state formation process as demonstrated in Section 4.2.3. The framework we are presenting in this publication fills this significant gap in the trust literature by integrating human factors theories and trust literature into a detailed model describing the formation of the trust state and the mechanisms used to define the levels of trust on another person. Staying in alignment with existing trust research, our model encompasses mechanisms to understand how trust regulating factors influence trust state formation and how trust levels influence the task performance. The scenario provided describes an example of how the model can be used to map the trust process and contribute to the development of more appropriate levels of trust (Langfred, 2004).

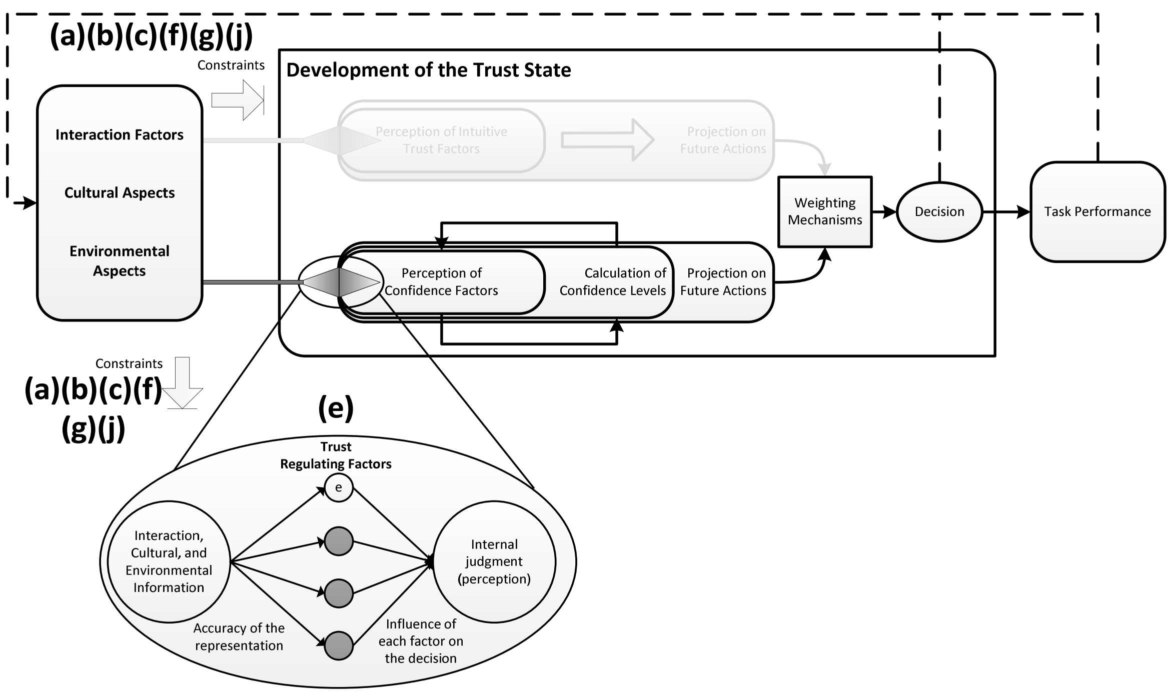


Figure 19: Interpersonal trust state formation model detailing the influence of the factors described in the scenario and in Table 1.

The next steps in this project will consist of the development of subjective measures for trust inside collaborative teams, followed by the creation and evaluation of trust supporting tools. Future study on the development of the model itself includes further validation through case studies in industry and healthcare environments, as well as further refinement of the calculation methods in which the perceived variables are integrated into a mental model.

Finally, the framework presented in this publication was designed, so it could be applied in any institutional context, for any type of interpersonal trust. There are no limitations to the number of people involved or the characteristics of the tasks. The comprehensive approach we have pursued has resulted in a framework that can support the development of systems that include interpersonal trust as one of the design requirements. Consequently, the design of communication and collaboration systems, system interfaces and overall complex systems for collaborative teams will benefit from catering for increased performance, safety and overall cooperation that will result from increased trust.

4.3 Additional Data and Discussion

Although the development of the model presented herein is self-contained and complete, I would like to highlight some of the published models and preliminary work that was used in the development of the Interpersonal Trust State Formation Model. This information is presented in in Table 2.

Table 2: Additional supporting information for Chapter 4.

Supplemental Material	Location	Additional Information
Preliminary version of the interpersonal trust state formation model	Appendix A	Preliminary version of the model as presented in my comprehensive examination.
Mayer et al. (1995) organizational trust model	Appendix B	Trust model that informed the development of the Interpersonal Trust State Formation Model.
McKnight et al (1998) initial trust formation model	Appendix C	Trust model that informed the development of the Interpersonal Trust State Formation Model.
Lee and See (2004) trust in automation model	Appendix D	Trust model that informed the development of the Interpersonal Trust State Formation Model.
Brunswik (1939, 1952) lens model	Appendix E	Conceptual model used in the development of the perceptual mechanisms of the Interpersonal Trust State Formation Model.
Endsley's (2003; 1995) Situation Awareness model	Appendix F	Conceptual model used in the development of the perceptual and trust development mechanisms of the Interpersonal Trust State Formation Model.
Ethics Approval certificate	Appendix AA	Ethics approval certificate for the ethnographic study used for identification of model components.

As previously mentioned, the trust model presented in Figure 18 will serve as a foundation for the development of the following papers in this thesis. Different parts of the model will be explored in the next chapters, serving as stepping-stones for the development of trust metrics and design techniques to foster trust. In order to foster trust through design, it is initially necessary to identify which mechanisms are used to convey trust supporting information in face-to-face collaborations and which information is most effective in triggering trust behaviours, so its effects can later be mimicked through the use of interface components. In the next chapter, I cover the ethnographic study conducted to identify these features.

Chapter 5
Identification of Trust Fostering Behaviours: Ethnographic Study

5.1 Foreword

The next step in the development of this thesis consisted of evaluating the perceptual mechanisms of the interpersonal trust model presented in Chapter 4. In this chapter, I describe the ethnographic study through which it was possible to identify how trust supporting information is transferred in face-to-face collaborations and which types of information were effective in fostering trust, so that I could mimic the transfer process through the use of interface design objects.

There is potential to replace part of the cues that are transferred through social contact by the use of surrogates. However this required initially identifying the dynamic process of exchanging trust-supporting information.

The observations that were part of this ethnographic study focused on evaluating specific parts of the trust model presented in Chapter 4:

1. Identifying the cues that are most frequently used by team members in a face-to-face collaboration to convey trust-fostering information to others in the team.
2. Identifying the cues that are most effective in fostering trust behaviour in face-to-face collaborations.
3. Identifying the transfer mechanisms used by team members to either perceive or provide trust-fostering information for the development of trust.

Each of the three components of the model that are explored in this chapter has been numerically identified in Figure 20 to demonstrate how this chapter and publication fit into the overall development of this thesis. These components contribute to the identification of effective trust-fostering cues that can be provided via interface design and provided evidence of which dimensions should be included in the trust metric developed in Chapter 6. In the next section, I present the paper covering the ethnographic study and the findings that will inform the development of the trust metrics and the trust tokens.

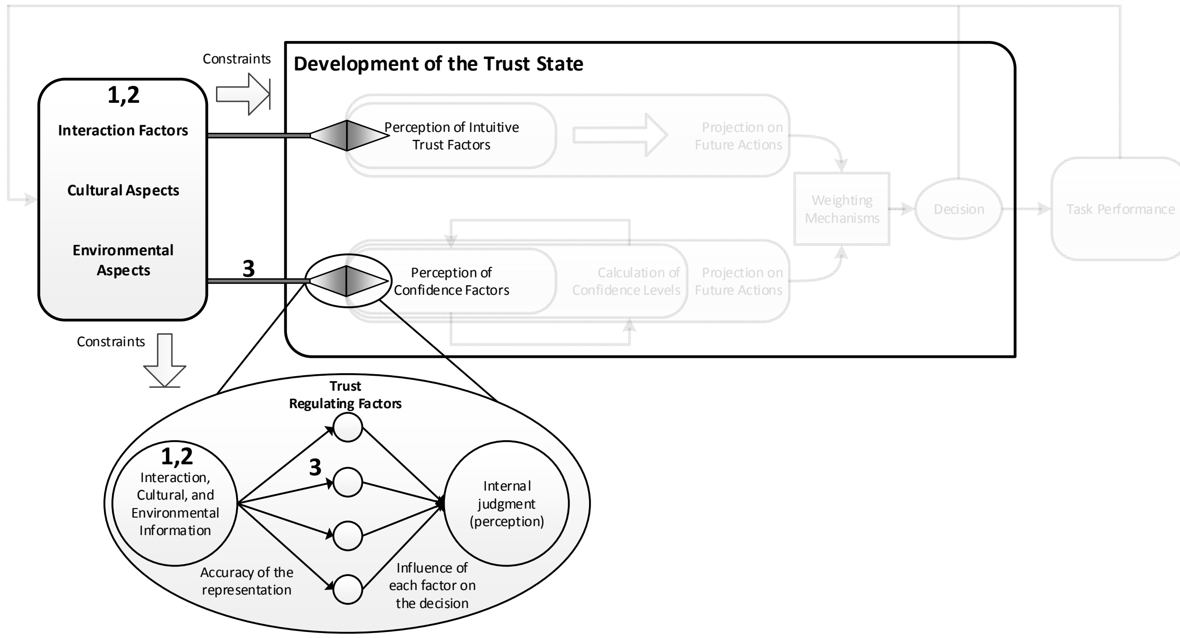


Figure 20: Components of the Human Factors Model of Interpersonal Trust (Morita & Burns, 2014b) that were explored in the ethnographic study.

5.2 Trust Tokens in Team Development

Morita, P. P., & Burns, C. M. (2014). Trust Tokens in Team Development. *Team Performance Management*, 20(1/2), 39-64.

5.2.1 Overview

Purpose – Computer-mediated communication systems (CMCSs) have become the standard for supporting virtual teamwork. However, interpersonal trust formation though CMCSs is impaired due to limited media richness of the communication channels. The intention of this study was to identify trust forming cues that occur naturally in face-to-face environments and are suitable to include in CMCSs design, to facilitate greater trust in virtual teams.

Design/methodology/approach – To select cues that had a strong effect on fostering trust behaviour, we conducted a non-participatory ethnographic study. Two student teams at the University of Waterloo were observed for 6-12 months. Researchers identified mechanisms used for building trust and bridging team developmental barriers.

Findings – We identified five Trust Tokens that were effective in developing trust and bridging team developmental barriers: expertise, recommendations, social capital, willingness to help/benevolence, and validation of information. These behavioural cues, or behavioural Trust Tokens, which are present in face-to-face collaborations, carry important trust supporting information that leads to increased trust, improved collaboration, and knowledge integration. These tokens have the potential to improve CMCSs by supplementing the cues necessary for trust formation in virtual environments.

Practical implications – This study identifies important mechanisms used for fostering trust behaviour in face-to-face collaborations that have the potential to be included in the design of CMCSs (via interface design objects) and have implications for interface designers, team managers, and researchers in the field of teamwork.

Originality/value – This work presents the first ethnographic study of trust between team members for the purpose of providing improved computer support for virtual collaboration via redesigned interface components.

5.2.2 Introduction

Trust is a key component of teamwork (Ahn, DeAngelis, & Barber, 2007; K. S. Barber et al., 2007; Moreland & Levine, 2002; Salas, Diazgranados, et al., 2008; Salas, Goodwin, & Burke, 2009), regulating the ability of people in the team to interact with other team members and influencing the level of information flow between parties (Jarvenpaa & Leidner, 1998). Trust is deeply connected to successful team performance and has been declared a key component of successful and effective teams (Berry, 2011; Driskell & Salas, 1992; Erdem & Ozen, 2003; Gibson & Cohen, 2003; Meyerson, Weick, & Kramer, 1996; Politis, 2003; Schuman, 2006), because without proper communication and collaboration, both of which are influenced by trust, teams cannot function properly.

With the evolution of workplaces and the quick adoption of remote collaborations, virtual teams, and computer mediated communication systems (CMCSs) (Jarvenpaa & Leidner, 1998; Pfaff, 2012), the formation of trust is now affected by the loss of media richness caused by the limited available communication channels (Aljukhadar, Senecal, & Ouellette, 2010; Daft & Lengel, 1984). Reduced media richness, associated with task-oriented communications (Rhoads, 2010), has diminished the availability of social and behavioural trust cues that are vital to the formation of informed trust states (Morita & Burns, 2014b). The major consequences for trust formation in these scenarios are low, slow, and fragile trust, which can impact team performance (Bos et al., 2002). Considering that performance is one of the most desirable indicators of an effective team, there is a need to address this diminished availability of cues in order to allow teams to achieve their optimal performance. Techniques such as relying on initial face-to-face contact (Corbitt, Gardiner, & Wright, 2004; Rocco, 1998; J. M. Wilson, Straus, & McEvily, 2006) or using personal profiles for the disclosure of information (Rusman et al., 2010) to increase the availability of information, have been explored by other authors with varied levels of success. Another possible technique still to be investigated is the use interface components to convey trust-supporting information. The major advantage of this last approach is that information is presented on every interaction mediated by the CMCSs, maximizing awareness and saliency of the trust supporting information.

In order to develop design methodologies and interface design components that can assure proper formation and maintenance of trust in these environments, we initially evaluated how people cope with improper trust and which behaviours fostered trust in face-to-face collaborations. Trust fostering behaviours have the capacity to transfer trust supporting information via behavioural cues that, when properly perceived by the trusting party, can act as either a perceived trust factor or as a catalyst or constraint in the trust perception mechanism (Morita & Burns, 2014b). Trust is expected to be linked to the evolution of team structures and capable of bridging team developmental barriers (Rickards & Moger, 2000). The identified trust building behaviours will be later converted into design features and interface design objects to be used in communication and collaboration systems that support the work of virtual teams.

With the purpose of identifying these trust building behaviours, we conducted a field study observing student teams at the University of Waterloo. We used the nexus between trust and team conflict (Curşeu & Schruijer, 2010) as a way to identify the techniques and information used to foster trust. In this paper, we will focus on teams locked on the soft barrier described by Rickards and Moger (2000) as an opportunity to assess how they managed to overcome their lack of trust. We will discuss our observations in the context of existing team formation models and trust models in an effort to explain how teams successfully manage to overcome development barriers through the use trust fostering cues.

Identifying behaviours that lead to increased trust will have significant impact on team management and team design (Gibson & Cohen, 2003; Salas et al., 2009; Sarker, Ahuja, Sarker, & Kirkeby, 2011), design of collaborative tools (Majchrzak et al., 2000), and interface design (Chopra & Wallace, 2003; Cyr, 2008; Y. D. Wang & Emurian, 2005a, 2005b). Using these behaviours, we will present ways in which designers can incorporate components into their systems that maximize the development of interpersonal trust amongst team members. The development of trust in virtual collaborations is of special importance as teams are constantly moving towards partial or complete virtuality (Duarte & Snyder, 2011; Gibson & Cohen, 2003), which requires communication systems that can properly fill the media richness gap (Daft & Lengel, 1984).

This work presents the first ethnographic study of trust between team members for the purpose of providing improved computer support for virtual collaboration via redesigned interface components.

5.2.3 Background

5.2.3.1 Trust and Teamwork

Trust is a vital component of collaboration. Trust represents how much risk we are willing to accept in exchange for benefits from an interpersonal interaction (Luhmann, 1979; Mayer et al., 1995; Morita & Burns, 2014b). Trust creates an opportunity to deal with the complexity of the world by unloading parts of our responsibilities (Luhmann, 1979) and better coping with aspects of a project that are outside our expertise (Six, 2005). Within a team, trust creates a network of people that can collaboratively support a project and facilitates knowledge integration (K. S. Cook, Levi, & Hardin, 2009). Virtual teams in particular, require effective and implicit knowledge integration as team members are often geographically separated and communications are generally task-oriented (Beranek & Martz, 2005; Chiu, Hsu, & Wang, 2006; Gibson & Cohen, 2003; Holton, 2001; Hung, Dennis, & Robert, 2004). The consequences are that, unless proper trust is established, information exchange and knowledge integration can be significantly impaired (Gibson & Cohen, 2003; Jarvenpaa & Leidner, 1998). Trust is, therefore, a necessary asset for the successful performance of virtual teams. The major problem with virtual teams is how to promote interpersonal trust within those constraints.

Multiple researchers have studied the role that trust plays within a team, presenting descriptions of how trust impacts interpersonal interactions and how interpersonal dynamics can be both constrained and catalysed by trust (Jarvenpaa & Leidner, 1997, 1998; McAllister, 1995; Moreland & Levine, 2002; Morita & Burns, 2014b). Without trust, collaborations would not benefit from the opportunity to build on the strengths of each team member and would not benefit from a collective knowledge (Katzenbach & Smith, 1992; Ringer, 2007). Trust acts as a network that binds a team together, providing mechanisms for knowledge integration that move teams into effective collective minds (Weick & Roberts, 1993). In order to achieve trust within teams, individuals have to exchange cues that convey their trustworthiness, allowing team members to form their mental models or representations of the other parties. These cues correspond to the main input of trust models, as described by Morita and Burns (Morita & Burns, 2014b), Mayer et al. (1995), and McKnight (1998).

In order to establish this relational network, team members rely on a wide range of resources to provide trustworthy cues of themselves (Morita & Burns, 2014b). Similarly to what is found in the use of artefacts in teamwork (Berlin & Carlström, 2010; Druskat & Pescosolido, 2002; Edmondson, 2003; Nemeth, Cook, O'Connor, & Klock, 2004; Salas et al., 2009; Shariq, 1998), individuals also rely on trust artefacts to convey trust supporting cues that range from specific behaviours (Edmondson, 2003) to physical or electronic artefacts (Chopra & Wallace, 2003; Edmondson, 2003) and represent one's characteristics and trustworthiness. Artefacts, in these cases, have the potential of acting as surrogates for non-available cues and improper acquaintanceship that can negatively impact trust formation (Berlin & Carlström, 2010; Rozakis, 2007). Artefacts have been shown to be carriers of potential trust fostering information in: healthcare settings in the form of trust building behaviours (Edmondson, 2003; Mitchell, Parker, & Giles, 2011) or physical artefacts (Berlin & Carlström, 2010; Xiao, Lasome, Moss, Mackenzie, & Faraj, 2001), in distributed teams and electronic environments (Chopra & Wallace, 2003; Trainer & Redmiles, 2012), and in military teams (B. D. Adams & Webb, 2002; N. A. Stanton, 2011).

Artefacts, as trust cues, correspond to the focus of our research as they represent mechanisms used by individuals to exchange the necessary trust supporting information. Artefacts correspond to a few of many available channels for presenting and perceiving the cues that will be used in the trust state formation process. Therefore, identifying behavioural artefacts used in face-to-face collaborations is the first step towards the development of redesigned interface components that have the ability to carry trust-supporting information in media richness constrained collaborations.

Digging deeper into team processes, it is possible to notice that trust has a strong link with team dynamics and team development. Some authors like Barber et al. (2007), Ahn et al. (2007), and Moreland and Levine (2002) have already discussed how important trust is for teams and how, without proper trust, teams cannot function successfully due to, among other reasons, improper communication and information exchange. Because the only possible exchange between virtual team members happens through CMCSs, improper trust in virtual teams has the potential to halt team performance by blocking the main communication channel. As an example of this effect, Wittenbaum et al. (2004) have discussed how group processes can impact performance and the importance of self-awareness. Expanding the dependence between trust and performance into the research from Hackman et al. (1976), we can easily find evidence that trust, as a tacit factor, can be an important catalyst in team development and performance. Additionally, the model presented by Morita and Burns (Morita & Burns, 2014b) explains how behavioural or environmental cues, transmitted through face-to-face interpersonal interactions of team members, can influence perceptions of trust and act as constraints or catalysts when developing trust. The message here is clear: trust is a necessary asset for effective teams and is highly dependent on perception of trust building cues available through artefacts in the collaboration.

5.2.3.2 Team Development

For the purpose of our paper, we will be looking at developmental models, focusing at how trust is connected to successful team evolution and development. In particular, authors such as Tuckman (1965) and Gersick (Gersick, 1988) have developed models that help us better comprehend team formation and evolution by breaking this process into its primordial developmental stages. The decomposition of team development into separate phases or stages allows us to assess the influence of trust on the multiple stages of team evolution and to identify transitions where trust is most relevant.

Although Tuckman's model (1965) has been challenged multiple times (Berlin, Carlström, & Sandberg, 2012; Rickards & Moger, 2000), it is still highly accepted and, for our purposes, will be used to provide a foundation to explain the impact of improper trust levels on team formation. For example, Bonebright (Bonebright, 2010) recently published a review of the history of utilization of Tuckman's model, in which she discusses several cases where Tuckman's model has either been challenged or validated. Cassidy (Cassidy, 2007) argued that some of the stages, in certain types of teams, might be shifted or blended with other stages. Miller (2003) and Sundstrom et al. (1990) outline that more complex teams do not follow the linear structure described by Tuckman, deeming the Forming-Adjourning model simplistic and unable to represent all types of team formation. However, Runkel et al. (Runkel, Lawrence, Oldfield, Rider, & Clark, 1971) successfully tested Tuckman's model in a classroom environment, suggesting its validity in an educational setting. It has also been widely used in the human factors field, as demonstrated by the work of Aragon and Williams (2011), Kim and McNair (2011), McComb et al. (2010), and Salas et al. (Salas, Diazgranados, et al., 2008).

Most importantly, Tuckman's model has been criticized by Rickards and Moger (2000) for being too idealistic. They assert that not all teams go through all the stages of team development. They have demonstrated that teams struggle with two barriers that may constrain their development. The first is a soft barrier between the stages of storming and norming. If teams do not overcome this barrier, they can become dysfunctional. The second barrier is a hard barrier after the stage of performing and preceding a proposed over-performing stage. Rickards and Moger (2000) argue that only a small percentage of teams will actually exceed performance expectations and progress to excellence. Failure to overcome either of these barriers can result in lower trust levels between team members, resulting in poorer conflict resolution and lower overall performance (Curşeu & Schruijer, 2010; Deutsch, Coleman, & Marcus, 2006). Consequently, this interpretation of Tuckman's model allows us to evaluate stages of team development within a team trust framework, creating a link between the two processes.

The presence of development barriers in the formation of some of the teams we observed presents us with an opportunity for assessing how individuals bridge these gaps through the development of trust. Trust, in some cases, will allow teams to surpass conflict stages through the development of bonds that facilitate information exchange and help resolve conflicts, as described by Lewicki (2006) and Curşeu and Schruijer (Curşeu & Schruijer, 2010).

5.2.3.3 Trust in Virtual Teams

Team development and trust formation in virtual teams are dominated by a different interpersonal dynamic, since interactions are mediated by a computer interface with limited media richness (Daft & Lengel, 1984), leading to a new set of interaction issues that influence team development. Authors such as Gibson and Cohen (2003), Rhoads (Rhoads, 2010), and Walther and Buns (2005) discuss some of these challenges, that stem from the lower social presence and lack of social contextual cues, which are usually available in face-to-face collaboration but are limited for virtual teams.

Virtual teams also suffer from constrained information availability for the development of trust (Berry, 2011; Holton, 2001; Jarvenpaa & Leidner, 1998). Physical and behavioural artefacts that are available in face-to-face collaborations that can be used for assessing trustworthiness are not available for remote team members (Gibson & Cohen, 2003), leading to a need to implement electronic supporting artefacts that convey necessary information (Bjørn & Ngwenyama, 2009; Eppler & Sukowski, 2000; Kimble, Hildreth, & Wright, 2001).

Similar to face-to-face teams, trust development in virtual teams remains based on the integration of cues available during the interpersonal interactions and from the environment (Morita & Burns, 2014b). Developing trust is still critical for virtual teams and represents one of the keystones of successful collaborations (Gibson & Cohen, 2003; Jarvenpaa et al., 1998). Virtual teams, whose communications are usually mediated by CMCSs, suffer from the limited media richness of the channels as many trust-building artefacts are not readily available. Trust formation is, in these cases, based on incomplete subsets of cues (Daft & Lengel, 1984; Rockmann & Northcraft, 2008). Important social cues that are transmitted via casual communications, social bonding experiences, and specific behaviours are usually missing as these are not easily transmissible through CMCSs (Rhoads, 2010; M. E. Warkentin, Sayeed, & Hightower, 1997). Misrepresentations generated by missing information have been shown to have a negative impact on trust and teamwork by generating hostility and lack of cooperation (Helmreich & Schaefer, 1994).

Authors such as Bos et al. (2002) have described trust in virtual teams as slow and fragile, where limited availability of cues and restricted interaction lead to a delayed evolution towards collaboration and into fragile trust states. There are, however, studies describing methods to supplement the lack of cues found in virtual environments by using trust building activities (Holton, 2001), or personal profiles (an example of an artefact that would be available to virtual teams) to supplement the trust decision process (Rusman et al., 2010). Each of these techniques can improve trust formation, but also carry significant disadvantages. The methods used by Holton (Holton, 2001) require extensive time and effort for the execution of team building activities, while the personal profiles constructed by Rusman et al. (2010) present privacy issues and depends on intentional action by the trusting party to go after the trust supporting information.

We are looking for a design solution for supplementing the trust decision process on collaborations mediated by CMCSs that can be embedded into multiple layers of the communication system, facilitating perception, and consequently, increasing the potential of CMCSs to influence trust. The goal is to provide cues that are native to face-to-face interactions as interface design objects presented on every interpersonal interaction mediated by CMCSs.

5.2.4 Motivation

The intention of this study was to identify trust-forming cues that occur naturally in face-to-face environments that might be suitable for inclusion in the design of CMCSs. By observing developing teams as they work through team-formation barriers, we observed situations of conflict and resolution where trust-formation was visible. Finally, from such observations, we extracted useful ideas for the design of CMCSs that will help virtual teams build trust between their members.

5.2.5 Methodology

We targeted team environments where we could see team formation during its early stages, allowing us to follow the entire team evolution process. Two different student teams at the University of Waterloo met the criteria for our observations and were selected. Firstly, teams had to be involved with student competitions, so we could observe team members with stronger commitment to the tasks. Secondly, we were interested in observing a small to medium sized team (n = 11), as well as a large team (n = 42), in order to be able to identify the effects of trust on a wider range of collaborations and team sizes. Lastly, we wanted teams with diverse compositions, so we could observe undergraduate and graduate students. More information can be found in Table 3.

Teamwork has become a major component in university education, in which great part occurs collaboratively in the form of design projects and assignments (Dunne & Rawlins, 2000; Millis & Cottell, 1998), since research has shown that students learn much more effectively when working together and collaborating as a team (Kirschner et al., 2009; Springer et al., 1999).

Team members from the University of Waterloo student teams represent a combination of novice team members, who just joined the team, and more experienced team members, who have grown in the team's leadership ladder. Additionally, several of these students have been exposed to teamwork environments during past work experience, working with other teams, and in research projects. Since these student teams are a combination of undergraduate students, graduate students, and industry professionals; they encompass a wide range of experiences and expertise, allowing us to assess multiple team characteristics, as described by Berlin et al. (Berlin et al., 2012).

Although students represent an interesting and convenient population for observations of trust and teamwork, it is understood that they do not directly correspond to working teams in industry, military, or healthcare environments. There are limitations as to commitment, involvement, and experience that can influence the study results (Carver, Jaccheri, Morasca, & Shull, 2003; Peterson, 2001). However, some studies have reported that the differences in team performance are minor across the team depending on the tasks being executed (Ashton & Kramer, 1980; Elliott, Hodge, Kennedy, & Pronk, 2007; Höst, Regnell, & Wohlin, 2000).

Students indeed provide a more novice population for the evaluation of teamwork. Nonetheless, the availability of these teams for long-term observations outweighs the disadvantages, by allowing us to observe the evolution of team dynamics and the effect of trust for longer periods. Not to forget that today's engineering students are tomorrow's workforce in the engineering industry.

5.2.5.1 The Observations – Methodology and Team Information

The two student teams hosted at the Student Design Centre were observed for an extended period of time (6-12 months) by two different observers (Denzin & Lincoln, 2005). A protocol was established between the observers to increase standardization, assure proper data collection, and guarantee anonymity of the participants. From the perspective of trust ethnographic research, using multiple observers has the advantage of reducing observer bias, but also brings larger complexity to the observations, as the understanding of the concepts being observed can vary (Denzin & Lincoln, 2005). In this case, observation notes were compared to assure standardization and congruence on the findings being reported (Denzin & Lincoln, 2005).

This approach allowed us to evaluate them under the purview of a wide range of teamwork models (Berlin et al., 2012) and trust state development stages (Morita & Burns, 2014b). Information about the teams can be found in Table 3, where teams are referred to as Team 1 and Team 2 in order to maintain their anonymity.

We were interested in identifying behaviours and artefacts used by team members to foster trust in face-to-face collaborations. We were looking both at the individual effect of each trust fostering event, as well as the frequency in which they happened in these collaborations. Observed behaviours were analysed and the most frequent and effective ones are presented in this paper. By using this method, we were present in situations where a larger number of team members would be present and collaborating on a similar task, where the exchange of trust supporting artefacts could be observed and analysed.

The observers followed team activities on tasks that included, but were not limited to, technical meetings, design meetings, design activities, hardware assembly activities, system testing, general demonstrations, recruitment activities, competition meetings, and final presentation of their projects. These tasks were carefully selected so we would cover a wide range of team activities and adequately represent the team development problems faced by these groups. In order to minimize the impact and influence of our presence in their daily activities, we conducted non-participatory observations or naturalistic observations (Denzin & Lincoln, 2005), in addition to semi-structured and non-directive interviews (Gillham, 2005; Spradley, 1979).

Information collected during the observations was used to tailor the questions for the interviews, allowing us to dig deeper into each trust-building situation. The interviews presented the opportunity to validate each trust-building event and to explore the reasons behind each trust decision. By using a

Table 3. Information about the observations, characteristics of the teams, and constraining factors that defined the structure of the observations.

	Team 1	Team 2
Deliverable	• Developing innovative vehicles for student competitions.	• Developing innovative vehicles for student competitions.
Approximate size	• 10 undergraduate students • 1 master student	• 35 undergraduate students • 7 master students
Information about the observations	• Duration: 6 months • Total hours: 56 • Total emails: approximately 200 • Two observers • Interviews: conducted on-site, during the activities, as part of the observations. Approximately 3 hours of interviews.	• Duration: 12 months • Total hours: 150 • Total emails: approximately 4000 • Two observers • Interviews: conducted on-site, during the activities, as part of the observations. Approximately 10 hours of interviews.
Team structure	• Small, independent, and disconnected sub-teams of 2 to 3 students working on different projects that, sometimes, do not even use the same components or the same vehicle. • Decentralized leadership and weak coordination.	• Single core team with multiple sub-teams responding to the main team management • Centralized leadership with solid management structures and techniques. • Activities managed by the core team and delegated to sub-teams.
Team management	• Usually led by a student that takes the leadership position. No fixed structure, nor strong leadership. Each sub-team is relatively independent and focuses on its own projects. • Support and mentoring by faculty members is almost absent.	• Pre-established by the organizers of the competition. Each team should have a minimum number of members and sub-teams responsible for parts of the deliverable. • Strong support and mentoring by faculty members, with leadership selection coming from the faculty supervisor.
Cycles	• Change most, if not all team members every 4 months.	• Competition cycles are 3 years long. Most members stay with the team for 1-2 years. Team life cycles are linked to the competition deadlines.

combination of semi-structured interviews (Spradley, 1979) and non-directive interviews (Corbetta, 2002; Gray 2004), we allowed participants to reveal their true subconscious responses to the situation that triggered the interview (Corbetta, 2002), as we were interested in validating and clarifying trust-building behaviours and their subconscious responses.

However, due to situational constraints, interviews were not recorded for the following reasons: (1) they were not conducted in controlled environments (participants were sharing private information); (2) we wanted to minimize disturbances as much as possible; and (3) participants felt more comfortable sharing their experiences without being recorded. Information collected during the interviews was added as part of the field notes. The presence of trust-building events (i.e. recommendations from third parties, validation of information, etc.) or conflict events (struggle for leadership, conflicting interpretations, disagreements in the design, etc.) triggered our need for more insight. After these events, we would follow up with the involved parties to investigate, in general, what had happened, what would the possible solutions be, from their perspective, and what their perceived impact on the group dynamics was. When necessary, open-ended questions were used to allow participants to describe the issues from their own perspective (Gillham, 2005; Spradley, 1979). Also, when needed, we would ask questions about parts of the tasks and collaboration being observed that we did not have easy access to (e.g., when people were working inside their vehicles).

The observers were present during the teams' daily activities in multiple environments, including: meeting rooms, team bays in the design centre, student and team offices, competition locales, and test locations. Interviews were conducted throughout the observations, between tasks or in moments when the tasks being performed would be minimally disturbed by the interviews. A third source of information consisted of the teams' internal communication through their multiple internal email lists. The researchers were granted full access and were given the opportunity to observe closely not only their communication through electronic channels, but also their relationship building process and conflicts through the electronic medium.

Messages that were exchanged through email were checked daily, and were organized in three categories: trust-building events, conflicts, and team development. Excess information that was not related to these three categories was stored separately. The collected information was handled using the same protocol of the observations, where we were evaluating the relationship between trust and team development as an opportunity to identify effective trust-building events. Information available in the emails was incorporated into our field notes, but was tagged as coming from email.

The three data collection processes outlined above were chosen to maximize the sources of information and to allow the researchers to validate their findings. Having multiple sources of information helps bring clarity and detail to the observations (Denzin & Lincoln, 2005; Fetterman, 2010) by allowing researchers to combine complementary sources of information. Furthermore, using multiple techniques can improve the breadth and depth of the data collected. Information that might be missed in field observations, due to a large array of events happening simultaneously, might also be available in more detail in other sources (Denzin & Lincoln, 2005).

5.2.6 Results

The ethnographic study presented us with a wide range of trust-fostering behaviours. These behaviours were identified, based on the premise that in order for an individual to trust, he has to weigh the inherent risk of collaboration with the benefits that will come from team integration (Das & Teng, 2004; Morita & Burns, 2014b; Six, 2005). However, we focused our attention on trust-building behaviours that actually influenced the development of team structures and the resolution of existing team conflicts (Curşeu & Schruijer, 2010). In the next subsection we will describe five of the most frequent trust-building behaviours, exemplified by a short narrative and followed by a discussion of the influence these behaviours had on influencing trust and overcoming team development barriers.

5.2.6.1 Team Development Process

The developmental process of the two teams being studied here is presented in Figure 21. The diagram describes the teams, locked into two different stages of the development process leading to conflict, and consequently, to opportunities to observe trust-building behaviour.

As described by Tuckman (1965) and Tuckman and Jensen (1977), different teams will follow different processes that can, in general, be mapped to the 5 stages of Tuckman's team development model (as shown in Figure 21). However, depending on the structure and the dynamics of the team, it can get stuck in different parts of the process (Langan-Fox, Anglim, & Wilson, 2004; Rickards & Moger, 2000). Team 1 clearly represents a case in which the team is constantly locked into the storming stage; Team 2 has good performance in most situations, but due to existing group and situational limitations, it cannot move into an over-performing stage.

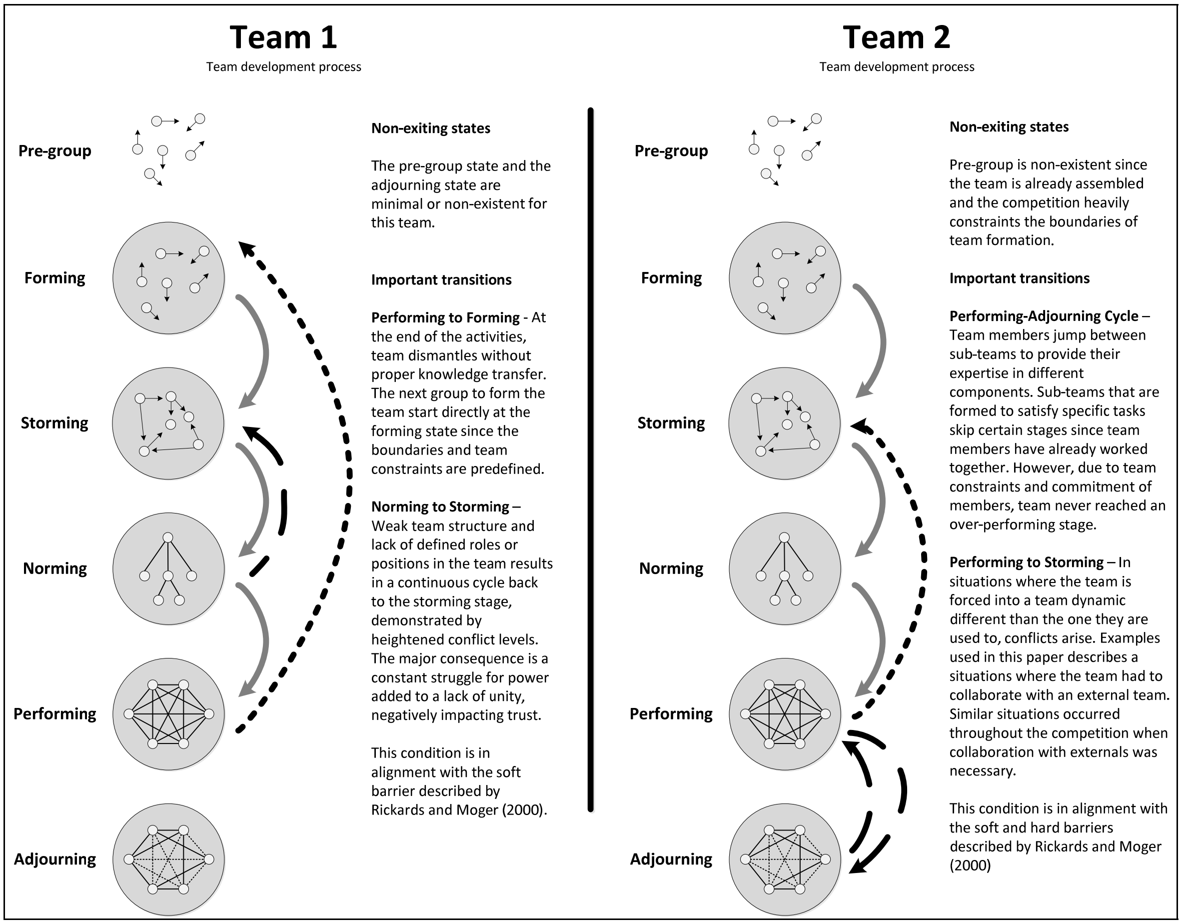


Figure 21. Team developmental stages according to Tuckman's theory. Dotted and dashed arrows represent transitions identified as important for the evaluation of trust.

5.2.6.2 Description of Trust-Fostering Behaviours

The narratives below will present examples of situations in which trust-building behaviours impacted trust levels and led to reduced conflict, allowing teams to move past the development barriers outlined above. Some narratives will include more than one trust-fostering behaviour.

5.2.6.2.1 Trust Fostering via Perceived Expertise

One of the team leads (TL1) arrives at the team bay, turns on the lights, and opens the bay doors. Nobody else is in the shop at the moment. He waits for a couple of minutes and then goes back to his own tasks on his laptop. 30 minutes after the scheduled time, two other team members arrive for the scheduled team meeting and design session (S1, S2). They all open their laptops and work on their personal tasks a further 30 minutes. During this time, they are each focused on their own activities and nearly no interaction happens. The second team lead (TL2) arrives 1 hour after the scheduled start time saying that the 3rd team lead (TL3) is not coming and they should move on with the design session without him. He sits down and opens his laptop. Once they finally engage in the tasks related to the project, each one starts to work on different tasks: TL1 is engaged with applying for some university funds, TL2 is focused on purchasing some components, and S1 and S2 are now working on a new approach to their control system. After about 30 minutes working independently, TL2 notifies TL1 of a new component he found for their camera mount. TL1 then complains that he already submitted the proposal and this new component was not on the list.

TL1 and TL2 argue for a couple of minutes, which make S1 and S2 uncomfortable with the situation (demonstrated by them leaving the bay and chatting about it on the way out). Due to this situation, S1 and S2 continue working on their design, without checking if it is in alignment with team requirements and if the team vehicle would be able to support it. A couple of days later TL2 finally inquires S1 and S2 about their design. Once it is explained, TL1 and TL2 explain to S1 and S2 that their vehicle cannot handle the weight of their camera design, requiring a complete redesign. TL1 and TL2 are emphatic in dismissing S1 and S2's approach, because from their perspective, it would not be possible to mount their design on the vehicle and it is thus not in alignment with the team's interests. After much discussion, S1 and S2 leave the team bay with the idea that their prototype would not be feasible, discussing new alternatives.

A couple weeks later, S1 and S2 come back to the shop to work on their alternative approach, when they meet an experienced team member (G1) who has been working *with the team for several years. He is currently a graduate student working on supporting the activities of the team, but has opted not to take an active leadership role. Once S1 and S2 present their design (the one that was dismissed by TL1 and TL2), G1 quickly appreciates it and promptly claims that TL1 and TL2 are overlooking the great potential of their idea. With a simple disassembly and parts replacement, S1 and S2 can now make their original design light enough to fit onto their vehicle.*

During the upcoming weeks, S1 and S2 go back to their initial design work and mainly discuss their work with G1, informing the team leads only when formally required (applying for funds and requisition of parts).

5.2.6.2.1.1 Expertise

In the narrative above, we see two situations where expertise was observed to have trust-fostering effect. The students assumed the team leads were experts based on the position they held and the graduate student is assumed an expert due to his lengthy experience with the team. During our observations, other student members started searching for counsel from the graduate student, creating a disconnection between team leadership and supervision, and hence fragmenting the team structure. Trust was demonstrated by the students accepting the suggestions of TL1, TL2, and G1, without challenging their knowledge.

These observations are in alignment with the works by Lahno (1995), Butler (Butler Jr., 1991) and Mayer et al. (1995), that present expertise and competence as an important perceptual trust factor that can lead to trust behaviour (Morita & Burns, 2014b).

5.2.6.2.2 Trust Fostering via Recommendations and Social Capital

Team 2 is ready to disassemble an important component of their vehicle to be shipped back to one of their sponsors. However, due to competition regulations, they cannot do it on their own. A team of three people from one of the sponsoring companies is sent to oversee the process due to liability and risks involved.

The team lead arrives early at the team bay, with other team members following within the next few minutes, preparing for the arrival of the external team. Once the *external team arrives, local team members are ready to start. Introductions are made and the job is discussed. At this point, we, as observers, begin to notice a level of conflict arising over the leadership of the project, with local and external team leads arguing over who should have control over decisions and who should coordinate team activities during the disassembly process. After a few minutes, the local team lead accepts the leadership of the external team since, otherwise, no work can be started.*

Nonetheless, during the remainder of the morning, there is a certain disconnection between management and tasks. Local team members still look to their local leads for assurance every time they receive instructions from the external team. At this point, the external team members consider themselves more experienced and liable, and subsequently assume management of the task; while the local team assumes that they have ownership, since it is their project and team. Conflicts are constant during this period, with the external and local teams discussing completely different approaches. The external team opts for a quicker disassembly, with more damage to the vehicle, while the local team tries its best to maintain the integrity of the vehicle at the expense of time. Each team acts independently and discusses their approach separately, only informing the other party of their resolution. This scenario repeats itself over the length of the day, preventing them from reaching agreement on which course to take.

In the middle of the afternoon, an important representative of a university centre arrives at the team bay. Not only he has a previous relationship with one of the external members, but he also brings with him the social capital associated with his position. While the local team assembles a stand so that the part can be removed, the external team and centre representative move outside the bay for some casual conversation. During their 30-minute meeting, they discuss the work that the local team has done in their multiple competitions and the excellent safety and quality record of the team. At several instances, the external team members questioned the track record of the team and the team lead, attempting to gain more information about them and to gauge their skills and abilities. The representative gave multiple compliments to the team and to the team lead, highlighting their capabilities, independence, and excellent performance.

Conversation between the external team and centre representative was then interrupted by the local team, who informed them that the assembly of the stand was completed. For the first time during the day, the external team lead asked: "what should we do now?", allowing the local team to lead the disassembly process from this point on. The team dynamics became more fluid as the external team's improved awareness of the capabilities and orientation of the local team allowed them greater confidence in letting the local team lead the process.

5.2.6.2.2.1 Recommendations

Team members constantly base their trust decisions on cues that, in most initial team interactions, are not readily available (Mayer et al., 1995; McAllister, 1995; McKnight et al., 1998; Morita & Burns, 2014b). In the description above, pre-conceptions did not allow the external team to trust the local team with the disassembly process until proper trust supporting cues were provided by the recommendations of the centre representative. Performance and behavioural cues were transferred through the recommendations (Hyllengren et al., 2011; Jarvenpaa & Leidner, 1998; Meyerson et al., 1996), allowing the external team to make an informed trust decision and, consequently, accept the risk of having the local team coordinate the disassembly process. This is a good example of a situation in which the provision of proper trust supporting cues, through recommendations, led to increased levels of trust and consequently bridged the developmental barriers described by Rickards and Moger (2000). Under Morita and Burns' theory (Morita & Burns, 2014b), the recommendations are having a dual effect over the trust formation: by providing transferred trust and by acting as a catalyst to the information about performance and capabilities of the local team.

5.2.6.2.2.2 Social Capital

In the narrative above, the information provided by the centre representative had its influence catalysed by the social capital associated with the representatives' position. Social capital acted as a regulator of the importance of the recommendation, increasing the credibility of the information provided by the recommender and influencing the internal weight on the trust state formation process (Morita & Burns, 2014b). Social capital has been described as a strong component of trusting behaviour (Kramer & Tyler, 1996; Tsai & Ghoshal, 1998). A similar recommendation coming from a less important person might not have had the same effect.

5.2.6.2.3 Trust Fostering via Perceived Benevolence/Willingness to Help and Validation

At a certain stage of the competition, Team 2 had to assemble a high-voltage system. However, none of their technical leads was experienced in the high-risk and high-voltage components of this project.

One student volunteer came forward, claiming to have worked with high-voltage systems and design of industrial components during his recent work terms. He identified himself as able to lead the group and to coordinate the assembly. However, as a new team member, the team lead viewed this volunteer as potentially unsuitable for the position as he had no experience and no previous history of collaboration with the team.

The team lead was concerned that the person might not have the necessary skills for the position. After a short interview with the team lead, we discovered that after this student volunteer stepped up, the team lead had indeed considered him for the position. When this student volunteer shifted from his previous team, his old team members and team lead mentioned several times how keen he was to help others and how engaged he was with the team. His decision to switch teams came from his interest in a larger scale vehicle. When he decided to move to Team 2, he made sure that his replacement was well instructed on his duties. The volunteer also continued to assist the previous team whenever necessary.

After a few more days, Team 2 was becoming desperate to find someone to fill the position. Management started to discuss the possibility of borrowing someone with the necessary skillset from another team. After exchanging a few emails with one of the corporate sponsors, the team lead found out that the company that the volunteer worked for was a branch of this sponsor's company and that he would be able to contact his past supervisor. After a few email exchanges, the team lead received a list of projects that the volunteer had worked on and to the surprise of the team lead, they were in better *alignment with the assembly task than he had anticipated. After a few more emails, the team lead decided to assign the volunteer to head the assembly of the power system.*

5.2.6.2.3.1 Benevolence or Willingness to Help

In this narrative, extracted from our observations, we can see willingness to help showing strong influence on trust behaviour. The knowledge of how the volunteer acted in the past and how engaged he was into helping others served as a behavioural cue that led to increased trustworthiness. Looking at the work of Giffin (Giffin, 1967), Ring and Ven (Ring & Van de Ven, 1992), Solomon (1960), Strickland (Strickland, 1958), Mayer et al. (1995), Colombo and Merzoni (2006), McKnight et al. (1998), and Kramer (Kramer, 1999), we can see willingness to help or benevolence defined as one of the key dimensions of trust. According to Morita and Burns' model (Morita & Burns, 2014b), willingness to help influenced the formation of trust in this example by acting as a perceptual factor. However, the effect of this cue alone was not enough to elicit trust behaviour, still requiring the opportunity to validate the information.

5.2.6.2.3.2 Validation

Information validation is described in the literature as a behaviour that showcases distrust (Beccerra & Gupta, 1999; James, 2002; Lahno, 1995). However, the effect of validation is also described as having a positive effect on the formation of trust levels, if the result of the validation process supports the claims and expectations of the individual trusting.

In this narrative, it was only after the team lead had the opportunity to validate the information he had previously acquired that he actually decided to trust. According to the team lead, the volunteer student *"... seems to know what he is doing and is pretty confident about it. We need to find someone soon, and he seems to be able to do the job. "* His decision was also influenced by positive words said by his past team members: *"People from the (other) team really had nice things to say about him … but I don't know, we only met a couple weeks ago…"*

Validation acted here as a confirmation of the information about the volunteer's expertise, catalysing the influence of the expertise on the formation of the trust state (Morita & Burns, 2014b).

5.2.7 Discussion

The storming phase of team development is often cited as an opportunity to strengthen the team through constructive conflict (Fall & Wejnert, 2005; Gilley, Morris, Waite, Coates, & Veliquette, 2010; Gilley, 2007; Tuckman & Jensen, 1977; Tuckman, 1965), which will result in the formation of a leadership core, hierarchical structures, and proper chain of command. During this phase, team members start highlighting their skills and defining their roles and the relationships they will form in the team, that will later be used to ground their trust behaviour in more developed states of team formation (Morita & Burns, 2014b).

Excessive conflict, however, has a severe impact on team and individual trust levels. In Figure 22, we visually represent the effect of the soft barriers described by Rickards and Moger (2000) over trust levels, with the depiction of trust levels after multiple cycles of conflict. At the peak of conflict situations, trust drops (Curşeu & Schruijer, 2010), slowly raising as team members interact, until the next conflict situation. Most importantly, there is a reduction in the average levels of trust over time. This can be explained by the fact that work collaborations have a limit to the stress they can take before ceasing to function, consequently being extremely susceptible to conflicts (Axelrod, 1984; Kramer & Tyler, 1996). Reductions of trust levels after several conflict cycles were perceived through the decline of collaboration (Curşeu & Schruijer, 2010; Holton, 2001), communication (Jarvenpaa & Leidner, 1998), and risk acceptance (Morita & Burns, 2014b).

Teams locked in this stage must quickly address trust issues in order to overcome the soft barrier successfully (Rickards & Moger, 2000). During our observations, sub-teams that successfully managed to overcome this blockage used what we are referring to as “trust tokens.”

Trust tokens are representations of units of trust fostering information that can act as cues to the perception mechanism of trust formation (Morita & Burns, 2014b). The information conveyed can range from behavioural cues, to experience and expertise in a certain field. These units carry perceptual and/or catalytic information for the development of informed trust levels by team members.

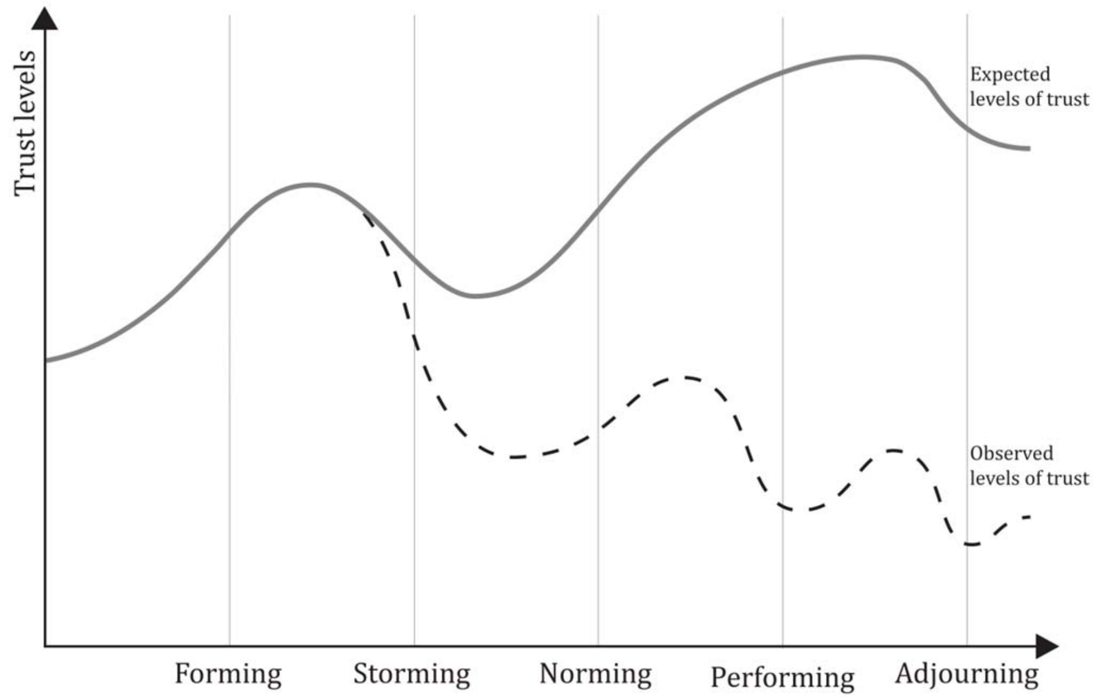


Figure 22. Consequences of excessive conflict on a team locked in the norming stage. This is similar to what Rickards and Moger (2000) describe as a soft barrier to team development. The solid line represents the expected levels of trust for each of the team formation stages, while the dashed line corresponds to the observed levels of trust for teams constrained by the soft barrier.

The exchanges of these units of trust-fostering information, or trust tokens, were identified as trust tokening behaviour. Trust tokening behaviour has ties with social referencing (Klinnert, Campos, & Sorce, 1983) and social influencing theories (Kelman, 1958). When individuals are faced with situations where they do not know if they should trust another person, they refer to others around them to scout for trust-supporting information to use to ground their trust decision (Klinnert et al., 1983). In situations where we see transferred trust (as in the narrative about recommendations), individuals' trust decisions are directly influenced by the trusting behaviour of others, similarly to what is explained by social influence theories (Kelman, 1958).

During the observations and as described in the narratives, we outlined five trust tokens that demonstrated stronger effects over soft barriers to team formation: expertise, recommendations, social capital, willingness to help/benevolence, and validation of information. Each of these tokens carries a different set of trust-supporting information, having distinct influence over the trust formation process (as described on Table 4). We categorize the influence as a perceptual factor being perceived by the trusting individual or as a catalyst to other trust tokens (Morita & Burns, 2014b).

The definition of a token, according to the theory of semiotics (Peirce, 1998; Wetzel, 2011) describes it as a representation of a type, a physically identifiable entity that can represent information. The same information can have different representations, or tokens, that allow adapting and embedding similar information in different contexts. In our study, for example, a trust token can have a behavioural representation, allowing it to be transferred via interpersonal face-to-face communication; or a physical representation of the same information as an interface design object embedded into CMCSs. These two tokens can represent the same type of information, or trust-fostering cue, but each is tailored to the characteristics and constraints of its particular environment.

Due to the wide usage of the term trust tokens in computer sciences, it is important to highlight here the differences between that and the trust tokens we are presenting. Trust tokens, from the perspective of interpersonal trust, are representations of units of trust-fostering information that will be used to compose a trust state (Morita & Burns, 2014b), while trust tokens in computer security are binary identifiers that indicate that a computer is trustworthy (Au, Looi, & Ashley, 2001; Chandran, Panyim, & Joshi, 2006; Moreton & Twigg, 2003). In the latter, if the token is present, trustworthiness is assured. The same is not necessarily true in the case of trust tokens in interpersonal trust formation.

Considering the loss of important trust cues in CMCSs that are otherwise transmitted via body language, casual communication, non-project related information, and interpersonal interactions, we propose here the adaptation of the behavioural tokens observed during our ethnographic study into interface design objects, in order to support the development of trust behaviour. Since the type of information being represented would remain the same, we would be supplementing the trust decision process (Morita & Burns, 2014b). Looking back at the narratives we have provided, in several cases, behavioural trust tokens would not be available if teams were collaborating through CMCSs. For example, the recommendation provided by the representative was only available since casual conversation took place, as there was no formally scheduled meeting. The representative was passing by and noticed someone he knew. Communications through CMCSs are focused on project related tasks and information, as described by Rhoads (Rhoads, 2010) and Warkentin et al. (1997), and casual interaction, which is vital for relationship building processes, is drastically reduced.

There is already some evidence of the use of interface design objects to influence social behaviours. For example, social network systems have already been using these interface objects within their designs for supporting selection of friends, screening of invitations/requests, and identification of shared interests via badges or textual information (Singh, Jain, & Kankanhalli, 2009; Zarrella, 2009). Examples can be found in Table 4, where we also discuss the trust dimension being represented in some of these badges. However, there is still a need for studying how these tokens could be used to foster trust behaviour and improve team dynamics in virtual teams.

The flexibility of a token creates an opportunity for incorporating the trust building information in different components of CMCSs, such as: communication interfaces, collaborative design tools, social profiles, virtual meeting environments, etc. Instead of relying on extensive descriptions like Rusman et al. (2010), we propose that similar information can be embedded into small interface design objects.

This study allowed us to identify evidence of the potential for conveying trust-supporting information from behavioural cues through interface design objects, supplementing trust decisions with missing cues. In the future, new tokens, conveying other types of trust-supporting information, may be designed to account for variations in systems and collaboration requirements. New tokens would allow designers to tailor their trust-supporting intervention according to the limitations of each system. This approach needs to be further evaluated, testing the influence that each token can have on trust decisions and the effect on trust levels.

5.2.8 Conclusions

Trust is deeply rooted into our cognitive processes and can be influenced by a large array of trust factors (Mayer et al., 1995; McAllister, 1995; Morita & Burns, 2014b); but since it is a decision-making process, it is highly dependent on the information people have available.

Table 4. Trust tokens, effects over the trust formation process, similar social networking systems conveying this information, and trust information being transferred.

	Influence (Morita & Burns, 2014b)	**Social network systems** (Badges)	**Trust dimensions being conveyed**
Expertise	• Perceptual factor	• Facebook • LinkedIn • TripAdvisor	• Abilities, skills, competence.
Recommendation	• Perceptual factor • Catalyst	• Facebook • LinkedIn	• Transferred trust as a perceptual factor. • Catalyst to the information provided in the recommendation.
Social capital	• Perceptual factor • Catalyst	• Facebook • LinkedIn	• Support network, connections, and reliability. • Catalyst to any associated information.
Willingness to help/benevolence	• Perceptual factor • Catalyst	• LinkedIn • TripAdvisor	• Benevolence, goodwill, engagement, and commitment.
Validation	• Catalyst	• Facebook • TripAdvisor	• Catalyst to the information being validated.

Through our ethnographic study, we had the opportunity to identify behavioural cues that were effective in fostering trust behaviour and overcoming the soft barrier in trust formation (Rickards & Moger, 2000). The selected trust tokens showcased the ability to foster trust in face-to-face collaborations, serving as augmented information for the decision-making process and effectively facilitating the reduction of conflicts during the norming stage of team formation.

The next steps of this project will focus on converting the behavioural trust tokens into interface design objects, or graphical trust tokens, to be embedded into electronic collaboration systems. With this approach, we intend to supply team members with missing trust cues that are important for the decision-making process and that are lost due to the low media richness of the collaboration channels.

From a broader perspective, the results from this study provide practitioners with information on trust-building behaviours during face-to-face collaborations, which yields an insight on which aspects of collaboration are important to facilitate the development of trust in teamwork. For practitioners involved with virtual teams, this research presents evidence of what is important to incorporate in virtual collaborations and CMCSs when the intention is to maximize trust, considering that virtual teams are deprived of many trust-building cues available in face-to-face collaborations.

This study also provides empirical evidence on the relationship between trust and team development processes, building on Tuckman's (1965) and Rickard and Moger's (2000) works. This relationship is of prime importance for practitioners who are interested in facilitating the development of team structures that can lead to effective and successful teams (Gibson & Cohen, 2003; Schuman, 2006).

Overall, this paper presents the results of the first ethnographic study of trust between team members, with the objective of informing the design of improved computer support for virtual teams though redesigned interface components.

5.3 Additional Data and Discussion

This ethnographic study fills an existing gap in the literature by identifying which cues should be embedded in CMCSs in the form of interface design objects such as badges and buttons, which have the potential to provide important information for the formation of informed trust states. In this chapter, I have provided a detailed description of five types of information that can have a positive effect on the trust behavior inside teams. In Chapter 7 I will describe how they are later converted into trust tokens. Trust tokens are interface design objects in the form of social-network inspired badges (Antin & Churchill, 2011) that can be incorporated in CMCSs to convey trust-supporting information for the team members.

A short list of the supplemental material used in the study covered in this chapter can be found in Table 5 below.

Table 5: Additional supporting information for Chapter 5.

Supplemental Material	Location	Additional Information
Ethics Approval certificate	Appendix AA	Ethics approval certificate for the ethnographic study used for identification of model components.

In Chapter 4 and Chapter 5, I have presented the development of modeling tools to better understand the perception of trust cues, identification of effective ways to foster trust, and important aspects of collaboration that can be measured by a trust metric. The following chapter present the development a tool to measure the effects of design and managerial interventions targeted at fostering trust. In the next chapter, I will discuss the development of the Quick Trust Assessment Scale (QTAS); a trust metric tailored to identifying existing trust issues within a team and possible interventions to address identified trust issues.

Chapter 6
Measuring Trust

6.1 Foreword

In order to create mechanisms for understanding and identifying trust problems inside teams, it was necessary to develop tools to model and understand trust and to identify effective cues and perceptual mechanisms for the acquisition of this information. These initial components of this thesis provide the necessary knowledge to develop a trust measurement tool with potential to inform the design of systems tailored for fostering trust, while also incorporating situational variability (an integral part of trust behavior) as a native component of the trust metric. Considering the shift towards the growing use of virtual teams, these two aspects of the trust metric developed herein provide significant contributions to the literature in trust research and trust measurement. Team members from virtual teams can be exposed to different work environments and institutional cultures, which reinforce the situational variability of trust (Dirks, 1999; Jarvenpaa et al., 2004; La Guardia & Ryan, 2007; Morita & Burns, 2014b; Payne & Clark, 2003; Schlenker et al., 1973). Therefore, incorporating such variability in a trust metric is importance when measuring interpersonal trust in virtual teams

Currently, one of the most accepted ways of identifying trust fostering interventions is conducting long and extensive ethnographic studies (Jirotka et al., 2005; A. Jones & Jones, 2011; Morita & Burns, 2014a; N. A. Stanton & Ashleigh, 2000). These provide very rich information and detailed insights on the trust dynamic inside a team but require a long data collection process. These studies allow researchers to gain the necessary awareness of team dynamics and issues that need to be addressed, as well as options on how to address conflicts and team constraints.

In this chapter of my thesis, I present the development of a tool targeted at simplifying this process. The Quick Trust Assessment Scale (QTAS) provides a simple and compact way to gaining awareness of teams' trust dynamics without the need to be immersed in their environment for extended periods of time. The effects of the perception mechanisms described in Morita and Burns (2014b) and presented in Chapter 4 inform the design of the QTAS, as the perceptual components of the trust model are replicated in this trust metric. This metric incorporates the internal and external weighting components of the trust model into a compounded trust metric. I will focus on the perception component of the Human Factors Model of Interpersonal Trust as highlighted in Figure 23.

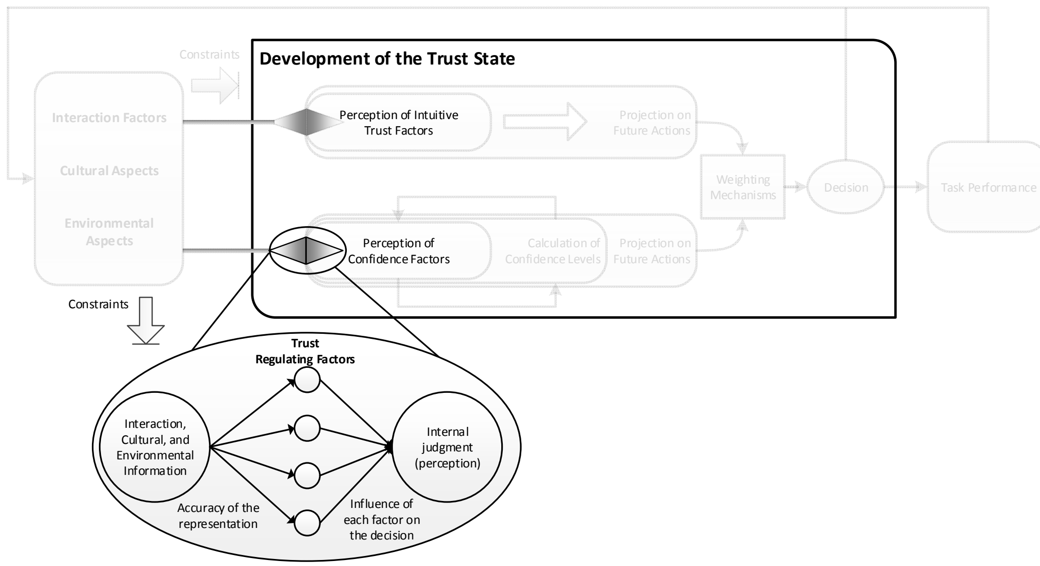


Figure 23: Perception mechanisms described in the Human Factors Model of Interpersonal Trust to be incorporated in the QTAS.

6.2 Towards a Quick Trust Assessment Scale (QTAS) – Measuring Trust in Collaborative Environments

Morita, P.P., & Burns, C.M. (submitted, in revision). Towards a Quick Trust Assessment Scale (QTAS) – Measuring Trust in Collaborative Environments. Manuscript submitted to *Ergonomics*.

This paper has been submitted to Ergonomics and is currently in the second round of revisions.

6.2.1 Overview

Trust is an important component of successful teamwork, facilitating communication, information exchange, and collaboration. Without trust, teams struggle to become effective, impacting team performance. In order to understand this scenario, it is necessary to evaluate interpersonal trust within these teams. Trust metrics available in the literature, however, lack the ability of measuring the differential loadings of the trust antecedents on the formation of trust states and are not designed for longitudinal studies. We propose the development of the Quick Trust Assessment Scale (QTAS), a trust metric that meets these demands and most importantly, helps designers identify effective interventions to foster the development of trust in teams without the need to conduct extensive ethnographic studies. In order to develop the QTAS, we present two studies used for designing the QTAS, and one study for the evaluation. Results show internal consistency and reliability through high Cronbach's alpha, combined with strong correlation with other trust metrics. Factor analysis identified one major construct, interpersonal trust, incorporating eight of the 9 dimensions used in the QTAS.

6.2.2 Introduction

Teamwork has become the norm in current operations of emergency services, military, healthcare, businesses, and industry, allowing multiple expertise to be brought to a project and creating a pool of resources that capitalize on the collective knowledge and collective minds of the team members (DeChurch & Mesmer-Magnus, 2010; Leonard, Graham, & Bonacum, 2004; N. A. Stanton & Ashleigh, 2000; N. A. Stanton, 2011; Weick & Roberts, 1993). However, it is known that the nature of teamwork exposes team members to novel social constraints and social conflicts that, if not properly managed, can impair team performance and effectiveness (Furst et al., 1999; N. A. Stanton, 2011). Constraints like trust, leadership, orientation, cultural differences, affect, and conflicting values (M.J. Ashleigh & Stanton, 2001; Baker, Day, & Salas, 2006; Salas, Sims, & Burke, 2005; N. A. Stanton, 2011) now regulate how a team performs and how individuals collaborate. As teams move into a virtual domain (Cordery & Soo, 2008; Gibson & Cohen, 2003; R. Lyons, Priest, Wildman, Salas, & Carnegie, 2009), the influence of such constraints on the team dynamics are accentuated due to the reduction in social interaction and lack of awareness and knowledge about skills, personality, and values of the other party (Cordery & Soo, 2008; Jarvenpaa & Leidner, 1998; Rae, Takayama, & Mutlu, 2013); which are all important antecedents for the formation of trust and consequently, effective teams (Cordery & Soo, 2008; Furst et al., 1999; Kiffin-Petersen, 2004). This disconnect has also been described in the perspective of patients and physicians in telehealth by Montague and Asan (Montague & Asan, 2012) and military teams by Liberg and Smith (2006).

Trust is an important part of teamwork (M.J. Ashleigh & Stanton, 2001; Jarvenpaa & Leidner, 1998; G. R. Jones & George, 1998; Salas et al., 2005; K. A. Wilson, Salas, Priest, & Andrews, 2007), leading to increased team effectiveness and collaboration (Cordery & Soo, 2008; Kiffin-Petersen, 2004; Kramer, 1999; McAllister, 1995; Salas, Stagl, Burke, & Goodwin, 2007; N. A. Stanton, 2011). Without proper trust within a team, information exchange (Jarvenpaa & Leidner, 1998; Jarvenpaa et al., 2004; Staples & Webster, 2008; K. A. Wilson et al., 2007) and collaboration (Driskell & Salas, 1992; Schuman, 2006; N. A. Stanton, 2011) diminish; with consequences for team performance and effectiveness (Cordery & Soo, 2008; Kiffin-Petersen, 2004; Sinclair, Siemieniuch, Haslam, Henshaw, & Evans, 2012; Smith & Blanck, 2002; Sundstrom et al., 1990), knowledge sharing (C. W. Chen, Chang, Tseng, Chen, & Chang, 2013; Chiu et al., 2006; Hunter & Pierce, 2010; J. K. Wang, Ashleigh, & Meyer, 2006), knowledge coordination (Kanawattanachai & Yoo, 2007), and knowledge distribution (M.J Ashleigh & Prichard, 2012; M.J. Ashleigh & Prichard, 2011; Prichard & Ashleigh, 2007). Appropriate interpersonal trust is a precursor to team performance and team effectiveness, yet trust remains difficult to measure (M.J. Ashleigh & Stanton, 2001; Smeltzer, 1997; Widen-Wulff & Ginman, 2004).

Measuring interpersonal trust can be useful when evaluating communication systems that support teamwork, particularly supporting diverse and non-collocated (virtual) teams (Bos et al., 2002; Carletta, Anderson, & McEwan, 2000; Gibson & Cohen, 2003). Communication systems in our perspective can include interactive multimedia conferencing systems (Fussell & Benimoff, 1995), text messaging systems (Knott, Nelson, Brown, Dukes, & Bolia, 2007), task coordination systems (Jenkins et al., 2010), and shared workspace systems (Gutwin et al., 2008; Q. Wang, 2010). These are commonly referred to as Computer Mediated Communication Systems (CMCSs) as normally defined in the ergonomics literature (Reid, Malinek, Stott, & Evans, 1996).

However, the simple knowledge about trust between team members, which can be collected using existing trust metrics available in the literature, only provides a snapshot of the current trust dynamic (Lewicki et al., 2006). However, if researchers intend to identify effective ways to influence trust behaviour in collaborations, a new metric that captures details about the trust formation process needs to be defined (Morita & Burns, 2014a, 2014b). With such a new trust metric, managers, designers, and human factors specialists would be able to collect insights on the interpersonal dynamics inside a team through the evaluation of how trust is formed within that specific and unique team (Lepak, Smith, & Taylor, 2007). Access to such information could help improve design of socially networked applications (Euerby & Burns, 2012; Morita & Burns, 2013; Rusman et al., 2010), provide measures of team effectiveness (Chou, Wang, Wang, Huang, & Cheng, 2008; Cordery & Soo, 2008; Costa, 2003; Furst et al., 1999), and provide insights on team development issues (Holton, 2001; Morita & Burns, 2014a; N. A. Stanton, 2011). Trust has great potential to act as a catalyst for human interaction and proper social integration of individuals inside teams and corporations (Bachmann & Zaheer, 2006; Kramer & Tyler, 1996; N. A. Stanton, 2011).

There are, however, several challenges to measuring interpersonal trust. First, although the word "*trust*" is loosely in everyday language, it is a complex construct involving several factors (e.g., personality factors, and antecedents) that combined, form our perception of trust (Lewicki et al., 2006; Mayer et al., 1995; McAllister, 1995; Morita & Burns, 2014a, 2014b; N. A. Stanton, 2011). Lewicki, Tomlinson, and Gillespie (2006) describe in their systemic review, three major approaches to model and measure trust. In general, they describe trust as dependent on trust antecedents (e.g., past behaviour, values), personality of the trustee (having an effect on predictability of behaviour), and the personality of the trustor (in the form of propensity to trust). These factors are integrated into cognitive states that represent the amount of trust on the other individual (Mayer et al., 1995; McKnight et al., 1998; Morita & Burns, 2014b; D. M. Rousseau et al., 1998)

Second, and most relevant for human factors and design, these factors and their relative importance in the perception of trust can vary with context (Morita & Burns, 2014b). For example, in a very technical environment, knowledge and competencies may strongly influence trust perception; whereas in a higher risk environment, such as healthcare, military, or fire-fighting (Lazzara, Fiore, Wildman, Shuffler, & Salas, 2009; Montague & Asan, 2012; Myers, 2005; Ruark, Orvis, Horn, & Langkamer, 2009; N. A. Stanton, 2011; K. A. Wilson et al., 2007), behaviour predictability may have a stronger influence. Current available trust metrics, however, do not capture these subtleties in trust formation, which are very relevant when used for the identification of effective interventions to foster trust (Knight, 2001; Morita & Burns, 2014b). According to Morita and Burns' model (Morita & Burns, 2014b), each perceived cue is dependent on an internal weight that regulates the effect of that cue on the formation of the trust state. These weights, which constrain the perception mechanisms, are highly dependent on task, cultural, environmental, and experiential constraints that shape the individual trust cognition (J. D. Lee & See, 2004; Morita & Burns, 2014a, 2014b; N. A. Stanton, 2011).

The current approaches to measuring and evaluating interpersonal trust include (1) behavioural observations (Jirotka et al., 2005; A. Jones & Jones, 2011; N. A. Stanton & Ashleigh, 2000), (2) trust metrics (Butler Jr., 1991; L. L. Cummings & Bromiley, 1996; Jian, Bisantz, & Drury, 1998; McAllister, 1995), (3) trust assessment through outcomes (Bos et al., 2002; Lewicki et al., 2006), and (4) trust games (Martin, Juvina, Lebiere, & Gonzalez, 2013). Behavioural observations require researchers to be embedded into the collaborative environment for extensive time-consuming ethnographic studies (Morita & Burns, 2014a; N. A. Stanton & Ashleigh, 2000). Existing trust metrics, on the other hand, correspond to a more efficient way of measuring trust, but lose some subtleties of trust formation that can usually be captured through ethnographic studies (Fetterman, 2010).

Nonetheless, trust metrics are a practical and widespread way of collecting trust data. However, the focus so far has been on collecting data as a "*snapshot*" of the trust interaction (Lewicki et al., 2006), without looking at the evolution of trust over time on longitudinal studies, nor capturing the subtle aspects of trust formation that are unique to each individual and each collaboration (Knoll & Gill, 2011; Morita & Burns, 2014b; N. A. Stanton, 2011). Metrics that are designed for this purpose need to be short and compact, clearly breakdown the trust subscales that lead to the assessment of trust, and include mechanisms that allow the identification of the most influential or most important cues on the trust formation process for those individuals being evaluated. Individual information collected also needs to be easy to combine into a team-wide assessment of trust.

Satisfying part of these needs, authors in the trust literature have developed a number of trust metrics designed for certain types of trust relationships being measured. For example, within the institutional trust domain, some of the existing trust metrics provide a compressive list of sub-dimensions that influence trust (Butler Jr., 1991), while others present a more condensed view focusing on global types of trust (McAllister, 1995). Other approaches have been on the evaluation of team-wide trust (Costa & Anderson, 2011; L. L. Cummings & Bromiley, 1996) or even trust propensity (M.J. Ashleigh, Higgs, & Dulewicz, 2012; Rotter, 1967). Still within a human factors domain, metrics were also developed for measuring trust in automation (Freedy et al., 2007; Jian et al., 2000; Master et al., 2005). These, however, do not directly apply to measuring interpersonal trust since factors that influence the formation of trust in automation (trust antecedents) are different, as discussed by Lee and See (2004), Madhavan and Wiegmann (2007), and Lyons and Stokes (J. B. Lyons & Stokes, 2012).

Although effective in capturing an instantaneous measurement of trust, none of the existing metrics currently focus on identifying the subtleties of trust formation and the constraints to the perception of trust factors (Morita & Burns, 2014b), nor are designed for longitudinal studies (Lewicki et al., 2006). The relative importance of various factors is critical to understanding how trust changes with context and how designers and managers can identify how to effectively foster trust. When looking at trust levels as an input to design cycles, choosing interventions that can positively impact trust formation is significantly more difficult without properly identifying which cues have higher significance for the team members inserted in that environment, as it has been widely discussed in the trust in automation domain (J. D. Lee & See, 2004; Merritt, Heimbaugh, LaChapell, & Lee, 2013; Merritt & Ilgen, 2008; Parasuraman & Riley, 1997; L. Wang, Jamieson, & Hollands, 2011).

Therefore, we have identified the need to develop a novel trust metric that, while compact and effective for longitudinal studies, can still capture the nuances behind the differential perception of trust factors.

6.2.3 Objectives

Our main objective is to provide human factors, ergonomics, and organizational research specialists with a trust measurement tool that helps elicit trust issues within a team through the measurement of trust, as well as providing information that helps identify the most effective interventions to target trust issues in each specific team. Therefore, we present the Quick Trust Assessment Scale (QTAS) in this paper; a trust metric that, while still reliable, achieves the following:

1) Measures trust on a specific individual inserted in a team environment by incorporating the evaluation of teamwork-related trust antecedents and personality factors into a reliable trust metric.
2) Evaluates which dimensions have stronger effects on the formation of trust, capturing contextual distinctions and helping identify effective trust fostering initiatives and interventions without pursuing extensive ethnographic studies.
3) Allows quick and efficient evaluation of interpersonal trust on another team member, both in face-to-face collaborations and virtual collaborations mediated by collaboration systems or computer mediated communication systems.
4) Allows longitudinal measurements of trust, using the same participant in different situations, by using a compact and efficient metric that captures situational differences.

It is important to clarify that it is not our goal to measure global trust (Farris et al., 1973), team-wide trust (Costa & Anderson, 2011), organizational trust atmosphere in teams or corporations (L. L. Cummings & Bromiley, 1996), nor trust propensity (M.J. Ashleigh et al., 2012; Rotter, 1967); as they follow a more holistic view of trust by evaluating either how an individual is inserted in the society, or collective evaluation of trust. Our focus is on measuring trust in another specific individual inserted in a team, using a metric which data has the potential for a post-hoc integration of individual measurements into a team-wide assessment of effective ways to foster trust. The design of QTAS allows a macro scale analysis of team-wide trust by integrating all the individual assessments, or a micro scale analysis looking at each of the trust relationships.

Within a human factors domain, the QTAS will shed light into the cognitive processes leading to the formation of a trust state, allowing human factors researchers to tailor interventions (e.g., redesigns of communication systems, deployment of team and trust building activities, managerial interventions, or training) that can address specific needs of each team (Burt & Stevenson, 2009; Grudzewski, Hejduk, Sankowska, & Wantuchowicz, 2008; Ruark et al., 2009; Wildman et al., 2009). A summary of possible interventions is presented in the discussion section.

The QTAS has been designed taking into consideration its applicability for face-to-face teams and virtual teams, by incorporating antecedents, constraints, and personality factors from these two domains (Bachmann & Zaheer, 2006; Grudzewski et al., 2008; Hung et al., 2004; Jarvenpaa et al., 1998; Mayer et al., 1995; Morita & Burns, 2014b; Ridings et al., 2002).

6.2.4 Literature Review

We start by reviewing the definitions of trust used in this publication, followed by a review of existing trust metrics that were used as a foundation for the development of the QTAS. Lastly, in order to design the QTAS to include a component that measures the differential loading of each subscale, we discuss the process used by Hart and Staveland (1988) to design the NASA-TLX – a workload measurement that uses a similar structure to measure loadings of each sub-dimension of human workload.

6.2.4.1 The Meaning of Trust

Characterizing trust and defining its meaning has always been a described as a hard endeavour, without consensus between the multiple authors in the field (M.J. Ashleigh & Stanton, 2001; N. A. Stanton, 2011). Authors like Rousseau et al. (1998) and Abdul-Rahman and Hailes (2000) have described its conceptualization as "*fragmented*", "*elusive*" and "*hard to define*". Nonetheless, multiple definitions have been used in the literature, being applied to different domains as close relationships (Larzelere & Huston, 1980; Rempel et al., 1985; Sorrentino et al., 1995), organizational trust (Kramer & Tyler, 1996; Maurer, 2010; Mayer et al., 1995; Wehner, Clases, & Bachmann, 2000), teamwork (L. L. Cummings & Bromiley, 1996; Jarvenpaa et al., 1998; N. A. Stanton, 2011), and even automated systems (Hancock et al., 2011; J. D. Lee & See, 2004; Muir, 1994; Pak et al., 2012; Parasuraman & Riley, 1997).

However, within the teamwork boundaries, a stronger focus has to be given to the cognition-based trust (McAllister, 1995) or calculative confidence (Morita & Burns, 2014b) as the interpersonal dynamics inside teams, specially virtual and swift teams, lead to minimal development of affective components of trust (Kramer & Tyler, 1996). Therefore, for the purpose of our research, we focus our attention on the definitions by Mayer, Davis, and Schoorman (1995) and Cummings and Bromiley (1996).

Mayer, Davis, and Schoorman (1995) defined trust as "*the willingness of a party to be vulnerable to the actions of another party based on the expectation that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other party*".

Cummings and Bromiley (1996) take a group view on trust and define trusting a group when people believe that "*(a) makes good-faith efforts to behave in accordance with any commitments both explicit or implicit, (b) is honest in whatever negotiations preceded such commitments, (c) does not take excessive advantage of another even when the opportunity is available.*"

Within the boundaries of our research, our focus is on behaviour predictability and projection of actions (M.J. Ashleigh & Stanton, 2001; Morita & Burns, 2014b), which allows team members to anticipate team members' performance and behaviour based on their trust antecedents and personality factors and consequently, manage the risks involved (M.J. Ashleigh & Stanton, 2001; Lewicki et al., 2006; Sinclair et al., 2012). This definition of trust has been chosen as trust can be described by a state that contains a representation of the individual being trusted (Mayer et al., 1995; Morita & Burns, 2014b). The trust state is composed via the perception of multiple characteristics of the individual being trusted, team, culture, environment, and task being performed that when integrated, define the level of trust on the other individual (M.J. Ashleigh & Stanton, 2001; Mayer et al., 1995; Morita & Burns, 2014b; N. A. Stanton, 2011; K. A. Wilson et al., 2007).

These individual, environmental, cultural, and task characteristics are commonly defined as antecedents to trust, being the focus of trust metrics.

6.2.4.2 Existing Trust Metrics

Ding and Ng (2007), Robinson, Shaver, and Wrightsman (1991), Dietz and Hartog (2006), and Lewicki, Tomlinson, and Gillespie (2006) presented comprehensive reviews of interpersonal trust metrics and organizational trust, serving as a primer for choosing which metrics we would include in this literature review. Information about each metric or scale was extracted from the original publications and referenced in Table 6. Such metrics were used as a foundation for the development of the QTAS by providing an initial list of dimensions and the methods generally used for measuring trust. The dimensions from the metrics described in Table 6 were combined with other trust antecedents identified in the literature review to generate the initial list of dimensions for the QTAS.

The metrics described in Table 6 were chosen for this study taking into consideration two characteristics that would help identify important components for QTAS: metrics that measure interpersonal trust within teams or corporations (any type of trust), and metrics that measure interpersonal trust in a specific individual (any type of domain). Based on this literature review, we grouped these metrics into four categories that define the type of trust being measured, the domain, and the issues of each metric when evaluated under the lens of our objectives:

1. Metrics that measure trust belief, trust atmosphere, or corporate trust, instead of specific trust on another team member.
2. Metrics that measure trust on a specific individual, but focus on measuring trust in close relationships or on significant others, in non-teamwork related relationships.
3. Metrics that measure trust on specific others in the workplace, but use longer questionnaires for this end.
4. Metrics that measure trust on specific others in the workplace, but incorporate many components of affective trust that are not readily available in non-collocated, swift, and/or diverse teams.

These metrics are not all encompassing, but were chosen based on the needs outlined in our objective section and assessed focusing on the identification of quick and effective trust metrics for the evaluation of trust on a specific other in a teamwork setting.

The focus of this paper is to help human factors and organizational research specialists to identify the major bottlenecks to trust development, so designers can create interventions or redesign collaboration and communication systems to support the development of trust in teams. However, without knowing which factors play significant roles in trust formation, designers cannot properly select and develop effective trust-fostering interventions. Currently, none of the metrics found in the literature provide mechanisms to measure the differential effect of specific factors on trust formation.

Table 6: Categorization of existing trust metrics, including size of the questionnaire categorized into the four limitation groups.

Issues and constraints	Name, author, and size of scale
1. Metrics that measure trust belief, trust atmosphere, or corporate trust instead of specific trust on another team member.	**Interpersonal trust scale** Rotter (1967) 25 questions **Trust and organizational climate** Farris et al. (Farris et al., 1973) 24 questions **Interpersonal trust at work** Cook and Wall (1980) 12 questions **Trust in teams** Costa and Anderson (Costa & Anderson, 2011) 21 questions **Organizational trust inventory** Cummings and Bromiley (1996) 12 or 62 questions (short and long versions)
2. Metrics that measure trust on a specific other, but focus on measuring trust in close relationships or on significant others in non-teamwork related relationships.	**The dyadic trust scale** Larzelere and Huston (Larzelere & Huston, 1980) 8 questions **Specific interpersonal trust scale** Johnson-George and Swap (1982) 43 questions **Trust scale** Rempel and Holmes (1985) 18 questions
3. Metrics that measure trust on specific others in the workplace, but use longer questionnaires for this end.	**Conditions of trust inventory** Butler (Butler Jr., 1991) 44 questions
4. Metrics that measure trust on specific others in the workplace, but incorporate many components of affective trust that are not readily available in non-collocated and/or diverse teams.	**McAllister's trust scale** McAllister's (1995) 11 questions

The next step towards the development of the QTAS was to identify a metric development method and a metric format that would provide mechanisms for quickly evaluating trust, while gauging the differential influence of each dimension on trust perception. These requirements call for a combination of two measurement techniques: one measuring each dimension individually, and the second evaluating the influence of each dimension on the overall trust formation process. We modelled our process from a different measurement tool, the NASA-TLX (S. G. Hart & Staveland, 1988). The NASA-TLX also measures both individual components and the importance of each component in the current context. Further, the use of the NASA-TLX is quite familiar to human factors practitioners. For these reasons, the NASA-TLX provided a useful model for developing a tool to measure trust.

6.2.4.3 NASA-TLX

The NASA-TLX is one of the most, if not the most, accepted metric for human workload (S. G. Hart, 2006; Rubio, Díaz, Martín, & Puente, 2004), with more than 550 published articles using this technique between 1988 and 2006 (S. G. Hart, 2006). The original NASA-TLX publication (S. G. Hart & Staveland, 1988) has been cited 3588 times according to Google Scholar.

Through a compounded measurement of dimensional ratings and dimensional pair comparisons, it is possible to adjust the weights of each component of the NASA-TLX on the overall workload level (S. G. Hart & Staveland, 1988). Not only does this create a more balanced and adaptable score, but it also provides secondary insights on each dimension (Rubio et al., 2004). However, multiple authors, as discussed by Hart (2006), have demonstrated that the raw version of NASA-TLX (without the pair selections) showcases various levels of sensitivity when compared to the original weighted version of the NASA-TLX, ranging from higher to lower sensitivity (Byers, Bittner, & Hill, 1989; Hendy, Hamilton, & Landry, 1993; Liu & Wickens, 1994). The importance of the subscale ratings, however, should not be diminished. Hart (2006) also presented that 20% of the studies she evaluated used the ratings to separately analyse the individual effects of each of the subscales on the overall workload.

We hypothesize that a similar approach could be used to develop trust metrics using the differential loadings of the subscales to investigate the importance of various factors on trust perception. When examining trust formation, as described by Morita and Burns (2014b), it is possible to notice a weighting mechanism on the perception component of the model, accounting for user variability and influences of external constraints on the perception of trust factors. Such characteristic of trust formation is in alignment with the pair comparison component of the NASA-TLX structure (S. G. Hart & Staveland, 1988), which allows the differential evaluation of the influence of each sub-factor on the composition of workload scores. The pair selections lead to more refined scores based on situation-specific and individual-specific weights of each dimension (Rubio et al., 2004).

6.2.5 Development of the Quick Trust Assessment Scale

The QTAS development process started by identifying the ideal structure for our metric, followed by the selection of dimensions through two studies named Study 1 (n=22) and Study 2 (n=151), and evaluated during Study 3 (n=144).

6.2.5.1 The QTAS Structure

We adopted a structure similar to that currently used by NASA-TLX (S. G. Hart & Staveland, 1988) for the development of the QTAS since its format is a good match to our objectives and the characteristics of trust formation, as described by Morita and Burns (2014b). Similarly to NASA-TLX, the QTAS will present participants with a combination of Likert-scale ratings for each dimension (measuring the level of each construct or dimension on the evaluation of the other party), in addition to pair selections of most important dimensions for trust (measuring the load of that dimension on the trust state formation process).

The pair selection of the QTAS was designed by arranging in pairs all the dimensions from the preliminary version of the QTAS identified through Study 1 and Study 2, corresponding to all possible combinations of the dimensions without repetition (S. G. Hart & Staveland, 1988). This method creates direct comparisons of each pair that can be integrated into a ranking of preferences or importance of each of the dimensions after counting how many times each dimension was selected as most important. The scores obtained can be used separately to identify individual preference or individual cognitive weighting; or can be integrated within a team to obtain a team-wide assessment of the importance of each dimension on the formation of a trust state.

Additionally, the results from the pairwise comparisons would also play as weights for the final calculation of a trust level, providing a weighted trust score that accounts for situational and individual variability in the perception of trust (La Guardia & Ryan, 2007; Morita & Burns, 2014b).

We decided that an ideal metric would have six to eight items to maximize time effectiveness, making it appropriate for use in longitudinal studies. We postulate that each question would take approximately 5 seconds to be answered, totalling a maximum of 3 minutes to complete the weighted QTAS version and 40 seconds for the raw QTAS (version without collecting the weights). The length of QTAS is an important factor as we have to consider that each team member would have to evaluate all their peers within a team.

6.2.5.2 QTAS Dimensions

As teams move into more technological domains (Grudzewski et al., 2008; Salas, Cooke, & Rosen, 2008; Townsend et al., 1998) as well as start working as virtual teams, trust antecedents and constraints expand beyond abilities, benevolence, and integrity as normally described by Mayer, Davis, and Schoorman (1995). Although most of the trust antecedents and personality factors identified through the literature review can still be clustered within those three categories, there is now a larger array of factors that define the work of teams in these technological environments (Cordery & Soo, 2008; Jarvenpaa et al., 1998; R. Lyons et al., 2009; Peters & Manz, 2007; Ridings et al., 2002). We are not claiming that the three categories defined by Mayer, Davis, and Schoorman (1995) are not important anymore, just that there is a need for exploring a larger set of factors to be included in a trust metric to be used in current technologically-dense society (Grudzewski et al., 2008; Salas, Cooke, et al., 2008; Townsend et al., 1998). As we are looking for ways to influence trust through design and managerial interventions, it is important to consider the inclusion of aspects of collaboration that impact trust and can be the focus of interventions.

Trust can be influenced by a significantly large number of variables (M.J. Ashleigh & Stanton, 2001; Jarvenpaa et al., 1998; Knoll & Gill, 2011; Lewicki et al., 2006; Mayer et al., 1995; N. A. Stanton, 2011), that once perceived, are combined through our perceptual and cognitive mechanisms to form a trust state (Morita & Burns, 2014b). We conducted an extensive literature review focused on finding individual, cultural, environmental, and task-related aspects that are described as influences to trust formation. Some examples of reviews that encompass a large number of these factors include Bhattacharya, Devinney, and Pillutla (1998), Mayer, Davis, and Schoorman (1995), Weber, Malhotra, and Murnighan (2004), Kramer (1999), Six (2007), Six, Nooteboom, and Hoogendoorn (2010), Stanton (2011), Ashleigh and Stanton (2001), Rousseau at al. (1998) and McLain and Hackman (Mclain & Hackman, 1999). This process emanated an initial comprehensive list of 90 factors that were described as influencing trust behaviour, which required further processing to collapse the 90 factors into a manageable number of dimensions for a trust metric.

Due to the large number of factors extracted from the papers that were reviewed, including a complete list in this paper has been deemed not feasible. Instead, we present the supporting references for each of the finalized 15 clusters in Table 7, which correspond to the clustering of trust factors after Study 1. We reached the final format used in the initial evaluation of the QTAS after running two studies (Study 1 and Study 2) that allowed us to refine the initial 90 factors into the 9 dimensions of the preliminary version of the QTAS. The two studies are presented in the next sections.

6.2.5.2.1 Study 1 – Card Sorting and Clustering of Trust Factors

Since one of our goals was to develop a compact trust metric, the 90 identified variables that influence trust needed to be managed into a smaller number of dimensions to be included in the QTAS, while still capturing the complex nuances of trust formation.

Methodology. A card sorting exercise was conducted to cluster the 90 factors into groups of similar or related factors, using the methodology described by Spencer (2009). The study was hosted at www.websort.com. The 90 factors were placed on different cards and participants were asked to cluster them into open groups, without any constraints from the experimenters (Spencer, 2009). Participants were free to choose the number of groups, the contents of each group, and the name that better represented their clustering criteria. Participants were recruited at the University of Waterloo, with attempts made to achieve a balance between students, professors, and industry partners. As part of the ethical requisites for all studies including human participants, our studies received full ethics approval from the University of Waterloo Office of Research Ethics.

Results. A total of 22 people (five undergraduate students, six graduate students, six professors, and five industry employees) participated in the card sorting exercise. There was a large variability in the number of groups in which the cards were sorted into (M= 9.73, SD= 4.38, SEM=0.96), consequently not presenting a reliable measure for defining the final number of factors to be extracted as clusters from this study (DeVellis, 2012; Spencer, 2009). Alternatively, we followed common practice in scale development (DeVellis, 2012; Hinkin, 1998; Neff, 2003). We started with the double of the number of clusters (corresponding to the possible dimensions of the QTAS) that we wanted to include in the final version of the QTAS, so we could later exclude less significant items (Hinkin, 1998). Using Syncaps v1.0 to analyse our results (Syntagm, 2012) and the criteria described above, we decided to cluster the factors into 15 groups, since that is about double of the size of the intended number questions for our QTAS. This number served as input to our clustering analysis, where we processed the data collected on Study 1 to generate 15 clusters (Table 7). Syncaps (Syntagm, 2012) allows us to choose the final number of clusters and processes the data collected on www.websort.com into our predefined parameters. Although the number of clusters was defined by the researchers following the requirements of our metrics described above, the groupings and contents of each cluster were defined based on the data collected from the clustering study. This approach was chosen to avoid researcher bias, as we were interested in identifying how participants would cluster these factors into smaller subgroups. The factors presented on Table 7 correspond to a combination of personality (Lewicki et al., 2006) and trust antecedents (Knoll & Gill, 2011) elicited through the literature review outlined above as factors described by multiple authors as influencing trust.

The method we chose to develop the QTAS is in alignment with the psychological approaches for measuring trust as described by Lewicki, Thomlinson, and Gillespie (2006) where we incorporate trust antecedents, behavioural antecedents, and personality factors that shape trust decision into components of trust metrics. As described by Lewicki, Thomlinson, and Gillespie (2006), in more complex views of trust, "*trust is deemed to be a single, superordinate factor, with cognitive, affective, and behavioural intention sub-factors*", requiring a comprehensive view of which factors influence trust and incorporating such array of factors into a trust metric (Lewicki et al., 2006; Lewis & Weigert, 1985). The combination of trust antecedents and personality factors into the measurement of trust is also supported by McKnight, Cummings, and Chervany (1998), Rotter (1971), and Schlenker, Helm, and Tedeschi (1973).

These clusters, however, included multiple personality factors that play an important role in the formation of trust into a single grouping (F4) – an oversight when evaluating trust. As discussed by Rotter (1967, 1971) and Schlenker, Helm, and Tedeschi (1973), trust is heavily influenced by personality factors, requiring a more careful assessment of separate psychological constructs. Based on this research, we chose to continue to evaluate personality factors individually, rather than clustering them into a single dimension.

The contents of all the clusters carried forward to Study 2 presented in Table 7 (including the personality cluster) correspond to clusters defined by the participants during Study 1. We acknowledge that some of the contents of the personality cluster (F1) orbit between personality and antecedents to trust, but the dominant theme in that cluster are the personality factors.

Discussion. The factors included in Table 7 are in alignment with the antecedents of interpersonal trust in collaborative workplaces and organizations (Jarvenpaa et al., 1998; G. R. Jones & George, 1998; Kramer & Tyler, 1996; Mayer et al., 1995; McAllister, 1995; McKnight et al., 1998), as well as military teams (Hyllengren et al., 2011; Ruark et al., 2009; N. A. Stanton, 2011; K. A. Wilson et al., 2007); supporting our claim that our trust metric is indeed focused on the antecedents that are relevant for teamwork environments.

Table 7: List of the 15 groups of trust influencing factors resulting from the cluster analysis. This table also presents an identifier and supporting literature for each cluster.

Cluster	Trust regulating factors	Literature supporting each cluster
F1	Basic personality of the person you are trusting (beliefs, goals, benevolence, interpersonal skills, and self-confidence).	Lahno 1995; Kramer 1999; Six, Nooteboom, and Hoogendoorn 2010; Mayer, Davis, and Schoorman 1995; Ashleigh and Stanton 2001
F2	Past behaviour that showcases the character/personality of the person you are trusting.	Lahno 1995; Beccerra and Gupta 1999; Six 2007; Kramer and Tyler 1996; Ashleigh and Stanton 2001
F3	Your awareness/knowledge of characteristics of the task, institution, and the environment where you work.	Kramer 1999; Six, Nooteboom, and Hoogendoorn 2010
F4	Formal training, competencies, and abilities of the person you are trusting.	Six 2007; Six, Nooteboom, and Hoogendoorn 2010; McAllister 1995; Mayer, Davis, and Schoorman 1995; Ashleigh and Stanton 2001
F5	Information about past experiences and history of collaborations passed by others in the institution, about the person you are trusting.	Kramer 1999; McLain and Hackman 1999**;**
F6	Role of the person you are trusting in the team or in the institution.	Kramer 1999; Six 2007; Six, Nooteboom, and Hoogendoorn 2010; Weber, Malhotra, and Murnighan 2004
F7	Risks for the person you are trusting and motivation behind the request for trust.	Bhattacharya, Devinney, and Pillutla 1998; Mayer, Davis, and Schoorman 1995
F8	Shared values and affection/empathy for the person you are trusting.	Six 2008; Mayer, Davis, and Schoorman 1995; Beccerra and Gupta 1999
F9	Your instinct/gut feeling in the situation, or your disposition to trusting the other individual.	Morrow, Hansen, and Pearson 2004; McLain and Hackman 1999; James 2002; Mayer, Davis, and Schoorman 1995; Ashleigh and Stanton 2001
F10	Risks that you accept when trusting the other person and your motivations for trusting.	Mayer, Davis, and Schoorman 1995; Bhattacharya, Devinney, and Pillutla 1998; Lahno 1995; Das and Teng 2004
F11	Your own formal training, competencies, and abilities.	Six, Nooteboom, and Hoogendoorn 2010; Kramer 1999; Bachmann and Zaheer 2006
F12	Availability of information about risks in the task, and abilities and competencies of the person you are trusting.	McLain and Hackman 1999
F13	Rules, culture, and goals of the institution where you work/study.	Beccerra and Gupta 1999; Kramer 1999; Six 2007; McLain and Hackman 1999
F14	Characteristics of the environment and the task, in addition to all risks in executing the task.	McLain and Hackman 1999; Weber, Malhotra, and Murnighan 2004; Bhattacharya, Devinney, and Pillutla 1998; James 2002
F15	The other's awareness/knowledge of characteristics of the task, institution, and the environment where you work.	Kramer 1999; Six, Nooteboom, and Hoogendoorn 2010

These 15 groups of trust antecedents and 9 groups of personality factors provide a representation of the 90 initial factors elicited during our literature review. The 24 factors described above were further refined into the preliminary version of the QTAS in Study 2. Personality items were extracted from the personality cluster by cross-referencing personality items with existing trust metrics presented in Table 6.

6.2.5.2.2 Study 2 – Selection of the QTAS Dimensions

The purpose of our Study 2 is to identify and select the clusters (from Study 1) that represent the most important factors considered by individuals when trusting in teamwork environments. The driving force for this second study was the fact that a trust metric modelled after the NASA-TLX, based on 24 items, would yield 276 pair comparisons for each participant, in addition to 24 variables for each single evaluation. This would make the QTAS too long for our purposes. Therefore, in accordance with our objectives, we still needed to further reduce the QTAS to six to eight dimensions to achieve a compact metric that while still effective, does not take too long to be filled. Therefore, in our second study, we asked participants to select, rate, and rank the most important of the 15 trust factors for their trust perception (Table 7), as well as rank the 9 individual personality factors (Table 10).

Methodology. This second study was hosted at www.surveygizmo.com, where participants were asked to perform three tasks using the fifteen trust antecedents refined in Study 1: to select the factors they considered most important for their trust decision, to rank the factors in order of influence on their trust decision, and to label each factor as having little/medium/strong influence on their trust decision. We also asked participants to rank the 9 personality factors extracted from the personality cluster in Study 1 in order of influence on their trust decision. The ranking tasks only allowed participants to rank one item, while selection and rating tasks allowed participants to identify multiple items.

We initially recruited 200 participants for Study 2. Due to our ethics protocols, we could not require participants to answer all the questions. Therefore, we had to remove a great number of datasets (25%) that were incomplete and consequently, were not useful for our analysis. A total of 151 participants returned complete and usable datasets for our analysis, providing a combination of representatives from industry, academia, and university students.

With the intention of identifying possible predictors for the use of each of the 24 trust and personality factors in a trust decision, we also collected data about age, gender, educational level, and locus of control (Rotter, 1966) of the participants. These variables have been proposed to influence how people make trust decisions, triggering our interest in evaluating if their effect would be significant enough to require separate metrics for separate groups (Frost et al., 1978; Johnson-George & Swap, 1982; Rotter, 1980; Sun, Zhang, Wiedenbeck, & Chintakovid, 2006; Sutter & Kocher, 2007). Johnson-George and Swap for example, developed two gender-specific trust metrics for measuring trust in close relationships to account for these differences (Johnson-George & Swap, 1982), while Stanton describes the influence of culture on trust (N. A. Stanton, 2011). Through logistic regression analyses (Hosmer & Lemeshow, 2004) we explored the relationship of each selected, ranked, and rated variable, with the demographics data collected.

Results. Statistical descriptors of this population can be found in Table 8. The population represented a pool of participants with a good representativeness of gender, age, education levels, and locus of control, allowing us to evaluate the influence of each of these variables as predictors to trust and personality factors.

Table 8: Demographic descriptors of the population of Study 2.

Variable	Value	Frequency	Percentage
Gender	Male	85	56.3%
	Female	66	43.7%
Age	Under 25	68	45.0%
	25 to 34	71	47.0%
	More than 35	12	8.0%
Education	No college or university degree	7	4.6%
	Currently an undergraduate student	25	16.6%
	Bachelor or college degree	18	11.9%
	Currently a graduate student	81	53.9%
	Post-graduate degree	20	13.2%
Locus of Control	Continuous score from 0 – 23	Mean = 11.64 Std error = 0.318 Minimum = 2 Maximum = 21	

In order to select which trust factors and personality factors would be included in the preliminary version of our trust metric as dimensions or sub-scales, we analysed the frequency in which participants:

- Selected each of the 15 trust factors as important for their trust decision.

- Rated each of the 15 trust factors as having strong influence on trust.
- Ranked which of the 15 trust factors as the most influential on trust.
- Ranked which of the 9 personality factors as the most influential on trust.

The results from descriptive statistics on the frequencies described above can be found in Table 9 for trust factors and in Table 10 for personality factors. The results were kept separate as they require different procedures for analysis as described below.

Since we had access to data from the ranking, rating, and selecting tasks performed by participants, we identified the items to be carried forward for further evaluation on Study 3 based on the overlapping results of the three tasks. In summary, we carried forward factors that were common to the top items of each task. These were identified by ordering the trust factors within each task according to the data collected and comparing the results of the three tasks to identify which items appeared on the top of all three tasks. According to the results in Table 9 and following these criteria, the following six trust factors were selected: F1, F2, F4, F5, F9, and F11.

One important aspect to highlight here is that "Basic personality of the person you are trusting (beliefs, goals, principles, interpersonal skills, self-confidence)," or Factor 1, was within the top six factors from all three tasks, further reinforcing the importance of personality factors and consequently supporting our decision to add a separate personality ranking task to our study.

Logistic regression analyses were performed to evaluate the predictability of the results of each of the three tasks, for the 15 factors identified in Study 1. These results will be important after the evaluation stage in Study 3, as they could provide evidence of which dimensions should be maintained or removed from our metrics. Trust factors that can be predicted by demographic variables are not appropriate for a unified trust metric that is intended to work in the entire population. Similar regression was performed for the ranking of the personality factors. We used gender, age, educational level, and locus of control score of the participants as predictors. A test of the full model versus a constant only model, indicating that the predictors can accurately predict the selection, rating, or ranking of that factor, was statistically significant for: rating of Factor 3 (chi square = 16.306, $p = 0.038$, $df = 8$, Nagelke's $R^2 = 0.038$, prediction success = 75.5%), ranking of Personality Factor 3 (chi-square 28.042, $p < 0.001$, $df = 8$, Nagelke's $R^2 = 0.5$, prediction success = 96%), and Personality Factor 7 (chi-square = 19.588, $p = 0.012$, $df = 8$, Nagelke's $R^2 = 0.184$, prediction success = 78.8%). All Nagelkerke's R^2 results indicate either weak (F3, PF7) or medium

Table 9: Results from the selection, rating, and ranking task of trust factors on trust decisions from Study 2. Percentage represents the total percentage of participants that selected, rated, and ranked that item, and the number in brackets shows the frequency (n=151).

Factors		Factor selected as important	Factor rated as having "Strong influence"	Factor ranked as most influential
F1	Past behaviour that showcases the character/personality of the person you are trusting.	65.56% (99)	39.07% (59)	15.23% (23)
F2	Formal training, competencies, and abilities of the person you are trusting.	86.09% (130)	61.59% (93)	25.17% (38)
F3	Information about past experiences and history of collaborations passed by others in the institution, about the person you are trusting.	52.32% (79)	23.84% (36)	3.31% (5)
F4	Basic personality of the person you are trusting (beliefs, goals, benevolence, interpersonal skills, and self-confidence).	74.83% (113)	50.99% (77)	15.89% (24)
F5	Your instinct/gut feeling in the situation, or your disposition to trusting the other individual.	70.86% (107)	38.41% (58)	5.96% (9)
F6	Your own formal training, competencies, and abilities.	58.28% (88)	17.88% (27)	1.99% (3)
F7	The other's awareness/knowledge of characteristics of the task, institution, and the environment where you work.	33.77% (51)	12.58% (19)	1.32% (2)
F8	Role of the person you are trusting in the team or in the institution.	37.75% (57)	13.25% (20)	0.66% (1)
F9	Your awareness/knowledge of characteristics of the task, institution, and the environment where you work.	65.56% (99)	35.10% (53)	9.27% (14)
F10	Availability of information about risks in the task, and abilities and competencies of the person you are trusting.	41.06% (62)	19.21% (29)	3.97% (6)
F11	Risks that you accept when trusting the other person and your motivations for trusting.	62.91% (95)	41.06% (62)	8.61% (13)
F12	Rules, culture, and goals of the institution where you work/study.	44.37% (67)	29.80% (45)	3.31% (5)
F13	Characteristics of the environment and the task, in addition to all risks in executing the task.	39.07% (59)	12.58% (19)	1.32% (2)
F14	Shared values and affection/empathy for the person you are trusting.	39.07% (59)	13.25% (20)	1.32% (2)
F15	Risks for the person you are trusting and motivation behind the request for trust.	62.91% (95)	30.46% (46)	2.65% (4)

(PF3) relationship between the predictors and the grouping. Models with the predictor variables only accounted for 3.8% (F3), 50% (PF3), and 18.4% (PF7) of the total variance in each model. Additionally, for all regressions conducted, no predictor showed statistical significance in predicting the participants' choices.

Table 10: Results from the ranking task of the effect of personality factors on trust decisions.

		Personality factors ranked as most influential on the trust decision
PF1	Interpersonal skills, self confidence	3.31% (5)
PF2	Benevolence/willingness to help/solidarity	1.32% (2)
PF3	Principles, beliefs, and goals	5.30% (8)
PF4	Integrity	17.22% (26)
PF5	Cooperativeness	5.30% (8)
PF6	Takes responsibility (doesn't pass the blame)	13.25% (20)
PF7	Reliability	23.18% (35)
PF8	Openness/clarity	6.62% (10)
PF9	Trustworthiness	24.50% (37)

Discussion. Instead of assigning only one task to the participants (for example, the selection of which trust factors are important for trust decision) and using the results to identify which factors to include in the QTAS, we used a combination of the results from the three tasks (selection, rating, and ranking). Since the results are binary and all results are within a quartile, we could not rely on standard deviations to evaluate our decisions since they are directly correlated to the frequency of the measurement. When looking at the top factors in each of the tasks, the top six factors are the same regardless of the task being evaluated. The top six trust factors that are common to all three tasks are: F1, F2, F4, F5, F9, and F11 (Table 9). Since F1 corresponds to the cluster of personality factors, we removed it, as its contents were included as separate personality factors on a separate ranking task (Table 10).

For the selection of personality factors to be carried forward, we only had access to the frequency of participants that chose each personality factor as being the most influential on trust decisions. Therefore, we decided to carry forward every factor selected as most influential by more than 11.11% of the participants. This threshold was chosen as every factor with a frequency higher than 11.11% would have been selected more often than if selections were evenly distributed (since we had 9 items) indicating a higher overall importance of those tokens. As per these criteria, we decided to include the top four personality factors in QTAS, resulting in a manageable 9 dimensions to be evaluated in Study 3. It is possible to notice that Trustworthiness (24.5%) and Reliability (23.18%) display very similar results, as they are indeed very similar and related constructs. However, we have decided to keep them separate in the first draft of QTAS. This decision was made based on the fact that the two constructs fall within many definitions of trust, however representing slightly different traits of an individual. For example, reliability does not directly infer an affective response, as it correlates more directly to behaviour expectation. Trustworthiness, on the other side, encompasses a broader behavioural umbrella that includes affective responses related to value similarity or personal affection. For example, authors like Kruglansky (1970) and Sztompka (1999) have presented these constructs as separated components of trust relationships.

The results from the logistic regressions gave us some cues that the effects of gender, age, educational background, and locus of control are minimal on determinants of trust. Consequently, there is no evidence to support the development of separate questionnaires for different groups, improving the reach and standardization of the QTAS.

The five trust factor groups (F2, F4, F5, F9, and F11) and the four personality factors (PF4, PF6, PF7, PF9) were then integrated into a preliminary version of the QTAS tested in Study 3, which can be found in Figure 24. It is important to remember that each item added to the QTAS impacts both the raw version of the QTAS and the pair selection, as the number of comparisons is based on combinations without repetition of 2 numbers where the order is not relevant, as per the following equation: $\frac{n!}{(n-r)!(r!)}$. According to the literature on scale development (DeVellis, 2012; Hinkin, 1998; Neff, 2003), the selection of number of items for a scale is dependent on the intended use of the metrics, the factors being evaluated, and the design process followed. We argue in favour of six to eight items in order to maintain the time efficiency of the metric, but there are no practical tests (other than applying all the initial 90 dimensions on a prototype) to evaluate the ideal number of items.

6.2.5.3 QTAS Preliminary Evaluation

The evaluation stage of this research was conducted using participants from Canadian MBA programs and industry representatives. We were interested in recruiting participants with significant teamwork experience to evaluate our metrics, since the focus is on application for teamwork-related collaborations. Due to the complexity of evaluating newly designed metrics, we acknowledge that further studies are still needed. The study presented in this paper provides preliminary results on the validity of the QTAS and about the important dimensions to be included in the final version of the QTAS.

The initial format of the QTAS that was presented to participants can be found in Figure 24, in addition to the 36 pairs containing all possible combinations of the dimensions that were present in the initial questionnaire.

6.2.5.3.1 Study 3 – Evaluation of the QTAS

In order to evaluate the QTAS, we collected trust data using the preliminary version of our metrics in order to test the validity and alignment with other existing trust measuring tools. In this study, we asked participants to rank people they had collaborated with in the past using the newly developed QTAS, as well as McAllister's Trust Scale (McAllister, 1995) and Butler's Condition of Trust Inventory (CTI) (Butler Jr., 1991). These metrics were selected from the existing literature since they both measure interpersonal trust on a specific individual in organizational environments and have widespread acceptance. Butler's seminal paper (Butler Jr., 1991) has been cited 1193 times and McAllister's (1995) work has been cited 3516 times, according to Google Scholar.

One aspect that is important to clarify is that the QTAS provides a measurement of trust and not a measurement of trust/distrust (Lewicki et al., 1998, 2006). Since the focus of our metric is on practical application of trust data for the design of interventions to improve team dynamics, we decided not to go in depth into the differences between trust and distrust as described by Lewicki, Tomlinson, and Gillespie (2006) and Lewicki, McAllister, and Bies (1998). Our focus is on identifying the best ways to improve the trust dynamic within a team by combining a measurement of interpersonal trust and a measurement of the influence of each trust factor into a compact metric. Although the measurement of distrust is a very important aspect of teamwork dynamics, it is outside the scope of this paper.

Therefore, for the evaluation of our metric, we have asked participants to evaluate two people using the questionnaires: one person they trusted, and one person they did not trust. We acknowledge that the bottom end of the spectrum, when participants are evaluating people they do not trust, might overlap with the distrust construct. However, as Lewicki, Tomlinson, and Gillespie (2006) describe, newer perspectives of trust research describe them as separate constructs. Since we are only focusing on a measurement of trust and the boundary between trust and distrust is still fuzzy and undefined (Lewicki et al., 1998, 2006), it would be difficult to trigger participants responses that exposed the bottom end of our metric without using the “do not trust” definition, as the general population can have a hard time understanding the subtleties that connect the trust and distrust constructs. When looking at the anchor points on the QTAS (Figure 24), it is possible to see that they focus on subjective sub-scales that do not relate to distrust, which would be the case of a trust/distrust metric.

Methodology. Participants were presented with three distinct trust questionnaires as outlined above, which were hosted at www.surveygizmo.com. They were asked to rate two people they had worked with in the past: one they trusted and one they did not trust. In order to avoid order effects, a Latin square design was used to select the order of the metrics being displayed to the participants.

To evaluate our metric, we postulate that a valid trust metric must be positively correlated, having Pearson correlation scores of at least $r > 0.5$ (J. Cohen & Cohen, 2003; J. Cohen, 1988; Gravetter & Wallnau, 2006), with trust scores from well-known trust metrics like McAllister’s (1995) and Butler’s (1991); that it should present internal consistency and reliability through high Cronbach's alpha of $\alpha > 0.7$ (Cronbach & Meehl, 1955; Cronbach, 1951); and have constructs consistent with trust measurement as defined through an exploratory factor analysis (Gorsuch, 1983). Correlation scores of $r > 0.5$ were selected based on literature in the social sciences studies and correspond to correlation scores deemed high for studies involving behavioural constructs (J. Cohen & Cohen, 2003; J. Cohen, 1988; Gravetter & Wallnau, 2006), while correlation scores of $r > 0.7$ are characterized as very highly correlated.

Results. After the data collection process, we had access to 144 complete datasets for analysis ($n=144$). Our population was composed of 59.7% males and 40.3% females. The average age of the participants was 31.64 ± 1.27 years, with an average of 10.28 ± 1.17 years of work experience.

QD1 - Reliability

In your collaboration environment, how would you evaluate the reliability of this person?

	1	2	3	4	5	6	7	
Very low	☐	☐	☐	☐	☐	☐	☐	Very high

QD2 - Integrity

In your collaboration environment, how would you evaluate the integrity of this person?

	1	2	3	4	5	6	7	
Very low	☐	☐	☐	☐	☐	☐	☐	Very high

QD3 - Trustworthiness

In your collaboration environment, how would you evaluate the trustworthiness of this person?

	1	2	3	4	5	6	7	
Very low	☐	☐	☐	☐	☐	☐	☐	Very high

QD4 - Takes responsibility

When bad things happen in your collaboration environment, does this person take responsibility for his/her actions?

	1	2	3	4	5	6	7	
Never	☐	☐	☐	☐	☐	☐	☐	Always

QD5 - Past behaviour

In your collaboration environment, how were your previous experiences with this person?

	1	2	3	4	5	6	7	
Very bad experiences	☐	☐	☐	☐	☐	☐	☐	Very good experiences

QD6 - Formal training, competencies, and abilities

In your collaboration environment, how are the formal training, competencies, and abilities of this person related to the work that needs to be done?

	1	2	3	4	5	6	7	
Poor	☐	☐	☐	☐	☐	☐	☐	Excellent

QD7 - Information about past experiences and history of collaborations passed by others in the institution

In your collaboration environment, what is the information passed by other people regarding past experiences with this person?

	1	2	3	4	5	6	7	
Negative	☐	☐	☐	☐	☐	☐	☐	Positive

QD8 - Your instinct/gut feeling in the situation, or your disposition to trusting

Based on your gut feelings/instincts, how likely are you to trust this person?

	1	2	3	4	5	6	7	
Not likely to trust	☐	☐	☐	☐	☐	☐	☐	Very likely to trust

QD9 - Your own formal training, competencies and abilities

How do your training, competencies and abilities fit in the requirements for the tasks that this person has done in the past? Are you capable/able to perform his/her tasks?

	1	2	3	4	5	6	7	
Poor	☐	☐	☐	☐	☐	☐	☐	Excellent

Figure 24: QTAS questionnaire used in Study 3, with the 9 dimensions identified in Study 2.

Using the entire dataset, Pearson correlation coefficients between the outputs of the weighted QTAS with McAllister's Trust Scale ($r = 0.939$, $p < 0.01$) and Butler's CTI ($r = 0.946$, $p < 0.01$), as well as between the raw QTAS with McAllister's Trust Scale ($r = 0.936$, $p < 0.01$) and Butler's BTI ($r = 0.941$, $p < 0.01$), show very high correlation between the QTAS versions and other trust metrics (J. Cohen & Cohen, 2003; J. Cohen, 1988; Gravetter & Wallnau, 2006). Scatterplots visually representing these results are shown in Figure 25.

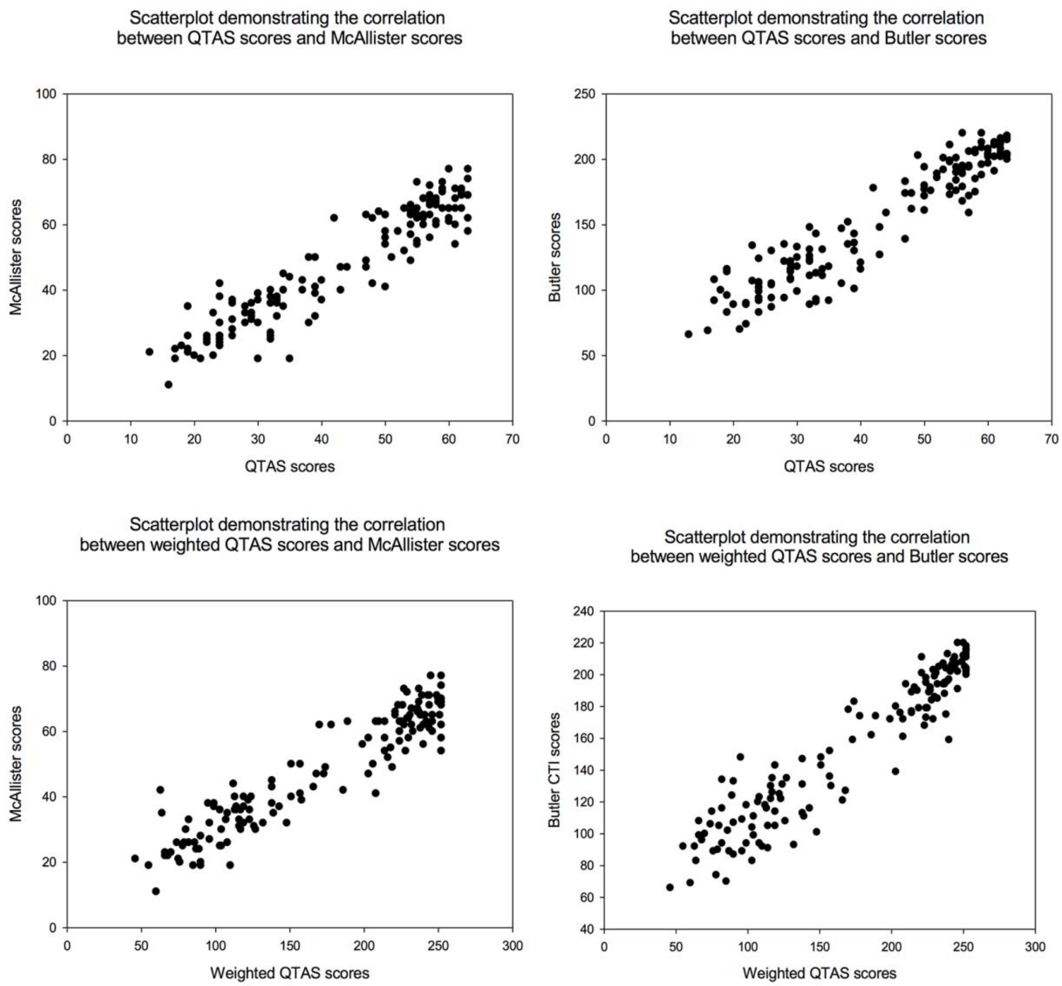


Figure 25: Scatterplots demonstrating the correlations between the metrics.

The data analysis process used in this study had an effect on the Pearson correlation scores. Since we asked participants to evaluate people they trusted and people they did not trust, we identified an inflation on the correlation between the trust metrics when using the entire dataset. In order to address this problem, we decided to also present the correlations of the data when grouped by people they trusted (top end of the spectrum) and people they did not trust (bottom end of the spectrum). This way, we can support the overall correlation by demonstrating the separate correlation scores as well.

At the top end of the spectrum (evaluating people they trust), we identified the following correlation coefficients: weighted QTAS with McAllister's Trust Scale ($r = 0.688$, $p < 0.01$) and Butler's CTI ($r = 0.796$, $p < 0.01$); as well as between the raw QTAS with McAllister's Trust Scale ($r = 0.671$, $p < 0.01$) and Butler's BTI ($r = 0.756$, $p < 0.01$). On the bottom end of the spectrum (evaluating people they do not trust), we identified the following correlation coefficients: weighted QTAS with McAllister's Trust Scale ($r = 0.748$, $p < 0.01$) and Butler's CTI ($r = 0.689$, $p < 0.01$); as well as between the raw QTAS with McAllister's Trust Scale ($r = 0.751$, $p < 0.01$) and Butler's BTI ($r = 0.696$, $p < 0.01$). The results show statistical significance on all correlations, but with lower correlation coefficients as we expected, since we have now removed the inflation. These results, however, still show strong positive relationship between the metrics and strong correlations (J. Cohen & Cohen, 2003; J. Cohen, 1988; Gravetter & Wallnau, 2006), supporting our claim that they are indeed measuring similar constructs.

To evaluate the internal reliability of the QTAS we used Cronbach's Alpha's coefficient of internal consistency (Cronbach & Meehl, 1955; Cronbach, 1951). We evaluated the raw QTAS ($\alpha = 0.945$) and the weighted QTAS ($\alpha = 0.679$) in this analysis, where both scales had 9 items.

As we were interested in keeping the QTAS size around 7 dimensions, we also evaluated the effect of the removal of up to 2 items on the reliability of the metric. Maximum reliability for the raw QTAS was obtained when removing the QD6 and the QD9 (7 items, $\alpha = 0.970$) and when removing the QD7 and the QD9 for the weighted QTAS (7 items, $\alpha = 0.746$).

Results from the exploratory factor analysis (EFA) gave us some clues about the constructs behind the dimensions being used. Factor analysis, at this point, allowed us to test if there were any sub-constructs being evaluated that we did not foresee, helping us to refine our trust metric.

Correlation tests between each of the QTAS dimensions also helped us decide which dimensions could be extracted from the QTAS, while keeping enough dimensions to assess trust. Pearson correlation coefficients above $r = 0.9$ (according to the EFA criteria) with statistically significant results were found on the raw QTAS between the QD2 and QD3 ($r = 0.906$, $p < 0.01$) and between the QD3 and the QD8 ($r = 0.930$, $p < 0.01$). Since the QD3 is highly correlated with two other dimensions, we repeated the Cronbach's Alpha test of internal reliability with the QD3 removed (8 items, $\alpha = 0.929$), still showcasing strong internal reliability. No strong correlations ($r > 0.9$) were observed between the weighted QTAS dimensions.

Ideally, the QD3 should have been removed from the EFA to avoid multicollinearity, but it resulted in having a determinant equal to zero after the removal. Therefore, we decided to maintain it for the factor analysis since the determinant for the raw QTAS with all the dimensions included was 0.000028, higher than the threshold of 0.00001 for non-multicollinearity. Important details showing the validity of the EFA of the raw and the weighted QTAS can be found in Table 11. We can assume non-collinearity for the dimensions (determinants larger than 0.00001), adequate sampling shown by KMO greater than 0.5 (Kaiser, 1974), and appropriate factor analysis due to significant result on the Bartlett's Test of Sphericity both for the weighted QTAS and the raw QTAS.

Table 11: Exploratory Factor Analysis supporting data.

	Test	Value
Raw QTAS	Determinant	0.000028
	Kaiser-Meyer-Olkin	0.930
	Bartlett's Test of Sphericity	Approximate Chi-square = 1458.563 df = 36 p < 0.01
Weighted QTAS	Determinant	0.102
	Kaiser-Meyer-Olkin	0.750
	Bartlett's Test of Sphericity	Approximate Chi-square = 317.772 df = 36 p < 0.01

The extracted factors and component loadings from the factor analysis, with factor extraction set at eigenvalues > 1, can be found in Table 12, where we present the rotated factors for each of the QTAS dimensions. The weighted QTAS resulted in 3 extracted components, through principal component analysis, that were labelled trust components, past history, and abilities. The raw QTAS resulted in 2 extracted components labelled trust components and trustor's abilities.

The data collected in Study 3 also provided insights into the pair selection task and the importance of each dimension for the formation of trust. Descriptive statistics on the weights collected can be found in Table 13. One aspect we would like to clarify is that in this study, we were conducting a validation exercise. Therefore, the participants from Study 3 were not part of the same collaborative environment, which resulted in great variability on the selection of factors, demonstrating the situational dependence of trust (Dirks, 1999; La Guardia & Ryan, 2007; Morita & Burns, 2014b; Sorrentino et al., 1995).

Discussion. Pearson correlation coefficients show strong correlations between the multiple trust metrics used in this study (J. Cohen & Cohen, 2003; J. Cohen, 1988; Gravetter & Wallnau, 2006). The scatterplots in Figure 25 corroborate these numbers. On the premise that all three metrics should be evaluating the same construct, we provided evidence that they are indeed highly correlated and that the construct behind each evaluation should be the same. When analysing the results grouped into the top end of the spectrum and the bottom end of the spectrum, although we found smaller correlation coefficients, we still demonstrated high levels of correlations between the metrics as per the literature in behavioural studies (J. Cohen & Cohen, 2003; J. Cohen, 1988; Gravetter & Wallnau, 2006).

Table 12: Loadings for each dimension after factor rotation. Blank cells on the table represent loadings < 0.4.

	Weighted QTAS			RAW QTAS	
	Trust components	Past history	Abilities	Trust components	Trustor's abilities
Reliability	0.794	-	-	0.925	-
Integrity	0.838	-	-	0.931	-
Trustworthiness	0.874	-	-	0.960	-
Takes responsibility	0.695	-	-	0.933	-
Past behaviour	-	0.613	-	0.932	-
Formal training, competencies, and abilities	-	-	0.738	0.688	-
Information about past experiences and history of collaborations passed by others in the institution	-	0.820	-	0.823	-
Your instinct/gut feeling in the situation, or your disposition to trusting	0.437	-	-	0.925	-
Your own formal training, competencies, and abilities	-	-	0.757	-	0.974

On the matter of metric reliability, the raw QTAS has demonstrated high internal reliability, with 9 items and $\alpha = 0.945$. The lower reliability of the weighted QTAS ($\alpha = 0.679$) is assumed to be caused by the fact that the participants are part of distinct collaborative environments. Consequently, the weighting of each dimension, which is strongly influenced by personal perception and situational variability (Dirks, 1999; La Guardia & Ryan, 2007; Morita & Burns, 2014b; Sorrentino et al., 1995), differed significantly between participants. Since the final score of the weighted QTAS takes into account the weights generated by the pair selections, this variability would indeed influence the scores. Future analyses, with participants from the same team or performing similar tasks, need to be conducted for further validating of the weighted version of QTAS.

Some of the raw QTAS dimensions showed some significant bivariate correlation to some of the other dimensions, which was already expected considering they are measuring very tight and subtle constructs (Butler Jr., 1991; McAllister, 1995). Correlations were much lower on the weighted QTAS as different collaboration environments have influenced the weights and correlation coefficients.

Results from the EFA showed the QD9 as a singular component. This was expected as the QD9 is the only factor not directly related to the trusting action. The skills and abilities of the person evaluating correspond to an important aspect of trusting behaviour (Kramer & Tyler, 1996), but clearly identify a different construct as it does not directly relate to the individual being trusted. Consequently, we will remove the QD9 – Your own formal training, competencies, and abilities from future analyses.

Table 13: Descriptive statistics on the QTAS weights collected during this study.

	Mean	St.Dev	St.Error of the mean
QD1	$\mu = 5.00$	$\sigma = 1.96$	$\sigma_M = 0.16$
QD2	$\mu = 4.76$	$\sigma = 2.32$	$\sigma_M = 0.19$
QD3	$\mu = 4.97$	$\sigma = 1.79$	$\sigma_M = 0.15$
QD4	$\mu = 4.48$	$\sigma = 2.16$	$\sigma_M = 0.18$
QD5	$\mu = 4.31$	$\sigma = 2.29$	$\sigma_M = 0.19$
QD6	$\mu = 2.98$	$\sigma = 2.04$	$\sigma_M = 0.17$
QD7	$\mu = 2.83$	$\sigma = 2.11$	$\sigma_M = 0.18$
QD8	$\mu = 3.93$	$\sigma = 2.18$	$\sigma_M = 0.18$
QD9	$\mu = 2.74$	$\sigma = 2.11$	$\sigma_M = 0.18$

The results from the EFA for the weighted QTAS cannot be fully interpreted at this moment. The next step in this project consists of collecting a new dataset in order to perform a Confirmatory Factor Analysis (CFA) on our restructured QTAS. At this point, we only have access to one population, but further studies will allow us to validate the QTAS with its final structure and conduct a CFA on its reduced format. Additionally, due to the close relationship between the Trustworthiness and Reliability constructs, as discussed in this paper, we will further evaluate their effect on the QTAS and consequently, decide if one of the two dimensions should be removed from the metric.

The information presented in Table 13 regarding the weights of each of the dimensions could also be used to inform our future decision on which dimensions should be removed. Within the boundaries of the participants used in this study, we can identify the QD9, the QD7, and the QD6 as the three least important factors as rated by the participants. However, as mentioned before, these results suffer from the variability of the participants recruited for this study and consequently, is not a reliable source for deciding which dimensions to remove.

In the next section, we will discuss the potential of the results shown in this paper, as well as the use of the pairwise selection component of the QTAS as a mechanism to identify effective interventions to foster trust.

6.2.6 The QTAS and the Human Factors and Ergonomics Domain

Within the scope of human factors and ergonomics specialists, we find the area of teamwork and the associated effects on performance, effectiveness, and safety (M.J. Ashleigh & Prichard, 2011; M.J. Ashleigh & Stanton, 2001; R. Lyons et al., 2009; Salas, Prince, Baker, & Shrestha, 1995; Salas et al., 2005; N. A. Stanton & Ashleigh, 2000; N. A. Stanton, 2011; N. A. Stanton et al., 2006; N. A. Stanton, Ashleigh, Roberts, & Xu, 2003). This broad field encompasses not only the area of teamwork dynamics (Morita & Burns, submitted, 2014a; Pilcher, Vander Wood, & O'Connell, 2011) but also the area of teamwork support technology (Artman, 2000; Funke & Galster, 2009). Ranging from the design of cognitive artefacts for command and control (Jenkins et al., 2010), going through identification technology to reduce friendly fire in military teams (L. Wang, Jamieson, & Hollands, 2009), and the design of communication and collaboration systems to support teamwork (Carletta et al., 2000), human factors specialists have significantly facilitated teamwork in multiple domains. It is our goal to provide an important tool for these specialists to evaluate and inform design that has the potential to support the development of trust in teamwork in our technology dense society.

The QTAS was designed to include the measurement of variables that are relevant for the formation of trust in a face-to-face environment, as well as for virtual teams. We have taken this approach to account for the widespread use of technology mediating the collaboration inside a team (Grudzewski et al., 2008; Salas, Cooke, et al., 2008; Townsend et al., 1998). Human factors specialists are known to be experts in bridging the gap between humans and technology, designing technology that account for the limitation of human perception and human behaviour in teams (Salas, Cooke, et al., 2008). With the QTAS, these professionals now have an additional tool for the measurement of trust levels now accounting for personal and situational variability on trust formation (Dirks, 1999; Morita & Burns, 2014b; Sorrentino et al., 1995), the integration into team-wide evaluations of collocated and virtual teams (Jarvenpaa & Leidner, 1997; J. Olson & Olson, 2012), and the identification of the most effective ways to design interventions and communication systems that mediate the collaboration of team members (Rusman et al., 2010; Walther, 1996).

6.2.6.1 Accounting for Individual Variability

The weighted version of the QTAS accounts for the personal variability described by the internal weights that constrain the perception of each trust cue (Morita & Burns, 2014b), and similarly to the NASA-TLX (S. G. Hart & Staveland, 1988), it is possible to incorporate this variation into a weighted overall trust score. Such variability can be identified in the standard deviation found for each factor on Table 13, demonstrating why it is so important to include this component on the assessment of trust.

The pairwise comparison component of the QTAS provides an effective way to rank the importance of each dimension of trust perception by comparing each pair of factors, and integrating these results into a ranking (DeVellis, 2012). The importance of the inclusion of the individual variability on trust analysis cannot be overlooked as described by Muir (1994), Merritt and Ilgen (Merritt & Ilgen, 2008), Lee and See (2004), Fiore et al. (2003) Rotter (1971), Dirks (1999), and Sorrentino et al. (1995). Without accounting for this individual variability, trust metrics risk oversimplifying the generation of a trust score when measuring interpersonal trust.

Accounting for interpersonal variability when measuring trust in virtual teams is especially important since team members are not necessarily working in the same environment and might be exposed to different cultural (Dafoulas & Macaulay, 2001; Fiore et al., 2003; Shachaf, 2008; N. A. Stanton, 2011) and institutional constraints (Gibson & Cohen, 2003; Orr & Scott, 2008) that will influence the perception of trust factors (Gibson & Cohen, 2003; Morita & Burns, 2014b). In this case, a construct being measured inside the same team might have very distinct influences on trust for different team members.

6.2.6.2 Using the QTAS to Identify Design Interventions and Design Requirements

Human factors specialists can support teams collaborating in an environment permeated by technology through the design of communication and collaboration systems that account for human limitations and specific of each team (Cordery & Soo, 2008; Fiore et al., 2003; Jenkins et al., 2010; R. Lyons et al., 2009).

However, the trust dynamic within virtual teams is more severely constrained than in face-to-face collaborations due to limitation in the media richness of the channels (Rockmann & Northcraft, 2008). This creates a great opportunity for human factors specialists and designers to contribute for the development of teams that capitalize on solid trust levels by designing communication systems that provide cues to facilitate the development of interpersonal trust in virtual teams (Fiore et al., 2003; Morita & Burns, 2013, 2014a; Walther, 1996).

The pair-comparison component of the QTAS can be used to help identify the most influential trust factors within each team. The results can inform designers on the tailoring of their interventions to address specific issues that are currently constraining trust and collaboration in that specific team. Differently than what has been done before by other authors like Rusman et al.(2010), we postulate that the QTAS may help identify the most effective aspects to address, allowing targeted and tailored interventions (Morita & Burns, submitted). In this paper, we will give brief examples of targeted interventions that can include:

- The redesign of communication systems by incorporating components that facilitate the development of interpersonal trust (Bos et al., 2002; Feng, Lazar, & Preece, 2003; Fiore et al., 2003; Kiesler et al., 1984; Morita & Burns, 2014a; Nguyen & Canny, 2007; Rae et al., 2013; Walther, 1996) like the use of multimedia systems (Bos et al., 2002; Carletta et al., 2000; Slovák, Troubil, & Holub, 2010).
- Trust-building activities or face-to-face contact (Cordery & Soo, 2008; Henttonen & Blomqvist, 2005; Holton, 2001; Rocco, 1998).
- Managerial interventions (Fiore et al., 2003; Webber, 2002; Zheng et al., 2002).

- Training (M.J. Ashleigh & Prichard, 2011; Kirkman, Rosen, Gibson, Tesluk, & Mcpherson, 2002; Prichard & Ashleigh, 2007; M. Warkentin & Beranek, 1999; Wildman et al., 2009).

Looking at the information from Table 13, the QD1 (Reliability) is outlined as most important dimension. Within this group of participants, it would be important to create mechanisms that can carry information that demonstrates the reliability of a certain individual. For example, creating a system that would allow individuals to anonymously recommend or endorse others (like what is currently done on LinkedIn) (Konstas, Stathopoulos, & Jose, 2009; Mcdonald & Ackerman, 2000; Walter, Battiston, & Schweitzer, 2008), or create an opportunity for social interaction with other team members over CMCSs like what has been done by Zheng et al. (Zheng et al., 2001, 2002), would allow team members to share past experiences that can reflect reliability of that individual (Morita & Burns, submitted, 2014a). This information could also be presented to other team members in the form of badges or cues on their communication systems (Antin & Churchill, 2011; Morita & Burns, submitted, 2013; Zimmerman & Kurapati, 2002).

Still in the same direction, in a situation where QD7 would be identified as an important dimension (information about past experiences and history of collaborations passed by others in the institution), creating channels for informal information exchange in the form of informal social networking systems or clear identification of past team members that collaborated with that person would increase the flow of information about past history (Jarvenpaa & Leidner, 1998; R. E. Kraut, Fish, Root, & Chalfonte, 1990), similar to what is currently done for automated systems (Gao & Lee, 2006; McGuirl & Sarter, 2006). This approach would provide information for an informed trust decision and trust calibration.

The array of possible interventions does not stop there. Some possibilities include the use of anthropomorphized interfaces and use of avatars in situations where trustworthiness has been deemed an issue (as anthropomorphism has been demonstrated to increase trustworthiness) as widely discussed in the human factors and ergonomics literature by de Visser et al (de Visser et al., 2012), Pak et al. (2012), Marsh and Meech (2000), Steptoe et al. (2010), Slovák, Troubill, and Holub (2010) and Rae, Takayama, and Mutlu (2013). Anthropomorphism increases the social presence of team members and removes the non-personal characteristic of electronic communications. Other researchers have used pictures on websites to increase trustworthiness (Riegelsberger et al., 2003;

Steinbrück et al., 2002) as well as displaying cues in the form of personal profiles (similar to LinkedIn) (Rusman et al., 2010).

All of the above are options to improve virtual team trust, but without identifying the most effective aspect of trust that needs to be addressed, most attempts are a gamble. The QTAS therefore presents an effective way to identify interventions without the need to pursuing extensive ethnographic studies.

6.2.7 Conclusions

The development and evaluation process for the QTAS presented a compact and reliable method to measure trust within collaborative environments. Following accepted scale development techniques (DeVellis, 2012; Hinkin, 1998; Neff, 2003), using a metrics structure in alignment with NASA-TLX (S. G. Hart & Staveland, 1988), and incorporating the capability to weight trust dimensions (Morita & Burns, 2014b), we developed the QTAS. The QTAS is a compounded trust metric measuring both trust perception and dimension importance for trust perception, being tailored for human factors and ergonomics interventions for fostering trust through redesign of communication systems and team management.

Results from a standard questionnaire (like the raw QTAS) may provide insights into how individuals rate each dimension, but not on the differences that each dimension can have on trust formation. The weighted version of the QTAS may present the necessary mechanisms for identifying the most effective ways to target trust within each specific team, in addition to creating a trust score that accounts for individual and situational variability (Dirks, 1999; La Guardia & Ryan, 2007; Morita & Burns, 2014b; Sorrentino et al., 1995). The information from the pairwise selection task, which corresponds to the information embedded in Table 13, could provide designers, managers, and team members with relevant information for the development of trust fostering interventions, tailored to the characteristics of each team and focusing on the aspects of teamwork that have the most influence on trust behaviour in their environment. Some examples of possible interventions have been presented to demonstrate the potential usefulness of a new trust metric like the QTAS.

The tool presented here has the potential to be included as a resource for human factors, ergonomics, and organizational research specialists interested in assessing the impact of trust on their designs and interventions. While further evaluation is still necessary, the QTAS presents a novel way to measure the impact of system changes to a vital component of teamwork: interpersonal trust.

6.3 Additional Data and Discussion

Due to the large number of studies covered in this paper, I have separated the supplemental material from each of the three studies in separate sub-sections, starting with a general list of materials that were important for the development of the QTAS. In Table 14 I present a list of the trust and workload metrics that served as a foundation for the development of the QTAS. In the same table, I also present the Appendix in which a sample of that specific metric can be found.

Table 14: Additional supporting information for Chapter 6, with the list of metrics that were used in the development of the QTAS. Detailed description of each metric can be found in Table 6.

Supplemental Material	Location
Rotter's Interpersonal trust scale (Rotter, 1967)	Appendix H
Trust and organizational climate (Farris et al., 1973)	Appendix I
Interpersonal trust at work (J. Cook & Wall, 1980)	Appendix J
Trust in teams (Costa & Anderson, 2011)	Appendix K
Organizational trust inventory (L. L. Cummings & Bromiley, 1996)	Appendix O
The dyadic trust scale (Larzelere & Huston, 1980)	Appendix M
Specific interpersonal trust scale (Johnson-George & Swap, 1982)	Appendix L
Trust scale (Rempel et al., 1985)	Appendix N
Conditions of trust inventory (Butler Jr., 1991)	Appendix Q
McAllister's trust scale (McAllister, 1995)	Appendix P
NASA TLX Workload Scale (S. G. Hart & Staveland, 1988)	Appendix G

6.3.1 Supplemental Information for Study 1 – Card Sorting and Clustering of Trust Factors

The first study conducted for the development of the QTAS was an online card sorting study hosted at www.websort.com and used to cluster the large number of trust antecedents identified in the literature review into manageable number of dimensions to be evaluated by participants. The supplemental materials supporting the findings in Study 1 are listed in Table 15.

Table 15: Additional supporting information for Study 1 – Card sorting and clustering of trust factors in Chapter 6.

Supplemental Material	Location	Additional Information
Ethics approval certificate	Appendix BB	Ethics approval certificate for study 1.
Consent form	Appendix W	Consent form displayed in the Websort page. Participants had to acknowledge it before moving to the card-sorting study.
Initial list of 90 trust factors	Appendix R	Initial list of 90 trust factors that were identified from the literature and used as cards in the card-sorting study as mentioned in sub-section 6.2.5.2. They correspond to the contents of the clusters presented on Table 7.

6.3.2 Supplemental Information for Study 2 - Selection of the QTAS Dimensions

The second study I conducted was hosted at www.surveygizmo and consisted of asking participants to rate and rank the 15 clusters generated in Study 1 in order of importance for their trust decision. Supplemental material from this study can be found in Table 16.

Table 16: Additional supporting information for Study 2 – Selection of the QTAS dimensions in Chapter 6.

Supplemental Material	Location	Additional Information
Ethics approval certificate	Appendix CC	Ethics approval certificate for Study 2 – Selection of the QTAS dimensions.
Consent form	Appendix X.	Consent form displayed in the SurveyGizmo page. Participants had to acknowledge it before moving to the card-sorting study.

6.3.3 Supplemental Information for Study 3 – Evaluation of the QTAS

The last study that was part of the development and preliminary evaluation of the QTAS was the experimental testing of the metric. Recruiting from multiple MBA programs in Canada, I asked participants to evaluate one person they had collaborated in the past and that they trusted and one person they collaborated with and did not trust, using multiple trust metrics I provided to them (including the QTAS). Supplemental material supporting the analysis in Study 3 can be found in Table 17.

Table 17: Additional supporting information for Study 3 – Evaluation of the QTAS in Chapter 6.

Supplemental Material	Location	Additional Information
Ethics approval certificate	Appendix DD	Ethics approval certificate for study 3 used to evaluate the QTAS.
Consent form	Appendix Y	Consent form displayed on the SurveyGizmo interface. Participants have to acknowledge their willingness to participate prior to moving to the study.

The data presented above provides more details about the development of the QTAS, presenting a comprehensive view of the studies I conducted. I would like to acknowledge here that not all the data collected in the studies was used for this thesis, but rather will be published at a later date. The applicability and relevance of the QTAS to Human Factors was discussed in Section 6.2.6.

In the next chapter, I explore one of the possible ways to foster trust behaviour in CMCSs by using interface design objects called trust tokens. These tokens, derived from the ethnographic study presented in Chapter 5, act as surrogates for missing cues in virtual collaborations.

Chapter 7
Fostering Trust

7.1 Foreword

The previous components of this thesis are passive components targeted at increasing the understanding and the awareness of trust issues inside teams. The components presented in the previous chapters provide the foundation for identifying and designing possible interventions for fostering trust in teamwork environments. The focus of this chapter will be on exploring one possible active mechanism to facilitate the flow of information into the perceptual components of the trust model, as highlighted in Figure 26.

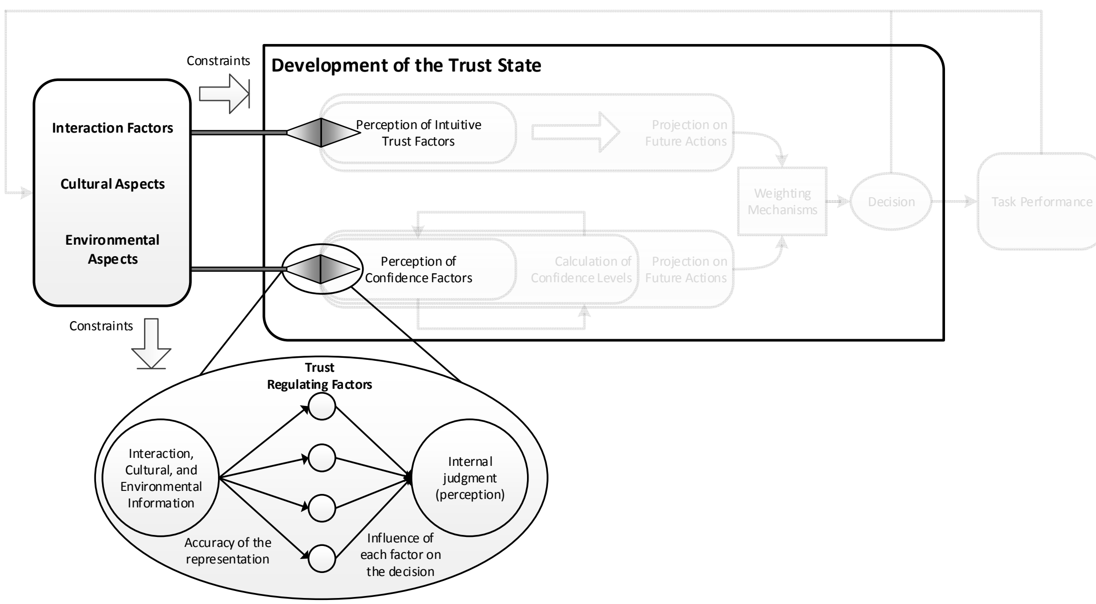


Figure 26: Perceptual mechanisms of the trust model explored in this chapter.

In this chapter, I discuss the potential for carrying trust supporting information through the use of interface design objects for the development of trust in virtual teams. These cues could be made available through the communication systems and convey information about trust antecedents that are missing due to limitations in the communication channel (e.g. low media richness of the channels) (Jarvenpaa & Leidner, 1998; Rockmann & Northcraft, 2008).

The purpose of this paper is to test the possibility of using surrogates derived from face-to-face contact to transfer trust supporting information through CMCSs. I was interested in identifying the most effective pieces of information for the development of a trust state and whether individuals use this information for building a trust state. This paper also explores the effects of constraining factors, situational risk in this case, on the perception and usage of trust cues to form a trust state. The purpose of this approach is to demonstrate the presence of situational variability and its effect on the design of systems tailored for fostering trust (Dirks, 1999; Jarvenpaa et al., 2004; La Guardia & Ryan, 2007; Morita & Burns, 2014b; Payne & Clark, 2003; Schlenker et al., 1973). Risk was chosen as a variable of interest as it is defined as a core component of a trusting behavior and highly dependent on the trusting situation (Das & Teng, 2004; Jøsang & Presti, 2004; Perkins, Miller, Hashemi, & Burns, 2010).

7.2 Trust Tokens: Insights for fostering interpersonal trust through interface design

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This paper has been submitted to IEEE Transactions on Human-Machine Systems.

7.2.1 Overview

Interpersonal trust is a core component of teamwork, influencing a team's communication, collaboration, and overall effectiveness. For this reason, interpersonal trust has been widely investigated in institutional settings, looking at mechanisms for improvement through training and managerial interventions. As teams move towards non-collocated teamwork and become virtual teams, communication is now mediated by electronic systems, which create new opportunities for facilitating the development of interpersonal trust through interface design.

We propose the development and evaluation of interface design objects, called trust tokens, to act as surrogates for behavioral cues that are normally used in the formation of trust. These tokens were designed to convey information about expertise, recommendations, social capital, validations, and benevolence/willingness to help. We have identified behaviours that were most effective in fostering trust. We developed interface design objects in the form of badges, called trust tokens, to convey trust-supporting information derived from the findings of the ethnographic study. Through a controlled study (n = 20) simulating a social network environment, we evaluated the usage of the tokens in trust decisions. Overall, participants relied on tokens that conveyed experience and expertise for their decision-making. Token influence was context-dependent and varied with the type of decision being made and its inherent risks.

These results contribute to the understanding of which factors may be most influential in building trust between individuals in social network environments. This work also examines the effect of trust tokens and badges, which are currently in common use in social network applications.

7.2.2 Introduction

Trust is an important component of collaboration and teamwork (Crowder, Robinson, Hughes, & Sim, 2012; P. Hart & Saunders, 1997; O'Hara-Deveraux & Johansen, 1994; Sheppard & Sherman, 1998) which facilitates the development of solid teams that achieve knowledge integration (Robert, Dennis, & Ahuja, 2008), boosts information exchange (Jarvenpaa & Leidner, 1998), and allows the formation of collective minds that improve the capacity, effectiveness, and capability of a team (Klein, 1998; Thordsen & Klein, 1989; Weick & Roberts, 1993). However, there is still a need to explore the potential for supporting or developing interpersonal trust between team members through the design of information and communication systems.

Trust is commonly described as a risk acceptance behaviour that allows individuals to benefit from skills and expertise they do not readily possess, making themselves vulnerable in exchange for knowledge and resources (Luhmann, 1979; Mayer et al., 1995; Morita & Burns, 2014b; Six, 2005). Choosing to trust is a complex decision based on the integration of cues perceived from the environment and interpersonal interactions, leading to the formation of a trust state inside each of our minds (J. D. Lee & See, 2004; Mayer et al., 1995; McAllister, 1995; McKnight et al., 1998; Morita & Burns, 2014b). As a result, a person's perception of features, artifacts, behaviours, and characteristics of the other person, as well as the environmental, cultural, and system constraints that define structures and norms and regulate behaviour, can heavily influence interpersonal trust (Mayer et al., 1995; Morita & Burns, 2014b).

Trust is a broad construct that spans several different areas of psychology, design, and human factors research, ranging from interpersonal trust (close relationships, workplace trust, virtual trust) to the realm of trust in websites, and finally, to the state of trust in automation, which relates closely to interpersonal trust in the ways that several automated systems mimic human behaviour (Bass et al., 2011; J. D. Lee & See, 2004).

One key area of trust research focuses on team trust and the benefits of solid trust for team performance and effectiveness (Holton, 2001; Kiffin-Petersen, 2004; Salas et al., 2009). As technology and work requirements evolve, teams are shifting to non-collocated virtual teamwork and are experiencing the constraints of remote interaction (Duarte & Snyder, 2011; Gibson & Cohen, 2003; Jarvenpaa et al., 1998)

7.2.2.1 Trust in virtual teams

Current networked technologies allow team members to collaborate from different locations (Jarvenpaa & Leidner, 1997; Lipnack & Stamps, 1999). Experts can now be brought together from geographically distant places and participate synchronously or asynchronously in team tasks, taking collaborations to new levels and significantly expanding team capabilities (Gibson & Cohen, 2003). Within this domain, computer-mediated communication systems (CMCSs) provide channels for team members to exchange information and to support collaboration (Hiltz & Turoff, 1985; Romiszowski, 1992).

Teams that collaborate virtually, however, face the issue of limited availability of cues when developing trust states (Berry, 2011; Gibson & Cohen, 2003; Holton, 2001; Jarvenpaa & Leidner, 1998). The consequences of this limitation include low, fragile, and delayed trust (Bos et al., 2002), all of which impact collaboration and team effectiveness (Driskell & Salas, 1992; Gibson & Cohen, 2003; Lazzara et al., 2009; Rhoads, 2010; Salas et al., 2005; Walther, Anderson, & Park, 1994). The theory of media richness (Daft & Lengel, 1984), in which the limited media richness of communication channels constrains the availability of cues normally perceived and used for the formation of trust states (Morita & Burns, 2014b), can be used to explain the impact of non-collocated virtual teamwork on trust formation. In these types of teams, trust decisions are based on limited representativeness of the reality. As an example, important trust cues such as value similarity, casual social experiences, and body language are typically not available in CMCSs (Holton, 2001). Lavrac et al. (2007) modeled trust in virtual teams, presenting useful visualizations and interpretations of virtual teamwork that can help us understand possible limitations in trust formation.

In order to compensate for the limited trust formation cues in virtual environments, researchers have used multiple techniques for building trust (Gibson & Cohen, 2003; Henttonen & Blomqvist, 2005; Holton, 2001; Kirkman et al., 2002; Ridings et al., 2002; Rocco, 1998; Rusman et al., 2010; Zheng et al., 2002). These techniques include initiating face-to-face contact prior to the establishment of the virtual team, employing trust-building activities, or using personal profiles to provide the extra information to lead to informed trust decisions (Cross, Rice, & Parker, 2001; Rusman et al., 2009, 2010). However, each of these techniques faces different problems of implementation. For example, teams may not have the ability to meet face-to-face (Gibson & Cohen, 2003) or the time available for trust building activities (Mckinney, 2005; Munkvold & Zigurs, 2007; Wildman et al., 2012), and the use of personal profiles can suffer from privacy issues (Rusman et al., 2009). Additionally, all of these techniques depend on team members actively engaging in trust-building activities or actively searching for information about the other parties (Cross et al., 2001), which reduces the saliency of the trust supporting information.

Instead, we suggest that computer-mediated communication systems can be designed to promote interpersonal trust in teams more effectively by selecting and displaying key information about the other team members as an integral part of the user interface. Key pieces of information about the person being trusted could be embedded into interface components to support informed trust decisions. These components would be similar to what is currently employed in the design of trustworthy automations and websites, in which designers can provide cues about the trustworthiness of the system (Corritore et al., 2003; Seong & Bisantz, 2002, 2008).

7.2.2.2 Design for trust in automation and trust in websites

When operators interact with automated systems, they must cope with the uncertain behaviour of the system (J. D. Lee & See, 2004; Parasuraman & Manzey, 2010; Parasuraman & Riley, 1997). As their experience and knowledge about the system grow, individuals start to be able to predict the actions of the system. If performance is satisfactory, trust in the automation tends to increase (Muir & Moray, 1996; Muir, 1994). Until that point is reached, however, the interaction with the system can be permeated with uncertainty. This uncertainty can impact operator performance severely, hindering interaction and information flow between the operator and the system. These new constraints on work dynamics must be accounted for in the design process so they can be addressed through training, interface design, or system design (J. D. Lee & See, 2004; Parasuraman & Riley, 1997).

Parasuraman & Riley (1997) have presented a review of major issues generated by automation, describing reasons why design characteristics can result in misuse, disuse, and abuse of automated systems.

The human-machine interaction is fragile, and resembles the interaction between humans in interpersonal collaborations in the sense that the relationship with the automation is permeated with uncertainty, strong dependence, and risk (J. D. Lee & See, 2004; Muir, 1994).

Although there are significant differences between the cognitive processes leading to trust, the outcomes of and mechanisms for fostering trust can share common ground (J. D. Lee & See, 2004; Morita & Burns, 2014b). Within the field of trust in automation research, one possible approach implemented by designers to increase trust in the system is presenting system information to operators, which increases system transparency and improves their awareness of the system (J. D. Lee & See, 2004; Seong & Bisantz, 2008). The trade-off here, however, is that more information can result in information overload (Parasuraman & Riley, 1997; Rice, 2009), so a delicate balance between the amount of information provided and the overall effect on operator performance must be achieved.

Studies in trust in automation by Muir (1994), and Muir & Moray (1996), Parasuraman & Manzey (2010), and Cummings, Clare & Hart (2010) have focused on identifying the underlying constructs that lead to trustworthy designs, such as transparency, calibration, robustness, and reliability (J. D. Lee & See, 2004; Seong & Bisantz, 2002, 2008). These studies focus on overall system design (Muir & Moray, 1996), as well as interface design that can present trust-fostering information to operators (M. L. Cummings et al., 2010; Parasuraman & Manzey, 2010). Trust in automation has also been modeled by Lee and See (2004), and Jian, Bisantz, and Drury (1998, 2000) have created an measurement techniques for the development and understanding of trust in automated systems.

Similarly, a significant body of knowledge exists regarding trust in websites (Corritore et al., 2003; Jarvenpaa, Tractinsky, & Vitale, 1999; D. Kim, Ferrin, & Rao, 2008; van der Heijden, Verhagen, & Creemers, 2003). Researchers have identified cues present in the design and characteristics of a website that lead to users having increased trust, like ease of use, risk, and reputation (Corritore et al., 2003). All of the above correspond to cues used by individuals to create a mental model of the website and predict the outcome of trusting that information. This same information can be used for malicious purposes in forged websites, reducing the perceived risk by the users and inducing a fake feeling of trust (Grazioli & Jarvenpaa, 2000).

Within these two domains, there is a common thread: background information about the system or website can be presented to the operator or user in order to facilitate the formation of informed trust decisions and increased awareness. This approach aligns with the trust model Lee and See (2004) have presented, as well as the interpersonal trust models of Morita and Burns (2014b) and Mayer et al. (1995). All of these studies describe perceptual models in which trust is highly influenced by individuals' perception of existing cues from the environment, the system, and the other party. Through the display of carefully selected trust-supporting cues, designers can increase the operator or user's knowledge about the system, which can lead to informed trust decisions.

Building on this work, we propose that information about the other team members can be embedded in communication systems to provide necessary information for trust decisions. Below, we discuss the development of one example of a design to promote trust between people. We refer to this type of interface design object as "trust tokens." The concept for trust tokens was developed based on an ethnographic study of trust behaviour in teams (Morita & Burns, 2014a) and shares similarities with trust artifacts used in collaborations (Chopra & Wallace, 2003; Edmondson, 2003). Morita and Burns (2014a) have observed that in cases of early trust development, certain people can act as conduits for referred or transferred trust between two untrusting people (Ferrin, Dirks, & Shah, 2006; McEvily, Perrone, & Zaheer, 2003; Nohria, 1994; Shapiro, 1987). We propose that this concept of referred trust can be implemented in design to foster interpersonal trust.

7.2.3 Designing trust tokens

In this section, we explain the process used to design trust tokens and the justification behind the expected effects of trust tokens on the development of trust. In order to clarify further what trust tokens are, we briefly describe the study that led to the selection of the five tokens used in this paper, as well as the semiotic theory behind this representation.

7.2.3.1 Identifying trust-fostering behaviours and information

In an ethnographic study conducted at the University of Waterloo (Morita & Burns, 2014a), two student design teams were observed during the initial stages of their project cycle, in which the majority of trust-building events were concentrated. A key observation made in this study (Morita & Burns, 2014a) was that, in many cases, a third party could intervene between two teams who were experiencing challenges with developing trust. This third party could use their familiarity with both team members to communicate factors critical to establishing trust. This phenomenon has been noted before (Doney et al., 1998): when individuals do not have proper information for a trust decision, behaviours similar to social referencing (Klinnert et al., 1983) and social influencing (Kelman, 1958) help individuals cope with the uncertainty by mirroring others' behaviours in the group and identifying pieces of behavioural information that can support their decisions. When individuals notice that others in the group have placed trust in a third party, transferred or referred trust can develop (Ferrin et al., 2006; McEvily et al., 2003; Nohria, 1994; Shapiro, 1987).

Morita and Burns (2014a) identified two behaviours that team members used to either promote trust in others or to acquire more information for informed trust decisions: recommendations and validations. When individuals in the study were skeptical about trusting, they acquired the necessary supplemental information to build trust based on recommendations from others within the team network and, in other cases, validated some information or deliverable presented by the individual being trusted (Morita & Burns, 2014a; Symeonidis, Nanopoulos, & Manolopoulos, 2008).

These two observations showed that information such as skills, training, safety records, and performance records are used to form trust (Morita & Burns, 2014b). These behaviours serve as conduits to convey information about the person being trusted that positively affect the trust behaviour.

We then hypothesized that computer interfaces could be designed to act as third parties, as proxies to carry information and establish trust. We proposed the creation of "trust tokens" that would have the potential to communicate trust through interface design.

7.2.3.2 Interface design trust tokens

The development of trust tokens was intended to replicate the characteristics of the trust-fostering behaviour observed in our ethnographic study. In the study presented in this paper, the effect of the third party in the trust relationship was replaced by an interface design object, or trust token, acting as a liaison between the parties, conveying information to support the development of an informed trust decision.

The five tokens created for this study were based on the five factors presented in Morita and Burns' ethnographic study. They convey the most frequent and most effective trust-supporting information which individuals use in face-to-face collaborations to build their trust states, as described by Morita and Burns (2014a).

The trust tokens were designed to convey similar information in the form of a sign. Following semiotic theory (Peirce, 1998; Wetzel, 2011), we tried to match the visual component of the token to the meaning of the information being conveyed. The field of semiotics specializes in the study of signs and sign systems, focusing on how meaning is embedded or incorporated in signs (Peirce, 1998;

Wetzel, 2011). There is a close relationship between the fields of semiotics and interface design, as the whole purpose of interface design is to embed meaning into its components so users can interact with the system to achieve intended goals (Nadin, 1988). Trust tokens were designed to serve as interface objects that represented types of trust-supporting information identified in the ethnographic study (Morita & Burns, 2014a). Conveying the same meaning through the use of a different physical representation underlies interface design trust tokens, which are physical entities or markers serving as vehicles for trust-supporting information (Peirce, 1998; Wetzel, 2011).

We hypothesized that the trust tokens could carry trust-supporting information in the same way as third parties or liaisons did in Morita and Burns' ethnographic study (Morita & Burns, 2013, 2014a). The badge representing the trust token, followed by its descriptive appended text, was carefully chosen to provide a comprehensive description of the type of trust-supporting information being conveyed by that token. Through the combination of textual and graphical representations, we increased the saliency of the information and catered to a larger range of individuals, both those who are text-oriented and those who are visually-oriented.

7.2.4 Methodology

In this study, participants were required to make decisions in different types of social networking scenarios (see Table 18), using the information conveyed in the form of trust tokens to better inform their decisions. In each scenario, participants were given a number of people to choose from and had to identify their top three choices. We were interested in how participants used the information from the tokens in their trust decision, how that choice was affected by different predictive factors, and how different scenarios influenced the use of tokens.

At the beginning of the study, participants were asked to fill out a demographic questionnaire with their age, gender, and years of work experience, all factors known to influence how people trust (Johnson-George & Swap, 1982; Sutter & Kocher, 2007). Personality questionnaires for locus of control (Rotter, 1966), propensity to trust (Mayer & Davis, 1999), and the Big Five inventory (John & Srivastava, 1999) were also used, as we were interested in evaluating the effect of different personality types on the use of tokens. Past research has suggested that personality factors have an influence on how much people trust others (Mooradian, Renzl, & Matzler, 2006; Rotter, 1971; Schlenker et al., 1973).

Participants were exposed to 30 scenarios, ten in each of three different contexts: an e-marketplace, choosing a physician, and reviewing travel recommendations (Table 18). These three contexts were selected because they presented three different kinds of risk: financial, health, and experiential. A healthcare scenario corresponds to one of the main areas in which trust research has focused its attention (Andreassen, Trondsen, Kummervold, Gammon, & Hjortdahl, 2006). The financial scenario represents one of the most common types of internet-related financial systems that depend on buyer-seller trust (Gefen, 2000). Finally, the travel recommendations scenario simulates experiential risk, drawing upon the type of recommendations that individuals look for in the internet and the wide development of travel websites as social network systems (Xiang & Gretzel, 2010).

Table 18: Description of the scenarios, variations within each scenario, and type of risk.

	Decision for these scenarios	**Variations on each scenario**	**Type of risk**
E-MarketPlace **10 scenarios**	Choose the top three vendors to purchase the identified product.	Each scenario presented a different product, but within the scenario the product was the same price from all vendors.	Financial risk Participants risk losing money by not receiving the product that was purchased.
PickYourPhysician **10 scenarios**	Choose the top three physicians that the participant would schedule an appointment to consult with on the medical issue presented on each scenario.	Different specialties being sought in each scenario for a specific medical condition.	Health risk If the wrong physician is chosen, participants risk having a bad experience or not getting properly treated or diagnosed.
TravelBuddy **10 scenarios**	Choose the top three suggestions from travelers to accept for the trips or destinations presented on each scenario.	Different requests for suggestions of hotels and restaurants in each scenario.	Experiential risk In this case, there is also an indirect financial risk embedded, but the most significant influence comes from accepting a bad suggestion and having a terrible travel experience.

Table 19: Trust tokens and the specific descriptions for each type of scenario. All trust tokens are described to the participants as being defined by the social system, where the person whose profile is being displayed in the interface cannot control what is displayed. Tokens are a combination of the symbol and the text beside it, as per Figure 27.

Trust Token		E-MarketPlace	PickYourPhysician	TravelBuddy
Expertise		**Product expert** Vendor is defined by the system as an expert in that product.	**Condition expert** Physician is defined by the system an expert in the specific medical condition.	**Destination expert** Traveler is defined by the system as an expert in that specific destination
Recommendation		**Recommended vendor** Vendor has been recommended by buyers in the network.	**Recommended physician** Physician has been recommended by other patients in the network.	**Recommended traveller** Traveller has been recommended by other travelers in the network.
Validation		**Helpful posts** Past contributions of this seller on the forums have been validated as useful by buyers.	**Helpful posts** Past contributions of this physician on the forums have been validated as useful by patients.	**Helpful posts** Past contributions of this traveller on the forums have been validated as useful by other travelers.
Network size		**Large client network** Seller has a large network of clients connected through the social network.	**Large client network** Physician has a large network of clients connected through the social network.	**Large traveller network** Traveller has a large network of clients on the social network.
Frequent contribution		**Frequent forum contributor** Seller regularly contributes on the supporting forums in which buyers can post questions about the products being sold.	**Frequent forum contributor** Physician regularly contribute on the supporting forums in which patients can post questions about medical conditions.	**Frequent forum contributor** Traveller regularly contributes on the supporting forums in which other travelers can post questions about destination and hotels.

In each scenario, participants had to choose their top three choices among ten sellers, physicians, or travellers' recommendations (see Figure 27). Five options included one of the described tokens, while the other five had no tokens associated, as Table 18 illustrates. Participants were informed that tokens were determined by the system, that the individual being represented had no influence on how these tokens were assigned, and that participants were free to choose individuals with or without trust tokens. In Table 19 above, we provide a more detailed explanation of each of the tokens, as well as their variations within each of the types of scenarios from our study.

To control for order effects, the order of presentation of the scenarios was randomized. We created five versions of each scenario with random variations in which vendor, physician, or traveler would carry the aforementioned tokens. All randomizations were generated using tools from random.org.

We did not evaluate the potential strength variations within each token (i.e., how many recommendations would be necessary to make a recommendation token more important than an expertise token). We were only interested in comparing the effects of a larger range of tokens, without varying the levels within each token, to evaluate the effect of tokens in different scenarios (different types of risk) that participants were exposed to.

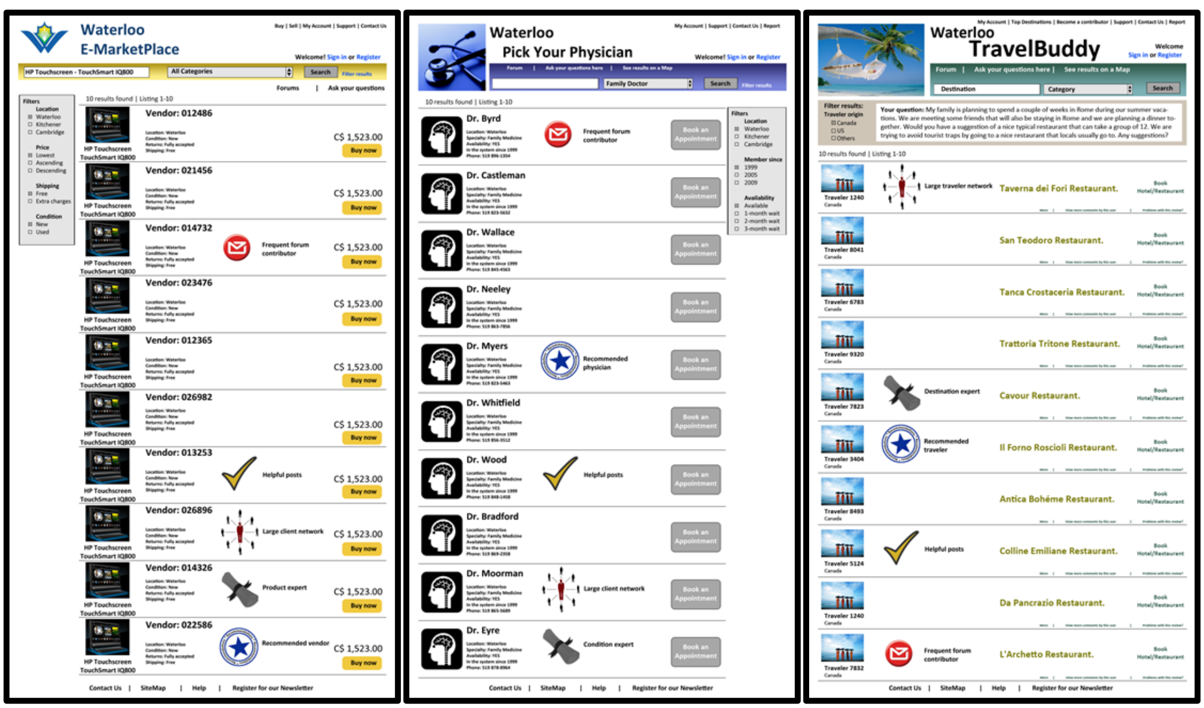

Figure 27: Samples of the scenarios presented to the participants.

7.2.5 Hypotheses

The trust state formation process Morita and Burns have described (Morita & Burns, 2014b) presents the perceptual mechanisms as being constrained by cultural, environmental, and experiential variables which allow us to hypothesize variations in trust token usage.

Individuals seek cues in the environment and interactions that provide more information about the individual being trusted, leading to a more informed trust decision (Bachmann & Zaheer, 2006; B. Barber, 1983; Morita & Burns, 2014b). Positive influences on the trust behaviour are expected if available information corroborates that trust decision (Kramer & Tyler, 1996; Luhmann, 1979). Therefore:

H1: Individual profiles of sellers/travellers/physicians that carry one of the tokens will be selected more often than profiles without tokens.

According to Morita and Burns (2014b), Mayer et al. (1995), and McKnight et al. (1998), trust decisions are highly constrained by cultural variables common to all the participants of our studies. Consequently, participants should display an overall tendency to rely more on a certain type of information than in others. Since most of the scenarios used in this study focus on tasks in which experience in a particular field was important (Doney & Cannon, 1997; Wright, Holcombe, & Salmon, 2004), we expected to see tokens carrying experience-related information to be used most (Expertise, Recommendation, and Validation tokens). Therefore:

H2: Tokens will show different levels of usage, as explained by Morita and Burns' model (2014b), but we expect to see more frequent usage of trust tokens that can carry experience-related information (Expertise, Recommendation, and Validation).

In accordance to Morita and Burns' model (2014b), each cue used for the formation of a trust state is constrained by an internal weight that accounts for the individual variability in the importance of each cue. Constraining factors such as risks or task characteristics heavily influence these internal weights (Morita & Burns, 2014b). Depending on the type of trusting situation and the type of risk, individuals will seek different types of trust-supporting information. We expected to see a more frequent usage of the Expertise token on the PickYourPhysician scenarios due to higher dependence on the skills of the physician (Hall, Camacho, Dugan, & Balkrishnan, 2002; Hall, Dugan, Zheng, & Mishra, 2001), the Recommendation token on the TravelBuddy scenarios due to high reliance of recommendations on travel sites (Parra-López, Bulchand-Gidumal, Gutiérrez-Taño, & Díaz-Armas, 2011; Xiang & Gretzel, 2010), and the Network size token on the E-MarketPlace scenarios due to the value of the vendor's number of clients (Srinivasan, Anderson, & Ponnavolu, 2002). Consequently:

H3: We expect to identify variations in the usage of tokens across the scenarios, since participants are exposed to a different set of constraints.

As we are evaluating three hypotheses using the same dataset and performing multiple statistical comparisons, we have established statistical significance at $p < 0.0133$ according to the Bonferoni correction (Gravetter & Wallnau, 2006; Howell, 2012).

7.2.6 Results

Initial tests of normality via the Shapiro-Wilk test (Wilk, 1965) have indicated that part of our data was not normally distributed. Since validity cannot be assured by a normality test, we have decided to pursue our analysis using non-parametric tests. Mann–Whitney U test, Spearman's correlation, Friedman's test, and Wilcoxon Signed Ranks Test were used for assessing the relationships between our dependent and independent variables (Gravetter & Wallnau, 2006; Howell, 2012).

7.2.6.1 Description of the population

We collected 20 complete datasets ($n = 20$) with balanced gender representation (Male = 50%, Female = 50%). Participants were all born in western countries and had lived most of their lives in Canada (one participant was born in Poland, but moved to Canada at age six). Participants' age averaged at 27.85 years ($\mu = 27.85$, $\sigma = 7.315$), with an average of 8 years of work experience ($\mu = 8$, $\sigma = 6.553$). Across the sample group, personality measures were within normal ranges.

7.2.6.2 Global usage of tokens

When looking at the overall usage of tokens, we observed that participants in general chose to trust individuals carrying trust tokens over those without tokens. Out of 1800 possible selections (as a first, second, or third option), we identified only 18 instances (1% of events) in which individuals without tokens were selected, all of which were selected as a third option. These results corroborate our first hypothesis (H1), in which we predicted that individuals would have a preference for making informed trust decisions and consequently would choose individuals who carried trust tokens (Abdul-Rahman & Hailes, 2000) to reduce the natural uncertainty in their trust behaviour (Kramer & Tyler, 1996).

We were also interested in observing the number of times participants selected profiles carrying each of the different trust tokens. We tested our second hypothesis (H2) by identifying differences in the usage the different trust tokens that were presented. Data in Table 20 shows the average frequencies of token selections in all 30 scenarios presented to each participant. In order to facilitate the analysis and to strengthen our statistical testing, we integrated all of the choices into one compounded score that accounts for the global usage of the tokens, based on the following equation: $Compounded\ score = 3 * First\ choice + 2 * Second\ choice + third\ choice.$

This integrated score was used to create a single variable that encompasses the overall usage of the trust tokens, so that paired comparisons between the scenarios using Friedman's Test (Gravetter & Wallnau, 2006) could be performed. The weights were chosen to allow the integration of second and third choices into a single variable. Choosing larger weights for the first choice would make the influence of the second and third choices on the compounded score too small, invalidating this integrative approach.

Table 20: Average, standard deviation, and compounded score of the frequency in which vendors, physicians, or travelers that carried each type of token were selected. Since we presented each participant with 30 scenarios, frequencies can range from 0 to 30.

	Averages of frequencies of selection			
	As a first choice	**As a second choice**	**As a third choice**	**Compounded score**
Recommendation	$\mu = 13.65, \sigma = 4.727$	$\mu = 10.80, \sigma = 5.961$	$\mu = 3.20, \sigma = 4.595$	$\mu = 65.75, \sigma = 13.96$
Expertise	$\mu = 13.00, \sigma = 4.768$	$\mu = 4.65, \sigma = 4.705$	$\mu = 6.70, \sigma = 5.478$	$\mu = 55.00, \sigma = 12.23$
Validation	$\mu = 2.50, \sigma = 3.706$	$\mu = 9.40, \sigma = 6.151$	$\mu = 11.75, \sigma = 6.257$	$\mu = 38.05, \sigma = 12.86$
Network size	$\mu = 0.45, \sigma = 0.887$	$\mu = 4.30, \sigma = 5.440$	$\mu = 5.75, \sigma = 5.618$	$\mu = 15.70, \sigma = 13.58$
Frequent contribution	$\mu = 0.40, \sigma = 1.188$	$\mu = 0.85, \sigma = 1.843$	$\mu = 1.70, \sigma = 3.028$	$\mu = 4.60, \sigma = 7.74$

Overall, the frequency of usage of each token was in descending order: Recommendation, Expertise, Validation, Network size, and Frequent contribution, as outlined in Table 20. When analyzing this data using a Friedman's test, the differences are statistically significant ($\chi^2(2) = 17.200$, p < 0.0005). These results align with the expectation of our second hypothesis. We anticipated a more frequent usage of the tokens carrying experience-related information (Recommendation, Validation, and Expertise), and in our scenarios, expertise in a relevant area was the most prominent feature.

We also tested our selection variables against the demographic variables collected in this study, but we could not identify any specific effect.

7.2.6.3 Effects of different scenarios on token usage

The third analysis we performed was to evaluate the effect of different types of risk embedded in the scenarios on the need for different trust-supporting information. According to Morita and Burns' trust model (2012), different types of risk constrain internal weights of trust formation differently, resulting in variations in the importance given to each trust cue. As we have hypothesized, each scenario is expected to have a dominant token, one that would be most frequently used by participants in that particular scenario.

In order to evaluate these differences, we present the averages of the compounded scores of each token in the different types of scenarios in Table 21. The results clearly display differences between the types of scenarios.

Table 21: Average and standard deviation of the compounded score for each tokens, separated by different scenarios. This data shows the difference between the usage of tokens in the different types of scenario.

	E-MarketPlace	**PickYourPhysician**	**TravelBuddy**
Recommendation	$\mu = 28.10$, $\sigma = 3.093$	$\mu = 20.05$, $\sigma = 7.119$	$\mu = 17.60$, $\sigma = 7.535$
Network size	$\mu = 7.35$, $\sigma = 7.625$	$\mu = 5.40$, $\sigma = 5.226$	$\mu = 2.95$ $\sigma = 3.886$
Expertise	$\mu = 9.40$, $\sigma = 7.294$	$\mu = 24.35$, $\sigma = 4.902$	$\mu = 21.25$, $\sigma = 7.538$
Validation	$\mu = 13.15$, $\sigma = 7.147$	$\mu = 9.35$, $\sigma = 6.115$	$\mu = 15.55$, $\sigma = 6.345$
Frequent contribution	$\mu = 1.85$, $\sigma = 3.884$	$\mu = 0.60$, $\sigma = 2.257$	$\mu = 2.15$ $\sigma = 4.771$

These results show that the Recommendation token was dominant in the E-MarketPlace scenarios, and the Expertise token was dominant on the PickYourPhysician and TravelBuddy scenarios. These results only partially support our hypothesis. Predictions were correct for the PickYourPhysician scenarios, but our hypothesis also stated that there should be a consistent difference in the usage of tokens across the scenarios, so we furthered our investigation.

To compare the different types of scenarios, Friedman's test was necessary for each of the tokens to statistically validate these differences. Results are presented in Table 22. Statistically significant differences have been found both in Recommendation and Expertise tokens when using the p-value established by the Bonferoni correction ($p < 0.0125$).

Table 22: Results from the Friedman's test (non-parametric) for each Trust token, looking at the compounded score.

	Friedman's Test Results
Recommendation	$\chi^2(2) = 25.872$, $p < 0.0005$
Network size	$\chi^2(2) = 7.485$, $p = 0.024$
Expertise	$\chi^2(2) = 20.615$, $p < 0.0005$
Validation	$\chi^2(2) = 5.333$, $p = 0.069$
Frequent contribution	$\chi^2(2) = 3.353$, $p = 0.187$

In order to better understand the variations presented in Table 21 and Table 22, we explored the differences within the statistically significant results (Recommendation and Expertise tokens) though post-hoc tests, using Wilcoxon Signed Ranks Test.

Results of these tests can be seen in Table 23. We identified a statistical significance in the use of the Recommendation and Expertise tokens when comparing the E-Marketplace scenarios with the PickYourPhysician and TravelBuddy scenarios, but not between the TravelBuddy scenarios and the PickYourPhysician scenario. Although participants were exposed to different types of risks, the use of tokens was similar for the Recommendation and Expertise tokens. The internal weighting for these two cues on the trust formation process thus probably has similar values (Morita & Burns, 2014b).

7.2.7 Discussion

In order to prove the similarity between referrals in face-to-face collaborations and the information carried by the trust tokens, we had to demonstrate that, as per Morita and Burns' model (Morita & Burns, 2014b), that usage of cues in the formation of a trust state would be constrained by situational factors such as the types of risk. This study successfully demonstrates this relationship.

Table 23: Medians and Pairwise comparisons of the statistically significant differences using Wilcoxon Signed Ranks Test.

	Medians and Pairwise comparisons (Wilcoxon Signed Ranks Test)			
	Recommendation		Expertise	
	E-MarketPlace	(Mdn = 30)	E-MarketPlace	(Mdn = 9)
E-MarketPlace vs.	PickYourPhysician	(Mdn = 22)	PickYourPhysician	(Mdn = 24)
PickYourPhysician	Z = -3.568, p < 0.0005		Z = -3.848, p < 0.0005	
	E-MarketPlace	(Mdn = 30)	E-MarketPlace	(Mdn = 9)
E-MarketPlace vs.	TravelBuddy	(Mdn = 19)	TravelBuddy	(Mdn = 23)
TravelBuddy	Z = -3.792, p < 0.0005		Z = -3.572, p < 0.0005	
	PickYourPhysician	(Mdn = 22)	PickYourPhysician	(Mdn = 24)
PickYourPhysician vs.	TravelBuddy	(Mdn = 19)	TravelBuddy	(Mdn = 23)
TravelBuddy	Z = -2.122, p = 0.034		Z = -1.272, p = 0.204	

Our results bring to light the fact that different tasks and scenarios in which people collaborate demand different trust-supporting information (in our case, in the form of trust tokens) for eliciting trust. Authors in trust research have suggested that situational constraints influence trust behaviours (Gill et al., 2005; Jarvenpaa et al., 1998; Knoll & Gill, 2011; Mayer & Schoorman, 1998; Morrow et al., 2004; Peters & Manz, 2007; Rusman et al., 2010) without engaging in the evaluation of these differences in an electronic domain. The results presented here turn an assumption based on the comparison of different models into empirical demonstrations of the effect of situational constraints on trust behaviour.

7.2.7.1 Global usage of tokens

In our first hypothesis, we postulated that we would see a larger percentage of participants choosing individuals who carried a trust token, supporting a preference for making informed trust decisions as described in the literature (Abdul-Rahman & Hailes, 2000; Morita & Burns, 2014b). Our results fully support our hypothesis, as 99% of all selections made by participants were associated with a token. These results reinforce the importance of providing supplemental cues (Morita & Burns, 2013) to individuals. When trusting agents are exposed to situations in which they are unfamiliar with the other party, they will actively look for information to help them make their trust decision (Morita & Burns, 2014a).

These results also align with social referencing (Klinnert et al., 1983) and social influencing (Kelman, 1958), as individuals who are provided with uncertainty will look for cues on how others are behaving to shape their own decisions. This stems from the desire to mirror the group's normative standards with one's own behaviour (Aronson, Wilson, & Akert, 2012).

Still, according to trust theory (Bachmann & Zaheer, 2006; Kramer & Tyler, 1996; Mayer et al., 1995; Morita & Burns, 2014b), different cues or pieces of trust-supporting information are used in the formation of a trust state. Consequently, according to Hypothesis 2, we expected each token to show a different distribution throughout the scenarios, but a general dominance of tokens that carried experience-related information (Expertise, Recommendation, and Validation).

The results presented in Table 20 show that that Recommendation, Expertise, and Validation were indeed the most frequently used tokens, while Network size and Frequent contribution tokens were used less often. These results fully support our initial hypothesis, because for initial trust formation, individuals focused on confidence over intuitive trust (Morita & Burns, 2014b), which results in a stronger emphasis on experience-related cues. The results from Friedman's test ($\chi^2(2) = 17.200$, $p < 0.0005$) demonstrate the statically significant difference in the use of the tokens.

The Recommendation and Validation tokens represent situations in which a person in the network or group has positively identified a vendor, physician, or traveller. This positive identification leads to transferred trust (Ferrin et al., 2006; McEvily et al., 2003; Nohria, 1994; Shapiro, 1987). The Expertise token reflects the focus on cognition- or confidence-based trust in work-related trust relationships and virtual trust (Bachmann & Zaheer, 2006; Hung et al., 2004; Mayer et al., 1995; McAllister, 1995; Morita & Burns, 2014b; Six, 2005).

7.2.7.2 Effects of different scenarios on token usage

The last step consisted of evaluating the effects of constraining factors—in this case, the varied risks in different trusting situations—on the usage of tokens (Hypothesis 3). We found statistically significant differences in the use of the Recommendation and Expertise tokens between the types of scenarios, as we can see in Table 22. These results partially support our hypothesis, as only the use of some tokens show statistically significant differences. However, these results clearly demonstrate the effect of situational factors on the usage of trust cues in the trust formation process (Bachmann & Zaheer, 2006; Mayer et al., 1995; Morita & Burns, 2014b).

As per Morita & Burns' model (Morita & Burns, 2014b), we can expect that, when forced with a decision to choose one type of trust-fostering information, individuals will rely on information they personally consider most relevant for that decision, based on experiences, values, and cultural background. This behaviour is consistent with the internal weights of the trust formation model (Morita & Burns, 2014b) and the weighting component of the Quick Trust Assessment Scale (Morita & Burns, submitted, in revision). Other authors in the field of trust research also discuss this effect (Gill et al., 2005; Jarvenpaa et al., 1998; Knoll & Gill, 2011; Mayer & Schoorman, 1998; Morrow et al., 2004; Peters & Manz, 2007; Rusman et al., 2010), and how different antecedents to trust are necessary to trigger trust behaviour.

Our prediction of dominant tokens, based on cues available in the literature, was only correct for the PickYourPhysician scenarios. These predictions were only based on assumptions grounded in pieces of information available in the literature, as there have been no studies investigating this type of approach for fostering trust. The empirical results collected in our study show that trust tokens indeed function similarly to cues acquired during face-to-face collaborations, which are also constrained by situational factors predicted by Morita and Burns' model (Morita & Burns, 2013, 2014b).

The Recommendation and Expertise tokens are most frequently used across scenarios, and are also the tokens for which usage across the different scenarios has shown to be statistically significant.

The Recommendation token was the most used in the E-MarketPlace scenarios. The financial risk in this case led to high reliance on the recommendation of others in order to minimize negative outcomes. This token reflects the seller's positive history with and recommendations from their clients. We initially expected that the Network size token would have this effect, as it also relates to the number of clients. However, the Network size token does not account for the quality of the experience, only for the number of past experiences. Our empirical results support the idea that individuals consider knowing about good experiences associated with a vendor to be more important than simply knowing about the number of interactions or their social capital.

When analyzing the Expertise token, statistical significance was found in the comparison between the E-MarketPlace and the other two scenarios. Expertise was deemed to be an important trait in both the PickYourPhysician and the TravelBuddy scenarios, but was relied on less frequently in the E-Marketplace scenario. One possible explanation is that individuals do not need to be experts in a certain product to be able to sell it, and so the influence of their expertise on the outcome of the transaction is relatively small. Expertise in the latter two scenarios, however, can be linked to the quality of the information or care provided, as medical or travel expertise can have a direct impact on the outcome of the trusting situation.

These results demonstrate the internal weighting mechanism from Morita and Burns' model (2014b), which explains why the same cue has different effects in different trusting situations. In this study, we demonstrated the effect of situational risk on the perception of trust cues.

7.2.7.3 Implication for Human Factors research

This research brings to light variations in the influence of trust factors for different trusting situations. This project demonstrates that a one-size-fits-all solution for trust fostering would not be the most efficient approach. Instead, designers should be aware of the types of collaboration so they can properly identify the most common tokens used in the system, or incorporate a wider range of tokens that collectively inform trust decisions.

The results presented above can be summarized in the following observations, while focusing on the design and trust fostering aspects for CMCSs:

- Different tokens will have different effects on trust formation depending on the situation in which people have to trust, demonstrating the effect of the internal weighting mechanism of Morita & Burns' model (submitted, in revision, 2014b). Different types of risk embedded in the different scenarios resulted in different uses of tokens, which allowed individuals to reduce the uncertainty of their decision based on the type of risk they faced.
- As a result, it was not possible to identify a global token that would elicit the most trust in any situation based on usage. We did observe, however, that the Network Size token and the Frequent contribution token were the least used tokens (Table 20). Therefore, a smart selection

based on the data from this study would be to choose Recommendation, Expertise, and Validation as tokens for further study.

7.2.8 Conclusion

In this study, we were interested in identifying variations in the use of trust cues in the form of trust tokens and their use in simulated social network environments as the basis for trust decisions. Using three types of scenarios, we evaluated the usage of the five tokens extracted from Morita and Burns (2013, 2014a). Differences in token usage are visible in comparisons between different scenarios. Participants most commonly relied upon Recommendation, Expertise, and Validation tokens.

Most importantly, this paper brings to our attention that, depending on the collaboration in which individuals are immersed, different trust cues are necessary to elicit trust behaviours. These results turn an assumption based on evidence in the literature into an empirically demonstrated effect.

The analyses presented here highlight the fact that individuals will use different tokens to form a trust state when facing different types of risks. At a micro level, different trusting situations will have different internal weights for each of the trust cues being perceived (Morita & Burns, submitted, in revision, 2014b). At a macro level, tokens must be tailored according to the type of environment and system being implemented, so that they maximize their trust building capacity.

7.3 Additional Data and Discussion

The paper presented in this chapter covers the development and testing process of trust tokens. Some additional material used in the development of this paper can be found in Table 24.

In this chapter I discussed one possible way of conveying trust fostering information through communication systems in the form of trust tokens. Another very important result from the paper presented in this chapter is the validation of the strong situational dependence of trust behaviour (Dirks, 1999; Jarvenpaa et al., 2004; La Guardia & Ryan, 2007; Morita & Burns, 2014b; Payne & Clark, 2003; Schlenker et al., 1973). Such variation can be explained by the Human Factors Trust State Formation Model through the inclusion of the internal weights in the perception mechanisms (Figure 26), which adds a constraint to the perception and use of each of the perceived cues on the formation of a trust state. The internal weights in the trust token study were influenced by the types of risks that the participants were exposed, changing the relative importance of each cue on the different scenarios.

Table 24: Additional supporting information for the trust token study in Chapter 7.

Supplemental Material	Location	Additional Information
Ethics approval certificate	Appendix EE	Ethics approval certificate for the trust token study.
Consent form	Appendix Z	Consent form presented to the participants at the beginning of the study.
Description of the trust tokens	Appendix S	This sheet as available to the participants at all times for consultation, providing a detailed description of the tokens.
Sample of the scenarios	Appendix T	Sample of the scenarios presented to the participants for training purpose. The other scenarios in the study follow the same model.
Sample questionnaires	Appendix U	Sample questionnaires used in the trust token study. Not all data from the questionnaires was used in the development of this paper.

In the next chapter, I investigate the influence of a different constraint on trust behaviour. Through the use of cross-cultural comparisons between different populations, I evaluate how different cultures (individualistic western cultures versus collectivistic eastern cultures) regulate and influence the use of trust fostering information.

Chapter 8
Influence of Cultural Differences in Trust Formation

8.1 Foreword

After having explored the effects of situational risk on trust behaviour in Chapter 7, I decided to further explore the effects of constraining factors on trust behaviour. When designing for interpersonal trust, it is important to consider the high situational dependency of trust behaviour (Dirks, 1999; Jarvenpaa et al., 2004; La Guardia & Ryan, 2007; Morita & Burns, 2014b; Payne & Clark, 2003; Schlenker et al., 1973) in order to for trust-fostering designs to have their intended effects. Variations in a wide range of trust antecedents and situational conditions define which information people will use when trusting and consequently, influence which cues designers should present in the interface in the form of interface design objects, or which managerial interventions are necessary to trigger the development of trust behaviour.

The rapid growth of communication technologies has led to the widespread use of CMCSs to support international collaboration. Virtual teams now span across borders, and culture plays a dominant role in defining trust behaviour (Cyr, 2008; Doney et al., 1998; Macy & Sato, 2002).

In this chapter, I explore the effect of the participant's cultural background in the formation of interpersonal trust. Through paired studies in Canada and Japan, I examine how cultural constraints influence which information individuals use when trusting. I investigate the differences between individualistic and collectivistic cultures and their impact on trust behaviour. The studies presented in the previous chapters were replicated using a Japanese population, and the results compared, to evaluate if there is a systematic difference in which information people use to form a trust state.

The analyses presented in this chapter investigate the perceptual mechanisms described in Chapter 4 of this thesis, providing more empirical evidence of how situational constraints influence the internal weighting of perceived cues, as Figure 28 highlights.

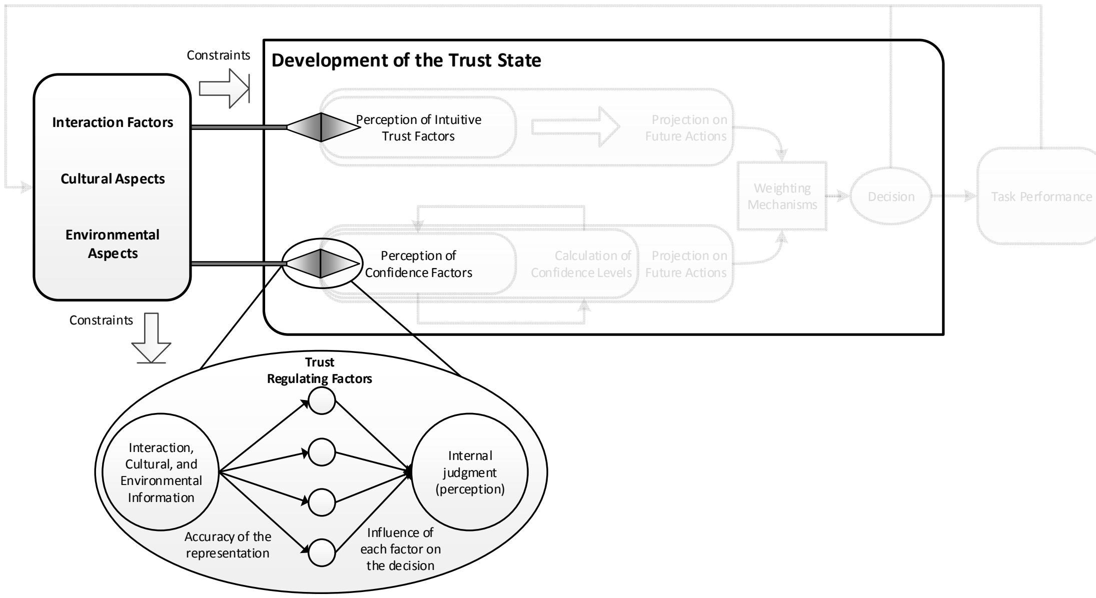

Figure 28: Perceptual mechanisms of the trust model explored in this chapter.

8.2 Designing for cross-cultural trust: What are the real differences when trusting?

Morita, P. P., Horiguchi, Y., Sawaragi, T. & Burns, C. M. (submitted). Designing for cross-cultural trust: What are the real differences when trusting? Submitted to *Computers in Human Behaviour.*

This paper has been submitted to Computers in Human Behaviour.

8.2.1 Overview

Interpersonal trust is an important requirement for successful and effective teamwork, influencing how people communicate and collaborate. With the development of communication and collaboration systems, teamwork is now a core component of international collaborations and organizations. Cultural differences and constraints, however, influence how individuals trust and how they perceive certain behaviors of others in the team.

We provide empirical evidence of the effects of cultural constraints on trust behaviour, demonstrating how different populations use different information when trusting. By conducting studies in Canada and Japan, we evaluated the effects of these two culturally distinct populations, discussing the effects of collectivistic and individualistic framing on trust behaviour. Japanese people, for example, based their trust decisions more often on cues that showcase social capital and group affiliation compared to Canadians. Across all three studies, the Japanese population showed different patterns of trust cue weightings from the Canadian population.

Culture defines how we trust, and consequently, how we should design for trust. This work adds to the existing literature on cross-cultural differences by examining variations in how cues build interpersonal trust. This work also contributes to the knowledge of how to design systems to improve trust between team members of different cultures.

8.2.2 Introduction

Teams have become the backbone of today's institutions and organizations (D. M. Rousseau et al., 1998; V. Rousseau, Aubé, & Savoie, 2006; Schuman, 2006; Wildman et al., 2011), with collaborative work defining the capabilities of a large array of organizations, such as the military (Artman, 2000; Hyllengren et al., 2011; Scott, Cummings, Graeber, Nelson, & Bolia, 2006; N. A. Stanton, 2011), firefighters (Carroll, Rosson, Convertino, & Ganoe, 2006; Tannenbaum, Mathieu, Salas, & Cohen, 2012), healthcare (Burke et al., 2004; A. Jones & Jones, 2011; Leonard et al., 2004; Manser, 2009), and business enterprises (G. R. Jones & George, 1998; LaFasto & Larson, 2001). Teamwork capitalizes on the strengths of each of the team members, leading to a collective with potential greater than the sum of its individuals (Brockmann & Anthony, 1998; Weick & Roberts, 1993). Social collectives in the form of teams greatly improve the capabilities of institutions and organizations, but are also strongly influenced by the social dynamics that define how individuals inside these teams interact (S. G. Cohen, Ledford Jr., & Spreitzer, 1996; Driskell, Radtke, & Salas, 2003; Salas, Cooke, et al., 2008). Consequently, the successful implementation and use of teams in organizational domains strongly depends on our capability to create conditions and tools to facilitate the social interactions of team members within these institutions (Gibson & Cohen, 2003; N. A. Stanton, 2011).

One social constraint which regulates team interaction (Reina & Reina, 2007), effectiveness (Kiffin-Petersen, 2004), and performance (P. Lee et al., 2010; N. A. Stanton, 2011) is the nature of interpersonal trust: how individuals rely on each other and their willingness to accept some risks for the greater benefit of the team (Das & Teng, 2001, 2004; Hupcey, Penrod, Morse, & Mitcham, 2001; Peñarroja, Orengo, Zornoza, & Hernández, 2013; N. A. Stanton, 2011). Teams with appropriate levels of trust (Langfred, 2004) benefit from cohesion and solid communication between the parties (Jarvenpaa & Leidner, 1998; Mellinger, 1956), leading to proper information exchange, collaboration, and effective teamwork (Boland, Cann, McCuaig, & Onslow, 1998; Costa, 2003; Kiffin-Petersen, 2004).

As teamwork and trust are regulated by a large range of factors and antecedents (Jarvenpaa et al., 1998; Morrow et al., 2004; Rentsch & Klimoski, 2001; Schuman, 2006; N. A. Stanton, 2011; Xyrichis & Ream, 2008), the cultural background of the individuals collaborating and the culture of organizations play an important role in how trust is formed and how teams achieve effectiveness (Doney et al., 1998; Gibson & Zellmer-Bruhn, 2001; Macy & Sato, 2002; Xyrichis & Ream, 2008). With the expansion of communication technologies and the expansion of business boundaries, institutions and organizations now span across multiple countries. Consequently, teams are composed of individuals who are not only raised with different cultural backgrounds, but also exposed on a daily basis to different cultural constraints which are part of their institutional cultures. These cultural differences need to be accounted for when designing teams (Gibson & Cohen, 2003; Mohrman et al., 1995; Reagans et al., 2004; Sundstrom et al., 1990), technologies to support teamwork (Jenkins et al., 2010), and interventions targeted at improving trust and teamwork (Holton, 2001; Zheng et al., 2001).

Since most teams who deal with international collaborations make use of computer-mediated communication systems (CMCSs) to support their remote and asynchronous work (Bos et al., 2002; Jarvenpaa & Leidner, 1998; Potter et al., 2000; Riedl & Gallenkamp, 2012), the additional constraints of virtuality need to be considered when targeting these teams. Such enabling technologies clearly create enormous opportunities for collaboration and task coordination, but also need to be considered carefully when trying to understand team social dynamics (Cheng, Macaulay, & Zarifis, 2013; Gibson & Cohen, 2003; Kirkman et al., 2002).

For example, when looking at the work of Rusman, Bruggen, Sloep, and Koper (2010) and Morita and Burns (submitted, 2013), it is important to consider cultural differences when designing interventions for fostering trust in teams. Different cultures may value different pieces of information for the development of their trust state (Doney et al., 1998). When the objective is to provide information that can effectively influence trust, it is necessary to consider wide variability in how we trust (Dirks, 1999; Jarvenpaa et al., 2004; La Guardia & Ryan, 2007; Morita & Burns, 2014b; Payne & Clark, 2003; Schlenker et al., 1973), cultural background being one of the important factors influencing these differences (Cyr et al., 2005; Doney et al., 1998; Farris et al., 1973; Macy & Sato, 2002). Significant cultural variations, like the distinction between collectivistic and individualistic cultures (C. C. Chen, Chen, & Meindl, 1998; Koeszegi, 2004; Slater & Robson, 2012; Takahashi et al., 2008), or even different national cultures from different countries (Doney et al., 1998), greatly influence how individuals trust, leading to changes in the types of information which are more effective for fostering trust behaviour in teams with different cultural backgrounds.

8.2.2.1 Trust in individualistic cultures

Western society is defined as an individualistic culture (Rothwell, 2010; Triandis, Brislin, & Hui, 1988). Consequently, most of the mainstream literature of trust research focuses on individualistic societies. Trust is described as a willingness to accept risks in exchange for the benefits of collaboration (Das & Teng, 2001, 2004; Hupcey et al., 2001; Lewicki et al., 2006; N. A. Stanton, 2011). In order to trust, individuals have to put the collective ahead of the self and prioritize benefits to the team as a whole, shifting from selfish motivations to selfless motivations.

For individuals in this type of society, trust is comprised of a choice which individuals have when collaborating with others (Lewicki et al., 2006; D. M. Rousseau et al., 1998). Opting not to trust is not seen as a negative behaviour, as the decision is made based on an assessment of risk (Das & Teng, 2004; Hupcey et al., 2001). Individuals evaluate their risks and make a decision to either trust or not trust based on their projection of future consequences of their choice (Morita & Burns, 2014b). An individual who decides not to trust is seen as cautious and concerned with his and the team's well-being (Das & Teng, 2004; Lewicki et al., 1998; Marková & Gillespie, 2008; Mayer et al., 1995; D. M. Rousseau et al., 1998), as it is assumed that the decision not to trust was based on a high risk evident in the trusting action.

A trust state upon which individuals base their choices is comprised of a mental model representing the individual being trusted, influenced by the large array of antecedents that have an impact on trust (Jarvenpaa et al., 1998; Mayer et al., 1995; McKnight & Chervany, 1996; McKnight et al., 1998; Morita & Burns, 2014b).Through the integration of these perceived factors, individuals create mental models from which to project their decisions and evaluate the risks in the trusting action (Das & Teng, 2004; Lewicki et al., 2006; Morita & Burns, 2014b).

8.2.2.2 Trust in collectivistic cultures

In collectivistic cultures, individuals prize the maintenance of the "Wa": the balance, the equilibrium, the harmony borne out of consensus in decision making, avoidance of confrontation, and mutual trust (Parry, 2006). In Japanese cultures, for example, the relationship is valued more than the contract itself, which limits the ability individuals have to not trust the other party. They value the collective more than the individual (H. E. Lee, Park, Imai, & Dolan, 2012). In these cultures, trusting becomes the obligation or the norm, instead of an option (Kuwabara & Willer, 2007; Okumura, Brett, Maddux, & Kim, 2011).

Collectivistic cultures limit the ability that individuals have to stray from expected behaviour through social sanctions, limiting the ability to cheat (Chung, Sternquist, & Chen, 2006), which in turn reduces the level of risk one is expected to accept in a trust relationship (Takahashi et al., 2008). Yamagishi and Yamagishi (1994) have shown that when sanctioning is absent, Japanese have a lower tendency to trust and cooperate than westerners, but when sanctioning is in place, no difference is observed. In Japanese societies, trust is mostly regulated by social sanctions, and is not focused on social interactions. Individuals who break this balance are described as being ostracized from the system (Chung et al., 2006; Van Wolferen, 1989). The social capital associated with interaction plays a major role in defining a business relationship (Slater & Robson, 2012).

Although a choice is still involved in trusting in collectivist cultures, the constraining effects of cultural background have a dominating effect on trust (Morita & Burns, 2014b). Some authors have discussed the importance of reputation in Japanese societies (Okumura et al., 2011; San-Martín & Camarero, 2012), which leads to a stronger focus on endorsements coming from others in the social network.

8.2.2.3 Impact of cultural differences on designing for trust

The main approach to designing for interpersonal trust is to provide trust-related information that allows for the development of informed trust decisions through social networking and communication systems (Morita & Burns, submitted; Rusman et al., 2009). When evaluating cross-cultural teams and developing interventions to facilitate the development of interpersonal trust, we need to consider that information that is useful for fostering trust in one part of the team might not have the same effect on all team members if they are exposed to different cultural constraints (Doney et al., 1998; Slater & Robson, 2012). Consequently, designing a single intervention for a team as a whole, or using a simple approach to the provision of trust fostering information (Morita & Burns, submitted, 2013; Rusman et al., 2009) may not be as effective as expected.

Teams that are involved in international collaboration or include members who have been exposed to distinct cultural constraints require careful consideration of how these characteristics influence team dynamic (Anawati & Craig, 2006; Chevrier, 2003; Elron, 1997). Literature in this area, however, still lacks publications that discuss and evaluate the impact of culture on trust-fostering initiatives, such as using design. Studies in website development (Cyr et al., 2005; Cyr, 2008; Marcus & Gould, 2000) and general interfaces (Fernandes, 1995; Khaslavsky, 1998) demonstrate that there is indeed a need to evaluate the effects of such differences on trust if the objective is to design systems that facilitate the development of trust. Morita and Burns (submitted) have compared different risks involved in the trusting situation, and there is similar evidence in the literature that cultural constraints play a major role in information usage when building a trust state (Lewicki et al., 2006; Mayer et al., 1995; Morita & Burns, 2014b; D. M. Rousseau et al., 1998).

As Cullen (2008) has described, privacy is a foreign concept to Japanese individuals. The word "privacy" is represented as an English adaptation, and is a novel concept in Japanese culture. Considering this difference, providing trust-related antecedents in a profile (Rusman et al., 2009; Xu, 2014) or via interface design objects (Morita & Burns, submited) might not be seen as a problem in these societies as it is in western societies (Morita & Burns, submitted; J. S. Olson, Grudin, & Horvitz, 2005; Steel, 1991). Such differences influence how individuals perceive the sharing of information and, consequently, how they use it for the formation of trust states.

8.2.3 Objectives and Hypotheses

Considering that trust is a core component of collaboration and teamwork (Hyllengren et al., 2011; A. Jones & Jones, 2011; N. A. Stanton, 2011) and a precursor to team effectiveness (Costa, 2003; Curşeu & Schruijer, 2010; Kiffin-Petersen, 2004), the effect of constraints on trust behaviour is of critical importance for organizational studies and teamwork. As the use of virtual teamwork spreads beyond national borders (Jarvenpaa et al., 2004; Sarker et al., 2011), socio-cultural constraints play an important role in defining trust behaviour in teams.

In this paper, therefore, we investigate the effects of cultural differences on risk assessment and trust behaviour. Through paired studies conducted in western and eastern populations—in Canada, an individualistic culture, and Japan, a collectivistic culture—we sought to identify the differences in how information is used in the development of a trust state and trust behaviour. These findings are of core importance for organizational researchers, as they will empirically validate observational and theoretical studies that discuss the impact of cultural constraints in trust behaviour (Cyr et al., 2005; Doney et al., 1998; Macy & Sato, 2002).

Considering the strong situational dependency of trust (Dirks, 1999; Jarvenpaa et al., 2004; La Guardia & Ryan, 2007; Morita & Burns, 2014b; Payne & Clark, 2003; Schlenker et al., 1973) and the wide discussion of the cultural influence on trust behaviour, we have formulated our first hypothesis:

Hypothesis 1: Cultural differences will have an influence on the importance of the different factors that lead to trust behaviour, and in the use of trust-supporting information on the development of trust decisions.

For example, considering the collectivistic nature of Japanese society, we expect individuals from this population to place heavier weight upon trust factors related to social capital compared to its Canadian counterpart (Freitag, 2003; Slater & Robson, 2012). Therefore:

Hypothesis 2: The collectivistic nature of the Japanese society will drive individuals to rank and select trust factors that convey the message of larger social capital or social network when compared the Canadian individuals.

Since our focus is on validating the effects of cultural constraints on designing for trust, we are interested in identifying any differences in the use of trust-supporting information in these two populations. Since there are no references for defining a threshold, we have used a guideline that identifies differences in at least one variable in each of our three studies.

Hypothesis 3: The influence of cultural constraints will result in statistically significant differences in at least one variable of interest in each of our three studies.

From a macro-level perspective, our objective is to turn theoretical and observational discussions on cultural differences between the populations (Cyr et al., 2005; Doney et al., 1998; Macy & Sato, 2002) into empirical evidence showing that designers must give careful consideration to the influence of cultural constraints when designing for interpersonal trust.

Since we are using the data from three separate studies to evaluate the influence of cultural constraints through different data collection methods, we present the methods and results separated by the different studies. However, the discussion is integrated into a single section, as we will correlate the results to the hypotheses outlined above. We have chosen this approach since the discussion requires data from multiple studies.

8.2.4 Methods

In order to evaluate the effects of cultural constraints, it is necessary to compare trust behaviour in different populations and assess differences in trust decisions (Brislin, Lonner, & Thorndike, 1973; Ember, 2009), the usage of trust cues in the formation of a trust state (Morita & Burns, submited, 2013, 2014a; Xu, 2014), or the balance between cognitive and affective trust (Erdem & Ozen, 2003; McAllister, 1995; Morita & Burns, 2014b; Morrow et al., 2004). We have, therefore, decided to use data from three separate studies that focus on which information individuals generally use for developing a trust state, assessing the differences between the populations through different data collection methods.

In each of these three studies, we had matching groups from Canada and Japan, which allowed us to perform direct comparisons between the culturally distinct populations. Participants were recruited for the studies using research contacts, university mailing lists, and advertisements on part-time job boards. During the recruitment process, we attempted to recruit participants with similar demographics distribution (age, gender, educational background, and work experience) in order to match the populations being compared. In order to organize the presentation of our methodology and results, we are referring to each as Study 1, Study 2, and Study 3.

Studies 1 and 2 were online studies hosted at www.surveygizmo.com, while Study 3 was an in-person study hosted at the University of Waterloo in Canada and Kyoto University in Japan. Prior to beginning the data collection process, all studies received full ethics clearance from the University of Waterloo Office of Research Ethics and from the Kyoto University Ethics Board. Results presented in this paper are part of larger studies about trust behaviour.

Study 1 Method – In the first study, we started with the subjective assessment of which variables were important for the formation of a trust state (Lewicki et al., 2006; Mayer et al., 1995; McKnight et al., 1998; Morita & Burns, 2014b). Participants were asked directly for their opinions on which information, from a list of 15 items, most influenced their trust decisions. The focus of this study was on the self-evaluation and the self-assessment of factors that were considered important in the decision to trust another person. We presented 15 factors to the participants (Table 25), who were free to select as many as they considered important when deciding to trust.

These 15 factors were drawn from previous studies through a systematic literature review and a card-sorting study conducted in Canada (Morita & Burns, submitted, in revision). Each factor corresponds to clusters that were created to convert the large array of trust antecedents available in the literature (Das & Teng, 2004; Lewicki et al., 2006; Mayer et al., 1995; Morita & Burns, 2014b) into a comprehensive package of trust-influencing factors. After normalizing the results by the number of factors selected by each participant (item selected as most important received a score of one and subsequent items received a score that was dependent on the number of items selected by that particular participant) and running Mann-Whitney U tests (Gravetter & Wallnau, 2006), we evaluated the incidence of each of the 15 factors in the two populations.

Table 25: Trust-regulating factors evaluated in Study one. Extracted from Morita and Burns (submitted, in revision)

Factors	Factor Description
F1	Basic personality of the person you are trusting (beliefs, goals, benevolence, interpersonal skills, and self-confidence).
F2	Past behaviour that showcases the character/personality of the person you are trusting.
F3	Your awareness/knowledge of characteristics of the task, institution, and the environment where you work.
F4	Formal training, competencies, and abilities of the person you are trusting.
F5	Information about past experiences and history of collaborations passed by others in the institution, about the person you are trusting.
F6	Role of the person you are trusting in the team or in the institution.
F7	Risks for the person you are trusting and motivation behind the request for trust.
F8	Shared values and affection/empathy for the person you are trusting.
F9	Your instinct/gut feeling in the situation, or your disposition to trusting the other individual.
F10	Risks that you accept when trusting the other person and your motivations for trusting.
F11	Your own formal training, competencies, and abilities.
F12	Availability of information about risks in the task, and abilities and competencies of the person you are trusting.
F13	Rules, culture, and goals of the institution where you work/study.
F14	Characteristics of the environment and the task, in addition to all risks in executing the task.
F15	The other's awareness/knowledge of characteristics of the task, institution, and the environment where you work.

Study 2 Method – In the second study, we asked participants to evaluate individuals from their existing social network with whom they had collaborated in the past in order to analyze the subjective relevance of each piece of trust-supporting information in developing a trust state (Morita & Burns, submitted, in revision). Participants were asked to choose two individuals whom they had worked with in the past in a team environment: one person whom they trusted, and one person whom they did not trust. For each of these two individuals, participants evaluated their trust in the other person using the Quick Trust Assessment Scale (QTAS) (Morita & Burns, submitted, in revision). The QTAS is a trust metric that provides an assessment of the importance of each dimension on the overall trust score, in addition to the direct ratings of dimension of trust. The compounded measurement technique used in the QTAS creates a more balanced trust score and accounts for the situational variability when measuring interpersonal trust.

In this analysis, we evaluated the weights of each subscale, as they represent the relative importance of each dimension (Morita & Burns, submitted, in revision, 2014b), which in turn correspond to the variables that most influence decisions. The list of dimensions presented to the participants can be found in Table 26. Using Mann-Whitney U tests (Howell, 2012), we compared the two populations to identify how differences in their cultural backgrounds can influence the relative importance of each dimension.

Table 26: Sample of the dimensions of the Quick Trust Assessment Scale (QTAS), trust metric used in Study 2. More information can be obtained in Morita and Burns (submitted, in revision)

Dimensions	QTAS Dimensions
D1	Reliability
D2	Integrity
D3	Trustworthiness
D4	Takes responsibility
D5	Past behaviour
D6	Formal training, competencies, and abilities
D7	Information about past experiences and history of collaborations passed by others in the institution
D8	Your instinct/gut feeling in the situation, or your disposition to trusting
D9	Your own formal training

Study 3 Method – In this final study, we investigated the effect of providing cues about the other party which might have the power to elicit trust behaviour. Through the provision of tailored information to the participants, we evaluated the use of trust-supporting information in the form of interface design objects, called "trust tokens," when choosing a physician, a vendor, or a travel recommendation (Morita & Burns, submitted). We focused on the participants' decisions to trust one specific vendor, physician, or traveller based on the information that we provided in the form of trust tokens.

Using simulated versions of socially networked systems like TripAdvisor or eBay, we evaluated the effect of system-provided information about the people being trusted on the trusting behaviour of the participants. Each participant was exposed to 30 scenarios and was required to choose the top three of ten choices presented to them in the scenarios. More details about this study can be found in Morita and Burns (Morita & Burns, submitted). Half of the vendors/physicians/travellers carried a badge, or trust token, assigned by the system. The trust tokens were designed to convey trust-supporting information about the person that the token was associated.

In this cross-cultural comparison, we were interested in evaluating the effects of different cultural background of the participants on the use of trust-supporting information. These results will help inform the future design of cross-cultural trust-fostering technologies by increasing the awareness of the importance of cultural constraints on designing for interpersonal trust. We compared the populations of each study using Mann-Whitney U tests, as our data was not normally distributed and transformations could not normalize them. Since we were conducting repeated measures on each of the three studies, we decided to use the Bonferroni correction (Gravetter & Wallnau, 2006). The correction was not strictly necessary in this case, since we already have evidence in the literature of the influence of cultural constraints on trust behaviour. Nonetheless, we have chosen a conservative approach to further validate our results.

The three studies outlined above were replicated in Japan and Canada in order to collect data from culturally distinct populations. The exact same experimental material was used for both populations to maintain consistency and to assure that the same questions were asked in the two populations. We acknowledge limitations in using an English experimental material with a Japanese population, due to the limitations of English comprehension (Harzing, 2005, 2006). Some authors are in favour of translating the study material (Brislin, 1970; H. E. Lee et al., 2012; Sperber, Devellis, & Boehlecke, 1994), despite the fact that nuances of the experimental material might be lost. Other authors support the use of the same experimental material in English, as long as the study includes an acknowledgment of limitations and uses a target population that has good English-language comprehension (Harzing, 2005, 2006).

Considering that trust is a subtle but simultaneously complex construct (Lewicki et al., 1998, 2006; Marková & Gillespie, 2008; Morita & Burns, 2014b; Rotter, 1967, 1980), we decided to use English material in both populations to avoid deviations in the translation, while evaluating the English comprehension of the participants prior to the study in accordance to Harzing (2006). One good example of critical language differences between the cultures is word "privacy." Privacy is a foreign word to the Japanese vocabulary, and is assimilated through the introduction of "loanword" *puraibashii* (Couch & Jones, 1997; Cullen, 2008; Mizutani, Dorsey, & Moor, 2004).This was an important aspect of our questionnaires when it came to evaluating how individuals would react to the disclosure of trust-supporting information about themselves (Morita & Burns, submitted, 2013, 2014b; Rusman et al., 2009).

The disadvantage of this approach is that participants' limited understanding of the material may mask the differences between the populations, homogenizing the responses and reducing the existing differences (Harzing, 2006). However, since we are interested in demonstrating the existence of such cultural differences, using an English questionnaire in both populations will result in more conservative analyses. If differences can be identified in this experimental condition, then differences might be even more accentuated in the real world. The results from the three studies covered in this paper can be found in the next section.

8.2.5 Results

The three studies presented in this paper provide a comprehensive evaluation of the use of trust-supporting information in the development of a trust state. Through the combination of subjective and direct assessments, we have identified some differences in formation of trust states in the two populations and, consequently, differences in the perception of cues.

We present separate comparisons of the results, organized by their respective studies. In the discussion section, we provide a comprehensive overview of the importance of these findings for design and explain how they integrate into our call for raised awareness of cultural constraints when designing for interpersonal trust.

Study 1 – In this initial study, we were interested in the direct evaluation of factors that can influence a trust decision by comparing a Canadian population (n = 176) with a Japanese population (n = 70). Since we had different distributions of responses in Japanese populations and Canadian populations (Canadian participants selected 45% more items than Japanese participants), we decided to normalize participants' responses by the number of items they selected. The normalization allows us to account for differences in the number of selected items in the different populations. We proceeded to compare the differences of the two groups using Mann-Whitney U tests, since data was not normally distributed and transformations could not normalize the data. The difference in the number of selected items might represent a cultural difference on its own.

Because we performed multiple tests in the same dataset, we corrected the p-values using the Bonferroni correction (Gravetter & Wallnau, 2006). For the analysis of the results in Table 27, we are using a p-value of 0.003. Results showed statistical significance for factors F4, F9, and F11, all showing a higher relevance of these factors in the Canadian population when compared to the Japanese population. A visual representation of the differences can be found in Figure 29. Considering we had a total of 15 factors, we could identify statistical significance in 20% of the variables being evaluated.

Having identified significant differences in the subjective evaluation of factors influencing trust, we proceed to presenting the results of Study 2, where direct evaluations of team members using trust metrics allowed us to assess the direct influence of cultural factors on the formation of trust.

Study 2 – The second study covered in this paper focused on the actual measurement of trust in past relationships. Using a trust metric that captured the nuances of trust formation by measuring the relative weighting of the dimensions that lead to trust behaviour, the Quick Trust Assessment Scale (Morita & Burns, submitted, in revision), we collected information from past relationships of participant populations in Canada (n = 144) and Japan (n = 88). Each participant was asked to evaluate one person they trusted and one person they did not trust. In this paper, we are only evaluating the dimensions-weighting component of the metric, which corresponds to the relative importance of each dimension on the formation of the trust state (Morita & Burns, submitted, in revision).

Table 27: Results of the Mann-Whitney test, comparing Canadian and Japanese populations.

Trust Factors		Mann-Whitney U Test
F1	Basic personality of the person you are trusting (beliefs, goals, benevolence, interpersonal skills, and self-confidence).	U = 6856.0, Z = 1.418, p = 0.156
F2	Past behaviour that showcases the character/personality of the person you are trusting.	U = 4871.5, Z = -2.589, p = 0.010
F3	Your awareness/knowledge of characteristics of the task, institution, and the environment where you work.	U = 6422.5, Z = 0.556, p = 0.578
F4	Formal training, competencies, and abilities of the person you are trusting.	U = 3498.5, Z = -5.474, p = 0.000*
F5	Information about past experiences and history of collaborations passed by others in the institution, about the person you are trusting.	U = 5669.0, Z = -1.004, p = 0.315
F6	Role of the person you are trusting in the team or in the institution.	U = 5453.5, Z = -1.501 , p = 0.133
F7	Risks for the person you are trusting and motivation behind the request for trust.	U = 6056.5, Z = -0.247, p = 0.805
F8	Shared values and affection/empathy for the person you are trusting.	U = 7158.0, Z = 2.229, p = 0.026
F9	Your instinct/gut feeling in the situation, or your disposition to trusting the other individual.	U = 4697.0, Z = -3.060, p = 0.002*
F10	Risks that you accept when trusting the other person and your motivations for trusting.	U = 5692.5, Z = -1.062, p = 0.288
F11	Your own formal training, competencies, and abilities.	U = 4745.5, Z = -2.972, p = 0.003*
F12	Availability of information about risks in the task, and abilities and competencies of the person you are trusting.	U = 5651.5, Z = -1.130, p = 0.259
F13	Rules, culture, and goals of the institution where you work/study.	U = 5955.5, Z = -0.466, p = 0.641
F14	Characteristics of the environment and the task, in addition to all risks in executing the task.	U = 6564.5.5, Z = 0.911, p = 0.362
F15	The other's awareness/knowledge of characteristics of the task, institution, and the environment where you work.	U = 5404.0, Z = -1.573, p = 0.116

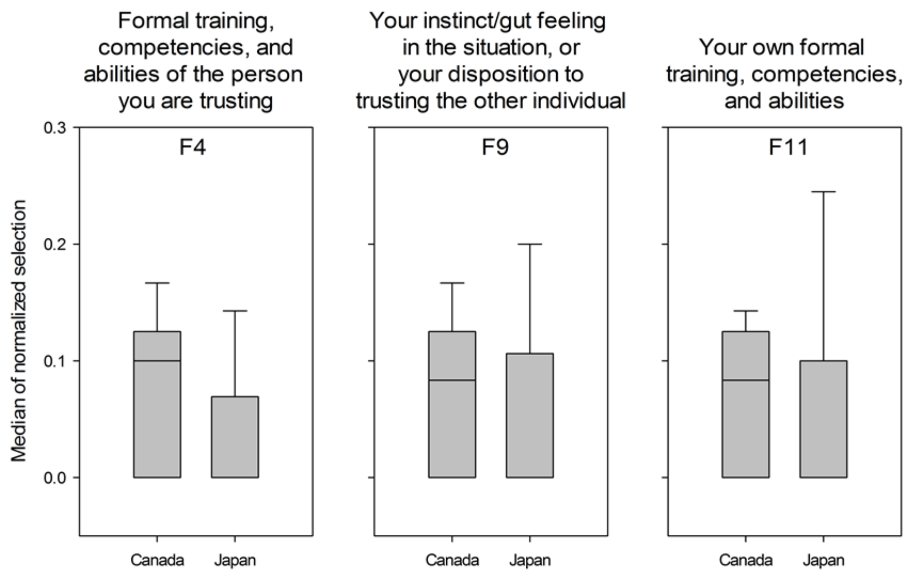

Figure 29: Comparison of the relevance of the three trust factors that showed statistical significant differences in Study 1.

The results presented in box plot form on Figure 30 compare the average weights of the two populations for the nine dimensions of the QTAS as covered in Table 26. Notable aspects include:

1. The differences between the populations and the relevance of each dimension were subtle and require further investigation through Mann-Whitney U tests.
2. The only dimensions that showed significant differences between the populations are D2 – Integrity and D7 – Information about past experiences and history of collaborations passed by others in the institution.
3. The standard deviations for all dimensions were relatively large, demonstrating a distribution of scores, as discussed by Morita and Burns (submitted, in revision).

To further evaluate these differences, we performed Mann-Whitney U tests (Gravetter & Wallnau, 2006) to compare the different groups, the results of which are compiled in Table 28. The Mann-Whitney U test was chosen because the variables from Study 2 were not normally distributed and transformations could not normalize the data.

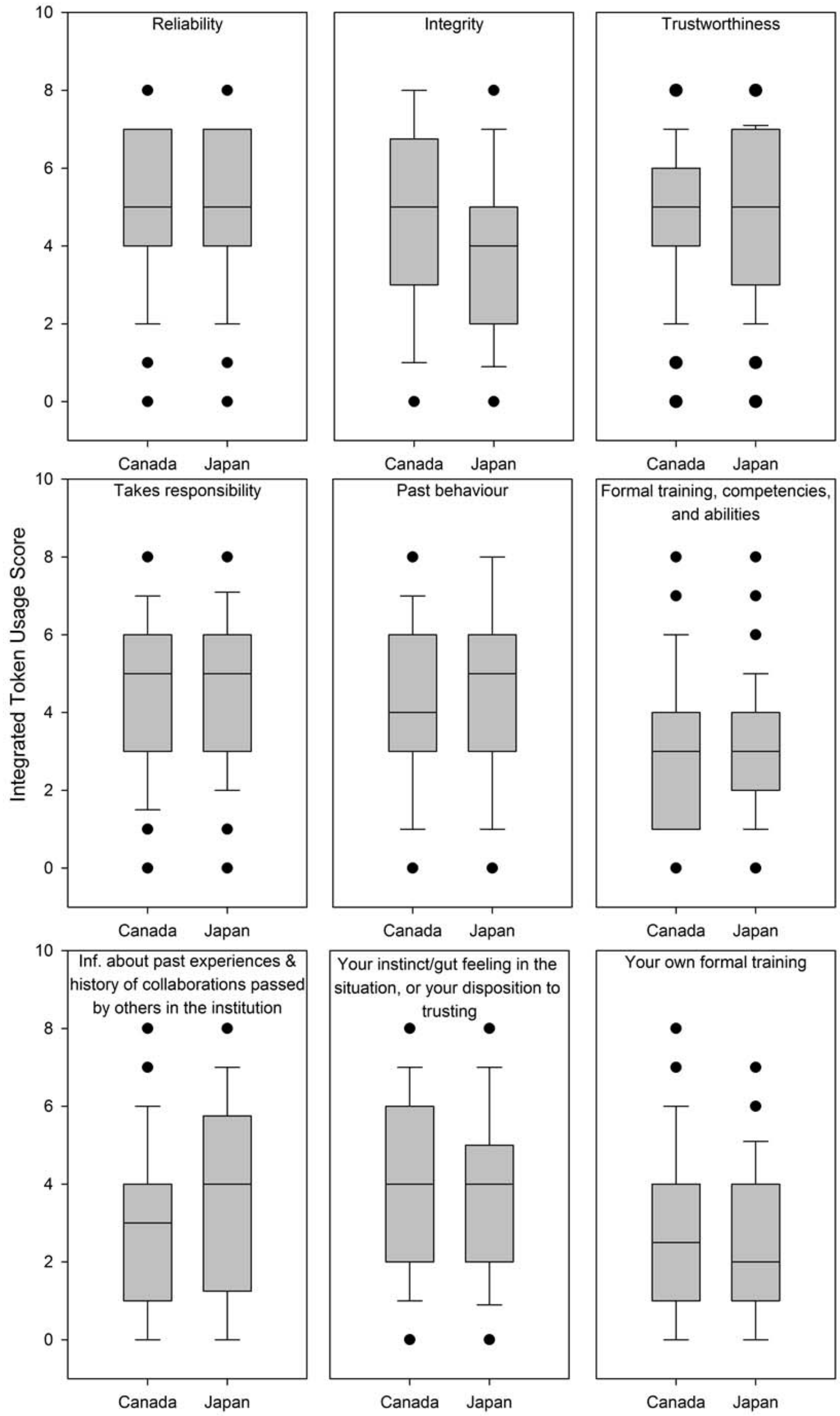

Figure 30: Comparison of the relevance of the dimensions of the QTAS in each of the two populations evaluated in Study 2.

Table 28: Results of the Mann-Whitney U test comparing Canadian and Japanese populations in Study 2.

QTAS Dimensions		Mann-Whitney U Test Results
D1	Reliability	U = 5925.5, Z = 0.838, p = 0.402
D2	Integrity	U = 4666.0, Z = -3.394, p = 0.001*
D3	Trustworthiness	U = 6252.0, Z = 0.172, p = 0.864
D4	Takes responsibility	U = 6238.0, Z = 0.199, p = 0.842
D5	Past behaviour	U = 6014.0, Z = 0.654, p = 0.513
D6	Formal training, competencies, and abilities	U = 5713.0, Z = 1.273, p = 0.203
D7	Information about past experiences and history of collaborations passed by others in the institution	U = 5247.5, Z = 2.216, p = 0.027
D8	Your instinct/gut feeling in the situation, or your disposition to trusting	U = 6142.0, Z = -0.395, p = 0.693
D9	Your own formal training	U = 6065.5, Z = -0.552, p = 0.581

As we are conducting multiple comparisons on the same dataset, it is necessary to apply the Bonferroni adjustment (Gravetter & Wallnau, 2006), with a new p-value now defined as 0.006. With this correction, only the difference in D2 – Integrity has shown statistical significance between the Canadian (Median = 5, SD = 2.318) and Japanese (Median = 4, SD = 2.184) populations, with small effect size.

Evidence of cultural differences was present in Study 2 when participants were asked to evaluate people with whom they had worked with in the past. In our third study, we changed our approach and evaluated the effects and use of system-provided trust supporting information in the development of a trust state.

Study 3 – The last study discussed in this paper evaluates the use of trust-supporting information in the form of interface design objects. Through an ethnographic study (Morita & Burns, 2014a), we identified common behaviours used to foster trust and later created interface design objects to act as surrogates (Morita & Burns, submitted) in social network and computer mediated communication systems. The trust tokens designed for this purpose carried important information shown to trigger changes in trust behaviour (Morita & Burns, submitted). In this study, we were interested in identifying differences in the use of the information carried by the trust tokens between Canadian participants (n = 20) and the Japanese participants (n = 20).

An initial assessment through a box plot on Figure 31 shows some relevant results:

1. The standard deviation in the Japanese population was larger than in the Canadian population, showing a larger distribution of scores.
2. Three of the trust tokens showed results that require further investigation through statistical comparisons: Network size, Validation, and Frequent contribution.

After performing a paired comparison of independent samples using Mann-Whitney U tests (Gravetter & Wallnau, 2006), we identified statistically significant difference for the Network size token ($U = 101.0$, $p = 0.007$, $r = -0.424$) between the Canadian population (Median = 10, SD 13.588) and the Japanese population (Median = 30, SD = 19.684). These results show that the Network size token was selected more often in the Japanese population than in the Canadian population, as it is possible to see on the box plots in Figure 31. Similar to the previous studies, we applied the Bonferroni correction, consequently using a p-value of 0.01.

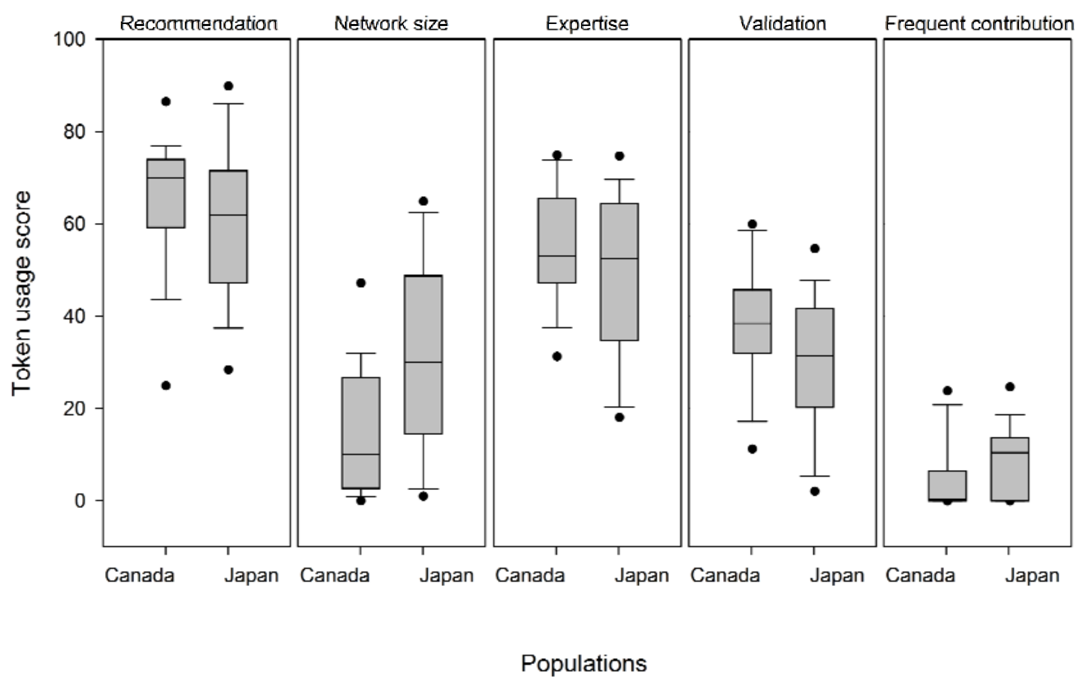

Figure 31: Comparison of the usage of each trust token in each of the two populations evaluated.

Table 29: Results of the Chi-Square test comparing Canadian and Japanese populations.

Trust Token	Mann-Whitney U Test Results
Recommendation	U = 142.0, p = 0.116, r = - 0.248
Large Network	U = 101.0, p = 0.007*, r = - 0.424
Expertise	U = 167.5, p = 0.379, r = - 0.139
Validation	U = 148.0, p = 0.159, r = - 0.223
Frequent Contribution	U = 137.0, p = 0.078, r = - 0.279

8.2.6 Discussion

The results presented in the previous section provide evidence of how cultural differences influence individuals' use of trust-supporting information to develop a trust state (Lewicki et al., 2006; McKnight et al., 1998; Morita & Burns, 2014b). We acknowledge that the differences are subtle, but nonetheless present. Statistically significant results were found for all studies, even after using the Bonferroni correction for repeated measures and accounting for the homogenization caused by the use of English questionnaires.

When looking at the results from our studies, 20% of the variables from Study 1, 11.11% of the variables from Study 2, and 20% of the variables from Study 3 have shown statistically significant differences between eastern and western populations. Considering that our intent was to identify differences in the relevance and use of trust-supporting information, these results support our objectives and suggest there were measurable differences in the use of trust information between the populations.

In accordance with *Hypothesis 1*, these results empirically demonstrate the influence of the participants' cultural backgrounds on their trust decisions and trust perception, supporting the existence and effect of cultural constraints on the internal weighting of trust-supporting cues used in the formation of a trust state (Morita & Burns, 2014b). This effect and the details and results of each study are discussed in the following paragraphs.

The following factors had statistically-significant differences in Study 1, all showing different relevance when evaluated by each of the populations:

- F4 – Formal training, competencies, and abilities of the person you are trusting ($U = 3498.5$, $Z = -5.474$, $p = 0.000$).
- F9 – Your instinct/gut feeling in the situation, or your disposition to trusting the other individual ($U = 4697.0$, $Z = -3.060$, $p = 0.002$)
- F11 – Your own formal training, competencies, and abilities ($U = 4745.5$, $Z = -2.972$, $p = 0.003$).

These results support our first hypothesis by showing that individuals in the different populations perceive factors differently when evaluating their trust on another person. Cultural differences influence their internal weighting of the perception mechanisms described by Morita and Burns (2014b), changing the relevance of each cue on the formation of a trust state.

Study 2 showed statistical significance in one of the nine dimensions, D2 – Integrity ($U = 4666.0$, $p = 0.001$*, $r = - 0.223$). One of the possible explanations for this difference is the fact that cultural constraints limit the deviation in behaviour, as covered in the introduction of this paper (Chung et al., 2006; Hagen & Choe, 1998). Social sanctions are a strong constraint on behaviours in Japanese populations, and consequently, individuals in a Japanese population may not consciously consider integrity to be an important variable since they do not expect any behavioural deviations to happen (Chung et al., 2006). This expectation reduces the relative importance of that variable on their trust assessment. The same effect was observed in the results of Study 1, in which one of the factors that showed statistically significant differences (F11) was related to the possibility of negative outcomes, which is limited by the societal normative framework (Chung et al., 2006; Takahashi et al., 2008).

In Study 3, we found a validation of *Hypothesis 3*, where out of the five variables being evaluated, Network size showed statistically significant differences ($U = 101.0$, $p = 0.007$, $r = - 0.424$) between the Canadian (Median = 10, SD 13.588) and the Japanese (Median = 30, SD = 19.684) populations. The relevance of this token for Japanese individuals is consistent with the collectivistic nature of their culture (Huff & Kelley, 2003; Macy & Sato, 2002; Yamaguchi, Kuhlman, & Sugimori, 1995), in which the social network and social capital are described as very important for trust (Freitag, 2003; Slater & Robson, 2012). In a collectivistic culture as the Japanese, an individual is characterized by the collective he or she is part of, not simply by his or her own actions (Igarashi et al., 2008; Okumura et al., 2011). Having a larger network of clients or friends, information provided in the form of trust tokens, provides social validation by showcasing your ties to other individuals in the network.

These findings are relevant when dealing with cross-cultural teams (Elron, 1997; Goodall & Roberts, 2003; N. Phillips, 1994; Pierce, 2002) and developing systems designed with the objective of facilitating the development of interpersonal trust (Morita & Burns, submitted; Rusman et al., 2009, 2010). The effects of cultural differences were demonstrated in all three studies presented in this paper, results which support our *Hypothesis 3*. At least one variable in each study has shown statistically significant differences between the populations, supporting the cultural variability of trust.

We would, nonetheless, like to acknowledge some limitations of our studies. Initially, these studies were developed for western populations, and were later adapted for use in eastern populations. The visual aspect of the interfaces followed western standards and was developed in English, which might mask the real depth of the cultural differences (Harzing, 2005). Another limitation that we should acknowledge is that we have evaluated the influence of cultural differences in trust behaviours in a limited set of situations and conditions. Since trust is highly situational, the influence of cultural constraints may be more or less significant depending on other factors which affect trust behaviour. We acknowledge that there is still need for further evaluation of the effect of these cultural differences through ethnographic and controlled studies which can provide more insight on trust formation in different populations.

8.2.6.1 Importance of cultural differences when designing for interpersonal trust

The main approach currently used for fostering interpersonal trust in virtual collaborations consists of providing more information about the person being trusted (Morita & Burns, submitted, 2013; Rusman et al., 2009). Additional information does not necessarily lead to increased trust, but it does lead to informed trust decisions (Malhotra & Murnighan, 2002; Xu, 2014; Zaheer et al., 1998) which are more solid and stable than trusting based on instinct alone (Lewicki et al., 2006; Morita & Burns, 2014b).

Design methodologies highlight the importance of considering user characteristics as an integral part of the design cycle (Burns & Hajdukiewicz, 2004; Mumaw, Roth, Vicente, & Burns, 2000; Vicente, 1999), and culture has always been an integral part of the variables of interest (Khaslavsky, 1998; Marcus & Gould, 2000; Marcus, 2002). Consequently, we have expanded this interpretation to the development of design techniques for interpersonal trust (Morita & Burns, submitted, 2013; Rusman et al., 2009, 2010; Zheng et al., 2001, 2002). If the intention of designers is to provide the necessary support for the development of interpersonal trust, the evaluation and understanding of the cultural background of the participants should be a native component of the design cycle.

We have highlighted the importance of considering a user's cultural background when designing for interpersonal trust. The provision-of-information approach normally used to foster trust behaviour in virtual teams is highly dependent on the type of information provided to the users, and in this paper, we have put forth evidence that the information requirements may be different depending on the cultural background of the individual. As explained by Morita and Burns' model (2014b), cultural constraints influence how people perceive trust-fostering cues and how they integrate them into a trust state. As a result, it is necessary to choose factors that are highly relevant for the target population of your design.

Considering that cross-cultural teams are exposed to different cultural and institutional constraints, it is necessary to provide an initial evaluation of the factors which will be of higher relevance for each of the culturally distinct groups being targeted, and choose which tailored information to provide. As we have further validated in this paper, social capital is a variable which has a distinct influence in a collectivistic population (Freitag, 2003; Slater & Robson, 2012).

8.2.7 Conclusion

Cultural constraints are an important part of our social behaviour (Triandis, 1989). They influence how we collaborate, work, and exchange information with others (Dafoulas & Macaulay, 2001; Takahashi et al., 2008; Tse, Lee, Vertinsky, & Wehrung, 1988), how we trust (Macy & Sato, 2002; Marková & Gillespie, 2008; Tan & Chee, 2005), and how systems should be designed (Khaslavsky, 1998; J. D. Lee & See, 2004; Marcus & Gould, 2000; Marcus, 2002; Vicente, 1999). As non-collocated teamwork (Bjørn & Ngwenyama, 2009; Gibson & Cohen, 2003; Maznevski & Chudoba, 2000) and cross-cultural teams (Elron, 1997; Goodall & Roberts, 2003; N. Phillips, 1994; Pierce, 2002) grow due to the expansion of international organizations, the cultural background and cultural constraints imposed by the workplace have become even more salient.

In this paper, we have demonstrated empirically that culture should be a variable of interest in the early stages of designing for interpersonal trust. The results presented in this paper support the idea that interventions need to be tailored to specific parts of the team, since different cultural background and cultural constraints will change the information needs of the team members. Overall, culture is not only what defines us as a society, but also defines how we trust and which factors we take into consideration when trusting.

8.3 Additional Data and Discussion

This chapter has provided empirical evidence for the influence of cultural background on trust formation and trust decisions. The experimental materials used in this study are the same that were used for the studies presented in Chapter 6 (Study 1 and 2) and Chapter 7 (Study 3). The additional materials not already covered are presented in Table 30.

Table 30: Additional supporting information for the trust token study in Chapter 7.

Supplemental Material	Location	Additional Information
Ethics approval certificate	Appendix FF	Ethics approval certificate for the three studies conducted at Kyoto University, Japan.

In this chapter, I have discussed the influence of cultural constraints on trust behaviour and how the difference between collectivistic and individualistic cultures defines how people trust . Through paired studies, I have provided empirical evidence of this difference, which allows me to discuss the implications for design. The findings put forth in this chapter stress the importance of considering the cultural background of the target population when designing for interpersonal trust. Additionally, the results further validate the perceptual mechanisms of the Human Factors Interpersonal Trust State Formation Model presented in Chapter 4 and the weighting component of the Quick Trust Assessment Scale (QTAS) presented in Chapter 6.

In the next chapter, I integrate the findings of the separate papers (Chapter 4 to Chapter 8 of this thesis) into a final discussion and draw conclusions from them. The implications of the results and contributions of this program for different fields of research are discussed, highlighting the broader value of this research program.

Chapter 9
Discussions and Conclusions

After presenting the papers that compose this dissertation, I will now discuss the research contributions derived from this research program, some limitations, and future research primed by the deliverables of this research program.

9.1 Research Contributions

The work presented in this thesis on the development of trust fostering, measuring, and comprehension tools has the potential to create important contributions for the areas of (a) human factors, (b) organizational and teamwork research, (c) interface design, and (d) trust research. These contributions will be discussed in more details in the next four sub-sections:

9.1.1 Contributions to Human Factors Engineering

Human factors focuses on understanding and supporting the interaction between humans and other elements of the system. The overall objective is to optimize human well-being and system performance by designing systems that properly account for human limitations and constraints. In this research program, I have covered the development of tools and mechanisms to understand (Chapter 4 and Chapter 5), measure (Chapter 6), and support (Chapter 7 and Chapter 8) interpersonal trust between team members working in technology-permeated environments. Considering the influence that technology can have over the team dynamics, it is important to supplement the existing literature and provide tools that allow designers, researchers, and practitioners to incorporate interpersonal trust into the design cycle.

Teamwork is an important variable of interest for systems design, whether as a requirement for operation of the system (systems that require a team of operators) or as a target of the system (systems designed to support the work of teams). Our research targeted increasing interpersonal trust and consequently team performance and effectiveness, hoping to have a positive impact on overall system performance. From a macro perspective, the tools presented in this dissertation targeting interpersonal trust can be used in the design of systems that support teamwork. Trust tokens, for example, can be used to facilitate the development of trust between team members, improving team dynamics, effectiveness, and performance. Additionally, the QTAS can be used for eliciting system requirements that might be outside the scope of other design methodologies. The focus of the tools presented in this dissertation is to supplement system design methodologies with tools that help better to understand and include interpersonal trust as a design component.

As human factors encompasses the fields of teamwork and interface design, the contributions for each of the two research areas described below can also be counted as contributions to human factors.

9.1.2 Contributions to Organizational and Teamwork Research

The Human Factors Interpersonal Trust State Formation Model presented in Chapter 4 brings new insights to organizational and teamwork research by providing a better understanding of how institutional and cultural constraints impact trust and consequently collaboration. Trust models in the literature have presented a comprehensive list of perceptual factors and outcomes of trust without explaining how they are perceived and integrated into a trust state. In my model (Chapter 4) the focus shifts from the outcomes of trust to the perceptual mechanisms that feed the trust formation process. Through the integration of the lens model (Brunswik, 1939, 1952) to help describe the perceptual mechanisms of trust formation, I have incorporated a combination of internal and external weights that not only explain the perception process of trust cues, but also the situational variability of trust perception.

The importance of this contribution lies in allowing researchers to better explain how their interventions influence trust, as the trust model presented in Chapter 4 includes components to explain the high situational variability of trust. In addition, in Chapter 5, I have presented an ethnographic study targeted at informing the design of trust-supporting tools and interface design objects for virtual teamwork. I have identified two mechanisms through which trust cues can be conveyed in face-to-face collaborations (recommendations and validation) and five cues that were frequently and effectively used to build a trust state (expertise, social capital, recommendation, validation, and willingness to help). These findings present an opportunity for evaluating the potential of replicating this effect through the use of surrogates that have the potential to carry similar information in teams that are deprived of this face-to-face contact. This study can serve as a primer for future development in the area of design for interpersonal trust, informing important areas of trust relationships to be targeted through design.

Lastly, the results presented in Chapter 8 of this thesis validate the constraining effects of culture on trust, something widely discussed in the literature (Cyr et al., 2005; Cyr, 2008; Doney et al., 1998; Farris et al., 1973). I have answered research questions 13 and 14 by demonstrating that individuals take a different stance when building their trust states and that this varies systematically by culture. I have empirically demonstrated cultural background changes how individuals perceive trust-supporting information (Chapter 8) and consequently, how they build their trust state. These results are important for understanding trust from the perspective of international collaboration, as behaviours are interpreted differently by different parties, and this has a direct relationship with the success of international business and partnerships. Culture has been described as an influencer in trust behaviour (Doney et al., 1998) and this study validates the influence of culture on the situational variability of trust.

9.1.3 Contributions to Interface Design

The work presented in this thesis serves as a primer for the inclusion of interpersonal trust as one of the variables of interest for interface design. Interpersonal trust should be considered as a requirement when designing tools to be used in teamwork environments—especially communication tools. Since tools that are designed for supporting teamwork rely on facilitating interaction between team members, it is important to consider interpersonal trust in order to maximize communication and collaboration between individuals (Berry, 2011; Jarvenpaa & Leidner, 1998; Reina & Reina, 2007).

In Chapter 7, I explore the use of interface design tokens, evaluating the possibility of using them to convey trust-supporting information in social networks and CMCSs. Through the use of surrogates called trust tokens, I evaluated the effect of using interface design objects to carry trust-supporting information on trust behaviour in social networking systems. This paper contributed to the idea of using interface design objects as surrogates for cues that are missing in virtual teams, but that are usually available in face to face collaborations. In addition, this paper raises awareness of situational constraints that must be considered when designing for trust. My results demonstrated the influence of risk (Chapter 7) and culture (Chapter 8) as constraining factors. Designers have to be aware of their domain and the population they are designing to, in order to include effective trust supporting cues in the system.

The trust tokens developed in Chapter 7 and the results from the trust token study answer research questions 9 and 10 by demonstrating the potential of interface design objects to convey the necessary information to build a trust state. These same results were used to answer research questions 11 and 12 by demonstrating the situational variability generated by the different risks participants were exposed to and highlighting the importance of considering situational risk as one of the variables of interest when designing trust-fostering technologies.

9.1.4 Contributions to Interpersonal Trust Research

The research area that has most benefitted from the results presented in this thesis is that of interpersonal trust research. Starting with the Human Factors Interpersonal Trust State Formation Model presented in Chapter 4, I presented a more detailed description of possible perceptual mechanisms in trust formation. This supplements works by Mayer et al. (1995) and McKnight et al. (1998), and provides more insights on possible modelling techniques to describe and explain the situational variability of trust (Dirks, 1999; Jarvenpaa et al., 2004; La Guardia & Ryan, 2007; Morita & Burns, 2014b; Payne & Clark, 2003; Schlenker et al., 1973). This same model also separates the trust formation process into two separate streams for intuitive trust (affect-based trust) and calculative confidence (cognition-based trust), helping explain the integration of the two types of trust, as well as the different cognitive pathways to a trust decision. The separation of the two types of trust, while keeping both in the same model, helps to explain the evolution from novice teams to mature teams, shifting the focus from a signalling perspective to an evolutionary approach to trust.

The next contribution of this dissertation lies in the identification of effective trust fostering processes in face-to-face collaborations (Chapter 5) with the objective of informing interface design. This study, integrated with the design and evaluation of interface design objects targeted at fostering trust in Chapter 7, is an attempt to foster trust behaviour in virtual teams through interface design and the first ethnographic study targeted at informing interface design of trust-fostering systems. This novel approach can greatly contribute to this area of trust research by priming the idea of using interface design as mechanisms to foster trust behaviour in virtual teams. The areas of trust in automation and trust in websites can lend significant knowledge in how to use cues to trigger trust behaviour, as discussed in section 1.2.4.

The final contribution of this program of study lies in the empirical demonstration of the situational variability of trust. In the studies presented in Chapter 7 and Chapter 8, I demonstrated the effects of situational risk and cultural background on the use of trust-supporting information for trust decisions. The importance of these results lies in understanding that different individuals, in different situations, will rely on different antecedents for making their trust decisions.

9.2 Limitations

In this section, I will describe some of the limitations in the development of this research program, as well as planned approaches to address them. Being cognizant of limitations creates opportunities for addressing them in future research.

9.2.1 Limitations in the Development of the Human Factors Interpersonal Trust State Formation Model

The Human Factors Interpersonal Trust State Formation Model was created through a combination of human factors frameworks and trust literature, in order to help better describe the perceptual mechanisms of trust formation. It is a descriptive model outlining the possible processes involved in the formation of a trust state. There is a need to further validate components of the model thorough field studies and controlled experiments. In this research program, I focused mostly on the perceptual mechanisms of the model, but there is a need to further explore the capability and implications of the lens model to understand the perception and integration of trust-supporting cues.

The need to evaluate the integration between calculative confidence and intuitive trust, as well as the detailed evaluation of the separate pathways for the formation of each type of trust still remains. Since different types of trust relationships will be dominated by one of the different pathways (Colquitt, Scott, & LePine, 2007; Das & Teng, 2004; Six et al., 2010; Six, 2007), there is a possibility for the evaluation and validation of different cognitive processes involved in trust formation. Another aspect that needs to be further investigated is the empirical demonstration of the balance between calculative confidence and intuitive trust in different trusting situations and team maturity. I postulate that swift teams (Robert, Denis, & Hung, 2009; Wildman et al., 2012) will weight towards calculative confidence (due to the little experience together) and that experienced and evolved teams will weight higher on intuitive trust (due to strong knowledge about the other party). However, these assumptions need to be validated through further studies.

The trust model presented in this thesis is a limited representation of the trust formation process, focused on perceptual mechanisms. There are some aspects of the model worth discussing that were not previously covered in the paper. I will organize this discussion around some changes and comments made on an updated version of the Human Factors Interpersonal Trust State Formation Model, as per Figure 32.

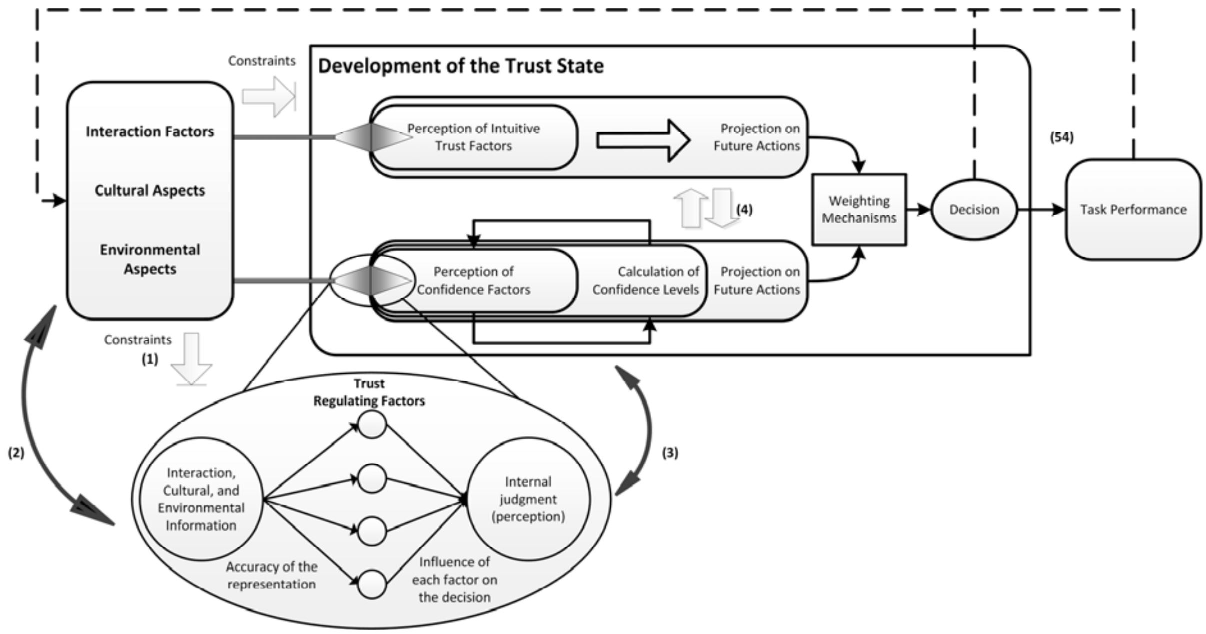

Figure 32: Limitations of the Human Factors Interpersonal Trust State Formation Model

No model is comprehensive enough to include the whole of the reality. Our model focused on the perceptual mechanisms of trust formation and on the integration of intuitive-trust and calculative confidence on a single model. However, some components were either not considered in the model or require some clarification. Using Figure 32 to guide our comments, I explore each of the five highlights below:

1. The constraint arrows presented in the model correspond to the situational constraints that influence trust perception and trust formation widely described in this thesis. Those constraints emanate from the same pool of perceptual factors or cues that are normally perceived by individuals. Our model does not focus on describing which specific cues are perceived and influence trust, but instead, on how they are integrated into a trust state. For this reason, all these factors and cues have been integrated into a single container in the model.
   The same pool of cues influences both intuitive trust and calculative confidence formation, but with differences on the internal weights associated to each cue. In cases in which a cue would be absent from the perception of an individual, the corresponding internal weight

would be zero. This approach allowed me to model all the cues within a single container, simplifying the model.

2. The model developed in this research program includes some level of redundancy. The circle on the left side of the perception mechanisms bubble described represents the same container that includes the interaction factors, cultural aspects, and the environmental aspects of trust on the main model. This duplication was necessary to explain how the trust perception operates and how it relates to the lens model.
3. This duplication was also necessary for the internal judgement component of the perception mechanisms. The circle on the right of the perception mechanisms bubble (internal judgment – perception) is a duplicate of the perception box, either for calculative confidence or intuitive trust. The perception bubble represents the perception mechanisms both for calculative confidence and intuitive trust, describing the arrows that connect the cues to the perception of each of the two types of trust.
4. Another aspect not included in this version of the model is the relationship between the formation of intuitive trust and calculative confidence. I argue that the formation of one type of trust might influence the formation of the other. For example, how an existing close trust relationship with the trustee might influence how an individual projects a trusting behaviour, resulting in a lower risk estimate. This reduced risk estimate can result in a trusting behaviour based on the incomplete assessment of the trustee. For this reason, I have incorporated the two new arrows on Figure 32. This connection is important to explain the evolution of trust, such as how we shift from calculative-confidence to intuitive-trust over the maturity of a relationship.
5. One last detail of the model that requires further exploration is the relationship between the decision bubble and the task performance bubble in the model. One could argue that they are one and the same. However, I defend the separation since an individual might decide to trust, but, due to timing or other constraints, might not be able to actually turn this trust decision into a trust action. Therefore, there is a need to distinguish between the decision to trust (decision bubble) and the trust action itself (the task performance bubble). In order to simplify the model, I did not explore the wide range of constraints that might influence the trusting action.

9.2.2 Limitations of the Ethnographic Study

In the ethnographic study targeted at identifying trust-fostering behaviours which is presented in this thesis, I observed two student teams at the University of Waterloo. I would like to acknowledge the limited collaborative experience of these teams and the fact that it might not directly correlate to corporate teamwork environment. Nonetheless, the study participants had significant work experience, and the teams were composed of undergraduate, graduate, and industry representatives with varied teamwork experience.

During our observations, in order to try to avoid confirmation bias, I was open to observing and including new behaviours that had shown up after the initial exploratory period. In our observations, after the exploratory period, I was looking at a subset of behaviours which dynamically changed over the duration of our ethnographic study, allowing me to include new behaviours in our data collection.

Nonetheless, any ethnographic study is subject to the bias of its observers. The range of behaviours observed in this study is limited to those within our expertise. Through the inclusion of a second observer, I tried to minimize the effect of such bias, since I had two distinct sources of information for our data. The two observers had distinct backgrounds, which allowed us to explore a wider range of behaviours leading to trust.

9.2.3 Limitations in the Evaluation of the Quick Trust Assessment Scale (QTAS)

Metrics require extensive evaluation for a full validation. In order for the QTAS to be accepted in different fields, I acknowledge the need to conduct further studies in distinct collaborative environments to further validate its effect. The situational variability of trust can result in the QTAS being applicable in certain types of trusting situations and not others, since focus might be shifted towards the evolutionary side of trust behaviour.

Additionally, the number of dimensions in a metric like the QTAS is directly proportional to the richness of the information provided. The more dimensions that can be includes in the metric, the more information can be extracted and used in the identification of tailored trust-fostering interventions. Since I was targeting an effective and compact metric, I have opted for lower levels of data richness with the benefit of time efficiency. Therefore, I recognize that my metric does not provide as much richness as other, longer, metrics or ethnographic studies.

9.2.4 Limitation in the Development and Evaluation of the Interface Design Trust Tokens

In the paper presented in Chapter 7, I applied trust tokens in social networking interfaces for the initial evaluation of their effect on trust decisions. Social network interfaces were chosen due to the ease with which they can be used to manipulate the risks the participants were facing and how familiar individuals in the society are with these interfaces. However, there is a need to apply trust tokens in real world collaborations through implementation in CMCSs. This approach was not taken in this research program due to the complexity of locating and recruiting participant teams for such implementation. In future publications I will present results of trust tokens applied to CMCSs designs.

Another limitation of this study that I would like to acknowledge is that the scenarios and experimental design used for testing the trust tokens were not collaborative situations. The study was not measuring trust in relationship-building, but instead on decisions and purchases. These studies were designed to test the trust tokens, to identify relative differences in the usage of trust supporting information, and to further the understanding of situational constraints on trust behaviour. The results identified in this chapter will support the implementation of trust tokens in virtual teams' communication systems by illustrating the impact of situational risk on trust behaviour and the relative importance of each of the five trust tokens on the formation of trust.

The five tokens presented in Chapter 7 and Chapter 8 were derived from the ethnographic study using student teams in Chapter 5. The teams observed were composed of students with various levels of work experience, ranging for a couple internships to several years of work experience. Nonetheless, I expect that work experience and overall individual maturity should influence how individuals trust. Therefore, I also identified the need to validate the trust fostering behaviours presented in Chapter 5 by observing different populations in different work environments and institutions.

9.3 Future Research

After presenting the research program covered in this thesis, two research streams that deserve further exploration emerged. Initially, due to the high situational variability of trust, it is still necessary to evaluate other possible constraining factors that can influence trust in teams (Peters & Manz, 2007; Schuman, 2006; N. A. Stanton, 2011). As described in the previous sections of this thesis, this variability can impact the design of trust-fostering interventions, making it necessary to validate their effects on trust behaviour. Possible ways of testing include, but are not limited to:

applying the QTAS to different groups and populations, varying the effect of constraints over each group, applying trust tokens in CMCSs in different work environments or institutions to verify the influence of institutional constraints, and verifying the effects of mood or affective states on the use of trust tokens in social networking communications.

The second direction proposed is the further evaluation of the QTAS. Datasets have already been collected in a wider range of teamwork environments and are being analyzed for publication. Metrics require extensive evaluation and this is planned for the coming years. To do so will require testing in different work environments, using in-situ populations, and evaluating the effectiveness of the QTAS in longitudinal studies. In these cases, it would be possible to use the QTAS to inform design and to extract data informing the possible effectiveness of interventions to address trust issues inside a team.

Also of interest for future research is the ethics of the use of trust-fostering techniques. What is the ethical boundary to using trust-eliciting techniques in websites? How far can designers go in eliciting trust behaviour without tricking users into trusting "non-trustworthy" information? This research would fall under the purview of persuasive and ethical design (Berdichevsky & Neuenschwander, 1999; Fogg, 1998, 2002), where the ethical implications of using techniques to foster user engagement and persuade user behaviour have been discussed.

9.4 Conclusion

Given the current state of technological development, teams constantly work in technology permeated environments, and consequently, are required to work and communicate through advanced communication systems. The complexities and uniqueness of virtual teamwork bring several new issues to the work domain, which if not properly addressed, could negatively impact teamwork.

In this thesis, I have presented a new toolset developed with the objective of helping researchers and practitioners understand, measure, and foster trust through the use of interface design objects. With the combination of the Human Factors Interpersonal Trust State Formation Model, the Quick Trust Assessment Scale (QTAS), and interface design trust tokens, I have presented tools to address issues of low, fragile, and delayed trust (Bos et al., 2002), all consequences of team virtuality.

The mechanisms presented in this thesis provide means for the integration of interpersonal trust as an integral component of designs, targeting the improvement of teamwork and collaboration. The ultimate goal of this body of work is for interpersonal trust to become an integral part of design requirements.

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Appendix A

Preliminary version of the interpersonal trust state formation model

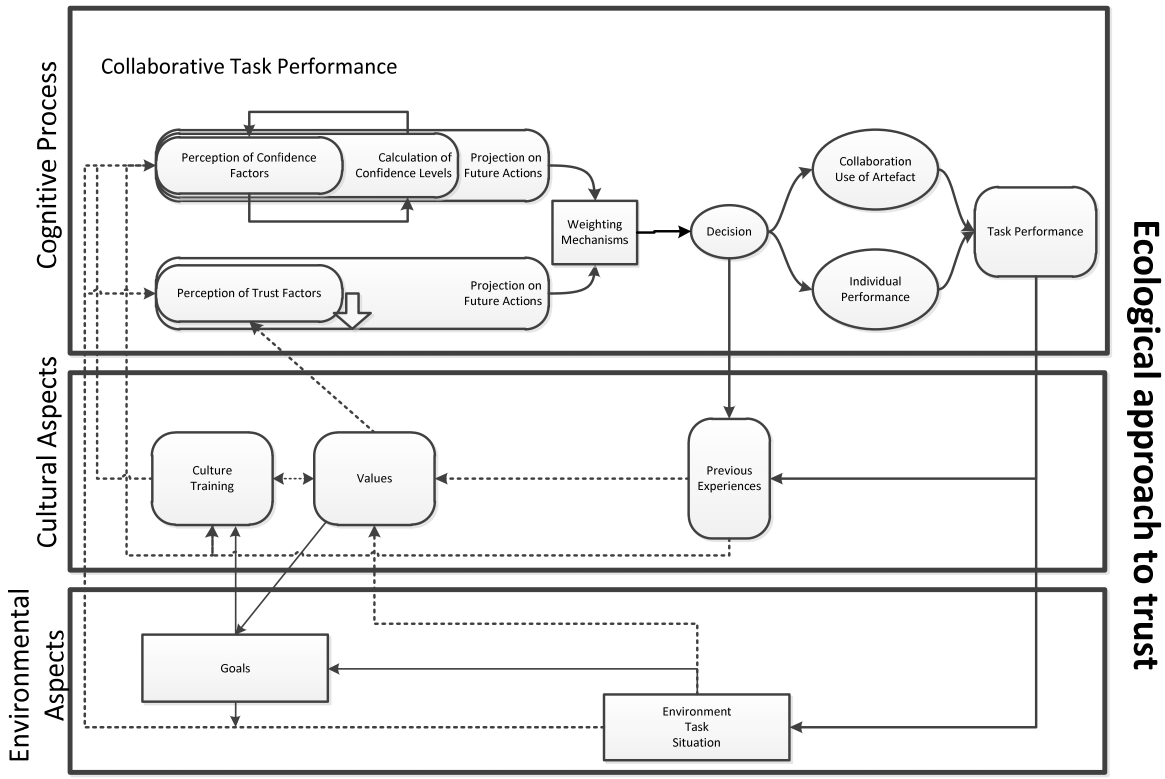


Figure 33: Preliminary version of the human factors interpersonal trust state formation model as presented in the comprehensive examination.

Appendix B

Mayer et al. (1995) trust model

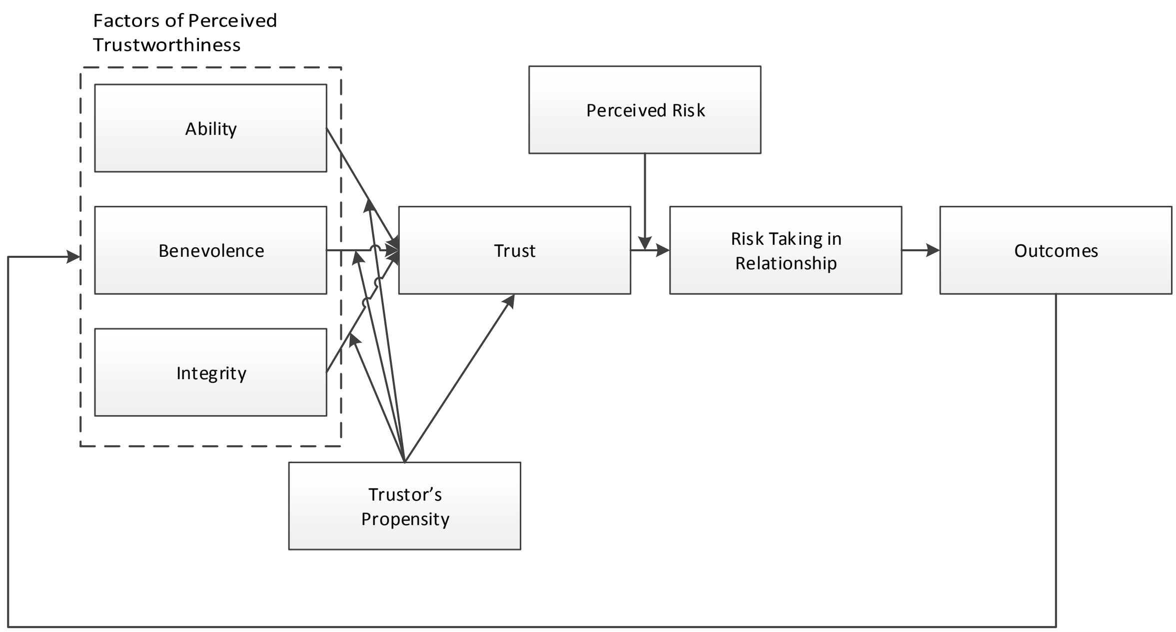


Figure 34: Mayer et al (1995) trust model.

Appendix C

McKnight et al. (1998) trust model

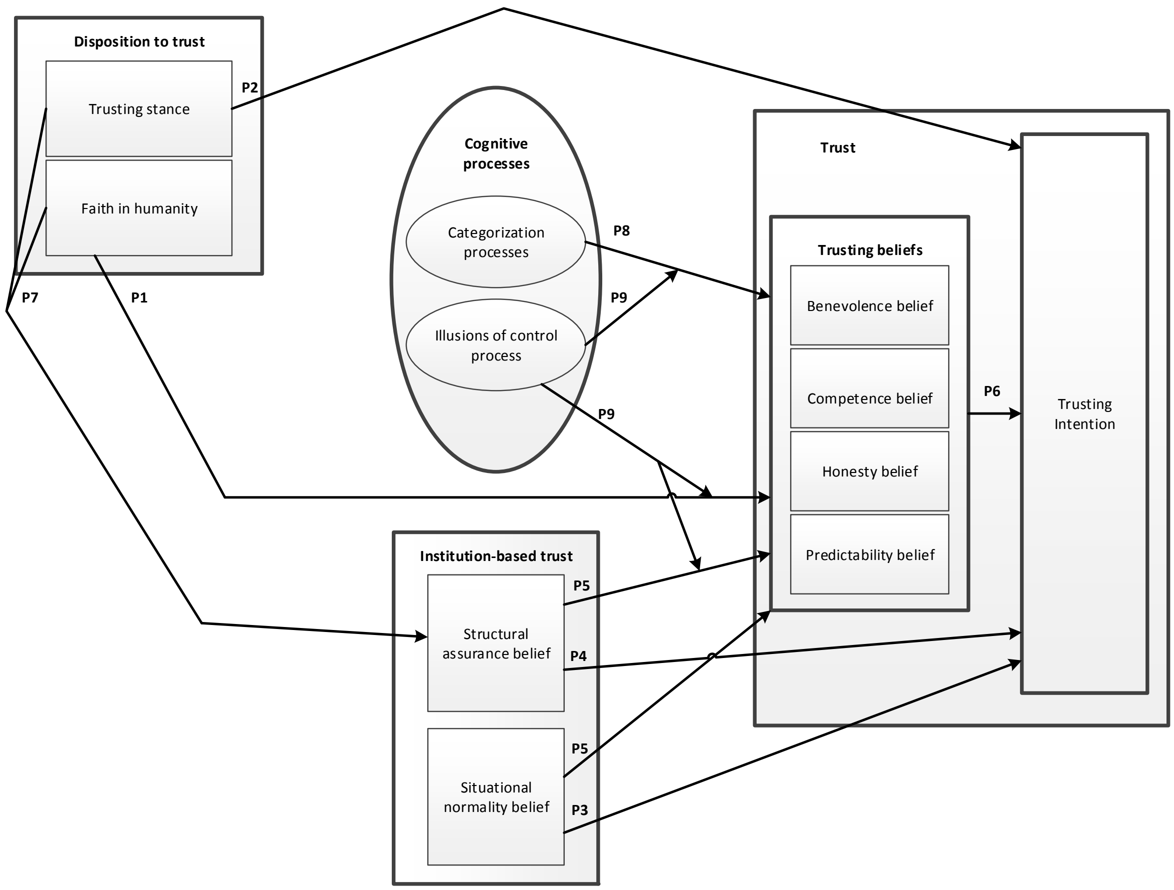


Figure 35: Structural version of McKnight et al. (1998) trust model.

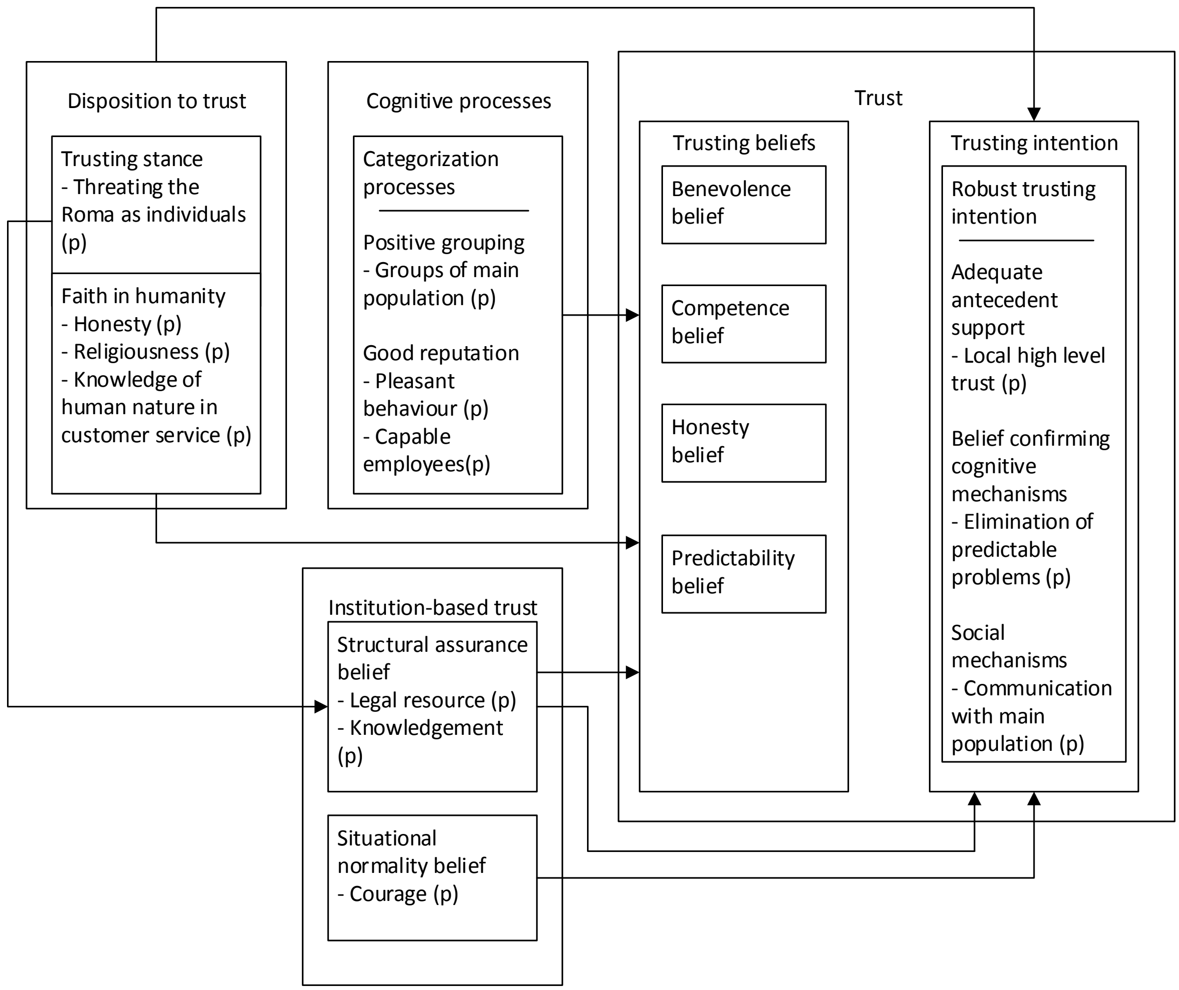


Figure 36: Detailed version of McKnight et al. (1998) trust model.

Appendix D

Lee and See (2004) trust in automation model

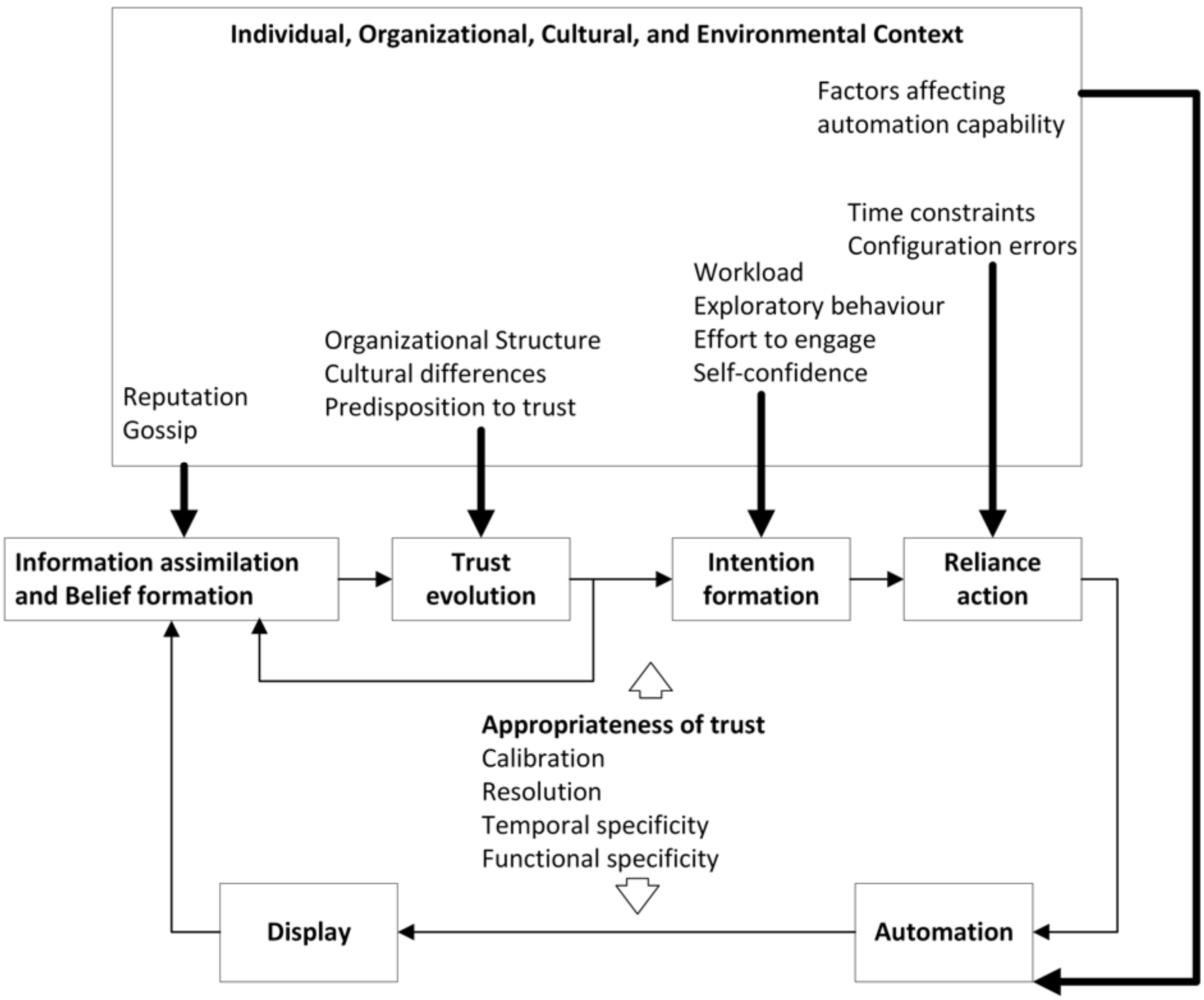


Figure 37: Lee and See (2004) trust in automation model.

Appendix E

Brunswik's Lens Model (1939, 1952)

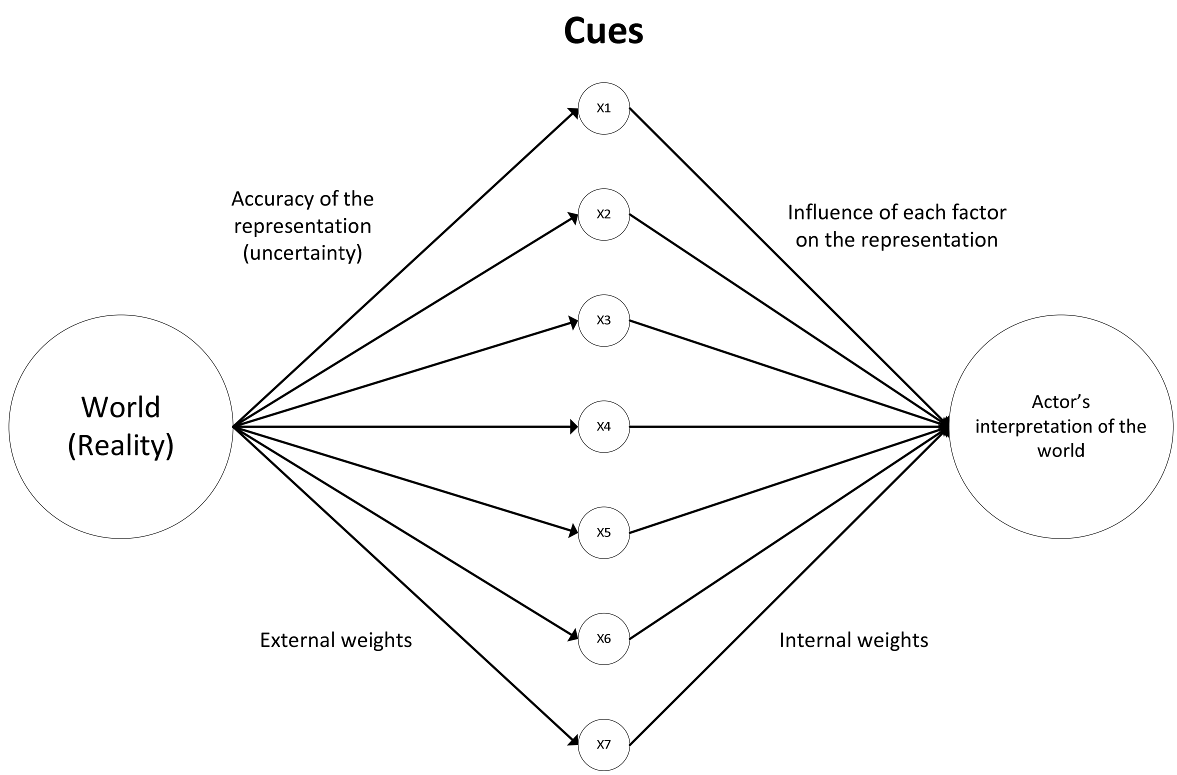


Figure 38: Brunswik's Lens Model (1939, 1952).

Appendix F

Endsley's Situation Awareness Model (Endsley et al., 2003; Endsley, 1995)

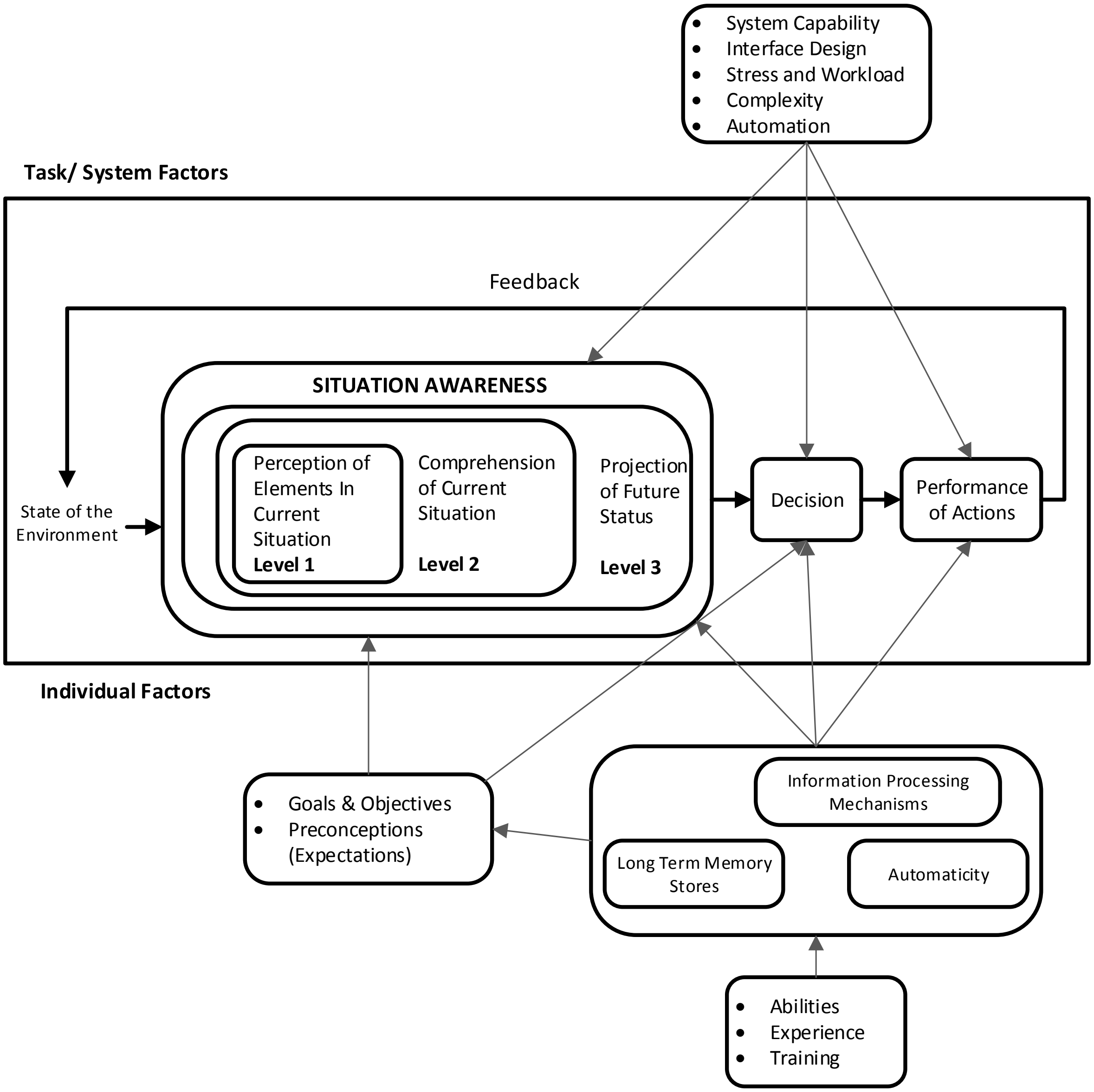


Figure 39: Situation Awareness model (Endsley et al., 2003).

Appendix G

Sample of NASA-TLX Workload Questionnaire (S. G. Hart & Staveland, 1988)

EXAMPLE:
COMPARE WORKLOAD OF TWO TASKS THAT REQUIRE A SERIES OF DISCRETE RESPONSES, THE PRIMARY DIFFICULTY MANIPULATION IS THE INTER-STIMULUS INTERVAL (ISI) – (TASK 1 = 500msec. TASK 2 = 300msec)

PAIR-WISE COMPARISONS OF FACTORS:
INSTRUCTIONS: SELECT THE MEMBER OF EACH PAIR THAT PROVIDED THE MOST SIGNIFICANT SOURCE OF WORKLOAD VARIATION IN THESE TASKS

PD	MD	TD	PD	TD	FR
TD	MD	OP	PD	TD	EF
OP	MD	FR	PD	OP	FR
FR	MD	EF	PD	OP	EF
EF	MD	TD	OP	EF	FR

TALLY OF IMPORTANT SELECTIONS

MD |||	**= 3**
PD	**= 0**
TD |||||	**= 5**
OP |	**= 1**
FR |||	**= 3**
EF |||	**= 3**
SUM	**= 15**

RATING SCALES:
INSTRUCTIONS: PLACE A MARK ON EACH SCALE THAT REPRESENTS THE MAGNITUDE OF EACH FACTOR IN THE TASK YOU JUST PERFORMED.

DEMANDS		RATINGS FOR TASK 1:		RATING		WEIGHT		PRODUCT
MD	LOW	X	HIGH	30	X	3	=	90
PD	LOW	X	HIGH	15	X	0	=	0
TD	LOW	X	HIGH	60	X	5	=	150
OP	EXCL	X	POOR	40	X	1	=	40
FR	LOW	X	HIGH	30	X	3	=	90
EF	LOW	X	HIGH	40	X	3	=	120
				SUM			=	490
				WEIGHTS (TOTAL)			=	15
				MEAN WWL SCORE			=	32

DEMANDS		RATINGS FOR TASK 1:		RATING		WEIGHT		PRODUCT
MD	LOW	X	HIGH	30	X	3	=	90
PD	LOW	X	HIGH	25	X	0	=	0
TD	LOW	X	HIGH	70	X	5	=	350
OP	EXCL	X	POOR	50	X	1	=	50
FR	LOW	X	HIGH	50	X	3	=	150
EF	LOW	X	HIGH	30	X	3	=	90
				SUM			=	730
				WEIGHTS (TOTAL)			=	15
				MEAN WWL SCORE			=	49

RESULTS:
SUBSCALES PINPOINT SPECIFIC SOURCE OF WORKLOAD VARIATION BETWEEN TASKS (TD). THE WWL SCORE REFLECTS THE IMPORTANCE OF THIS AND OTHER FACTORS AS WORKLOAD-DRIVERS AND THEIR SUBJECTIVE MAGNITUDE IN EACH TASK.

Figure 40: Sample of the NASA-TLX workload questionnaire developed by Hart and Staveland (1988).

Appendix H

Rotter Interpersonal Trust Scale (Rotter, 1967)

	1	2	3	4	5
1. Hypocrisy is on the increase in our society.					
2. One is better off being cautious when dealing with strangers until they have provided evidence that they are trustworthy.					
3. This country has a dark future unless we can attract better people into politics.					
4. Fear and social disgrace or punishment rather than conscience prevents most people from breaking the law.					
5. An honor system in which teachers would not be present during exams would probably result in increased cheating.					
6. Parents usually can be relied on to keep their promises.					
7. The United Nations will never be an effective force in keeping world peace.					
8. The judiciary is a place where we can all get unbiased treatment.					
9. Most people would be horrified if they knew how much of the news that the public hears and sees is distorted.					
10. It is safe to believe that in spite of what people say most people are primarily interested in their own welfare.					
11. Even though we have reports in newspapers, radio, TV, and the Internet, it is hard to get objective accounts of public events.					
12. The future seems very promising.					
13. If we really knew what was going on in international politics, the public would have reason to be more frightened than they now seem to be.					
15. Many major national sports contests are fixed in one way or another.					
16. Most experts can be relied upon to tell the truth about the limits of their knowledge.					
17. Most parents can be relied upon to carry out their threats of punishments.					
18. Most people can be counted on to do what they say they will do.					
19. In these competitive times one has to be alert or someone is likely to take advantage of you.					
20. Most idealists are sincere and usually practice what they preach.					
21. Most salesmen are honest in describing their products.					
22. Most students in school would not cheat even if they were sure they could get away with it.					
23. Most repairmen will not overcharge, even if they think you are ignorant of their specialty.					
24. A large share of accident claims filed against insurance companies are phony.					
25. Most people answer public opinion polls honestly.					

1 = strongly agree   2 = mildly agree   3 = agree and disagree equally   4 = mildly disagree   5 = strongly disagree

Appendix I

Farris et al. (1973) Trust and Organizational Climate scale

1. The majority of people does not deserve to be trusted
2. Now-a-days one never knows whom he can really count on.
3. A good general rule is “every man for himself”.
4. After all, nobody really pays any attention to what happens to you.

Appendix J
Cook and Wall (1980) Interpersonal Trust at Work

Interpersonal Trust at Work

Introduction: I shall read to you some statements which express opinions that people might hold about the confidence and trust that can be placed in others at work, both fellow workers and management. Would you use this scale to say whether you agree or disagree with each statement, and to consider how much you disagree or agree with them.

Card W

1. No, I strongly disagree.
2. No. I disagree quite a lot.
3. No. I disagree just a little.
4. I'm not sure.
5. Yes. I agree just a little.
6. Yes. I agree quite a lot.
7. Yes. 1 strongly agree

Questions

9.1 Management at my firm is sincere in its attempts to meet the workers' point of view.
9.2 Our firm has a poor future unless it can attract better managers.
9.3 If I got into difficulties at work I know my workmates would try and help me out.
9.4 Management can be trusted to make sensible decisions for the firm's future.
9.5 I can trust the people I work with to lend me a hand if I needed it.
9.6 Management at work seems to do an efficient job.
9.7 I feel quite confident that the firm will always try to treat me fairly.
9.8 Most of my workmates can be relied upon to do as they say they will do.
9.9 I have full confidence in the skills of my workmates.
9.10 Most of my fellow workers would get on with their work even if supervisors were not around.
9.11 I can rely on other workers not to make my job more difficult by careless work.
9.12 Our management would be quite prepared to gain advantage by deceiving the workers.

Organizational commitment

Introduction: In this section we look at what it means to you being a member of your organization. Some people feel themselves to be just an employee, there to do a job of work, while others feel more personally involved in the organization they work for. The following items express what people might feet about themselves as members of their organization. Will you please indicate on this scale how much you agree or disagree with each statement in turn.

Card W

1. No, I strongly disagree.
2. No. I disagree quite a lot.
3. No. I disagree just a little.
4. I'm not sure.
5. Yes. I agree just a little.
6. Yes. I agree quite a lot.
7. Yes. 1 strongly agree

Questions

10.1 I am quite proud to be able to tell people who it is I work for.

10.2 I sometimes feel like leaving this employment for good.

10.3 I'm not willing to put myself out just to help the organization.

10.4 Even if the firm were not doing too well financially, I would be reluctant to change to another employer.

10.5 I feel myself to be part of the organization.

10.6 In my work I like to feel I am making some effort, not just for myself but for the organization as well.

10.7 The offer of a bit more money with another employer would not seriously make me think of changing my job.

10.8 1 would not recommend a close friend to join our staff.

10.9 To know that my own work had made a contribution to the good of the organization would please me.

Personal need non-fulfilment

Introduction: It is a fairly obvious truth that people differ from one another in what they need and expect to get from different areas of their lives. Could I now ask you to think about the work that you do and, because most jobs are not perfect, consider what would make it a better job from your point of view. I shall read out a list of characteristics which a job might have, and the question I would like you to answer about each is 'do you have as much of this characteristic in your job and work life as you would like, ideally?'

Card N

1. I have more now than I really want.
2. It's just about right.
3. I would like a little more.
4. 1 would like considerably more.
5. I would like very much more.

Questions

11.1 The opportunity to meet challenge in the work.
11.2 The prestige that your job carries at work.
11.3 The opportunity to talk with others.
11.4 The chance to use more of your skills and abilities.
11.5 The opportunity to make friends.
11.6 The chance to learn new things.
11.7 Making decisions about how you do the work.
11.8 Having influence over opinions of others at work.
11.9 Independence from other people's control.
11.10 Being part of a social group.
11.11 The status your work carries in your social life.
11.12 The opportunity to discuss or question instructions about work.
11.13 To be able to work without constant supervision.
11.14 Friendly contact with other people.
11.15 To be able to extend your abilities further.
11.16 Recognition received for your achievements.

Appendix K

Costa and Anderson (2011) Trust in Team Scale

Propensity to trust

1. Most people in this team do not hesitate to help a person in need.
2. In this team most people speak out for what they believe in.
3. In this team most people stand behind their convictions.
4. The typical person in this team is sincerely concerned about the problems of others.
5. Most people will act as ‘‘Good Samaritans’’ if given the opportunity.
6. People usually tell the truth, even when they know they will be better off by lying.

Perceived trustworthiness

7. In this team people can rely on each other.
8. We have complete confidence in each other’s ability to perform tasks.
9. In this team people will keep their word.
10. There are some hidden agendas in this team. (r)
11. Some people in this team often try to get out of previous commitments. (r)
12. In this team people look for each other’s interests honestly.

Cooperative behaviours

13. In this team we work in a climate of cooperation.
14. In this team we discuss and deal with issues or problems openly.
15. While taking a decision we take each other’s opinion into consideration.
16. Some people hold back relevant information in this team. (r)
17. In this team people minimize what they tell about themselves. (r)
18. Most people in this team are open to advice and help from others.

Monitoring behaviours

19. In this team people watch each other very closely.
20. In this team people check whether others keep their promises.
21. In this team most people tend to keep each other’s work under surveillance.

All items measured on a 7-point response scale (1¼‘‘completely disagree’’, 7¼‘‘completely agree’’). Reverse scored items denoted by (r). Researchers are encouraged to use the scale in future research with the written permission of the authors.

Appendix L

Johnson-George and Swap's (1982) Specific Interpersonal Trust Scale

Specific Interpersonal Trust Scale (SITS)

Directions: Indicate how much you agree or disagree with each statement, using a scale ranging from 1 = strongly disagree to 9 = strongly agree. Whenever there is a blank in the item, use the name of the one person closest to you emotionally other than a member of your family.

Male Form

Response:

1. If _____ gave me a compliment I would question if _____ really meant what was said.

STRONGLY DISAGREE	1	2	3	4	5	6	7	8	9	STRONGLY AGREE

2. If we decided to meet somewhere for lunch, I would be certain _____ would be there.
3. I would go hiking with _____ in unfamiliar territory if _____ assured me he/she knew the area.
4. I wouldn't want to buy a piece of used furniture from _____ because I wouldn't believe his/her estimate of its worth.
5. I would expect _____ to play fair.
6. I could rely on _____ to mail an important letter for me if I couldn't get to the post office.
7. I would be able to confide in _____ and know that he/she would want to listen.
8. I could expect _____ to tell me the truth.
9. If I had to catch an airplane, I could not be sure _____ would get me to the airport on time.
10. If _____ unexpectedly laughed at something I did or said, I would wonder if he/she was being critical and unkind.
11. I could talk freely to _____ and know that _____ would want to listen.
12. _____ would never intentionally misrepresent my point of view to others.
13. If _____ knew what kinds of things hurt my feelings, I would never worry that he/she would use them against me, even if our relationship changed.
14. If _____ promised to do me a favor, he/she would follow through.
15. If _____ didn't think I handled a certain situation very well, he/she would not criticize me in front of other people.
16. If I told _____ what things I worry about, he/she would not think my concerns were silly.
17. If my alarm clock was broken and I asked _____ to call me at a certain time, I could count on receiving the call.
18. If _____ couldn't get together with me as planned, I would believe his/her excuse that something important had come up.
19. If _____ were going to give me a ride somewhere and didn't arrive on time, I would guess there was a good reason for the delay.

Scoring instructions for SITS-M:

1. For the following items, use the recorded number as the score. Item 2, 3, 5, 6, 7, 8, 11, 12, 13, 14, 15, 16, 17, 18, 19.
2. For the rest of the items, take the recorded response and convert it on the following scale: 9 becomes 1, 8 becomes 2, and so on. Do this for items numbers 1, 4, 9, and 10.
3. Add up the points for the total score.
4. A high score indicates greater interpersonal trust.

Female Form

Response:

1. If I were injured or hurt, I could depend on _____ to do what was best for me.

STRONGLY DISAGREE	1	2	3	4	5	6	7	8	9	STRONGLY AGREE

2. If _____ borrowed something of value and returned it broken, _____ would offer to pay for the repairs.
3. If my alarm clock was broken and I asked _____ to call me at a certain time, I could count on receiving the call.
4. If _____ agreed to feed my pet while I was away, I wouldn't worry about the kind of care it would receive.
5. If _____ promised to do me a favor, he/she would follow through.
6. If _____ were going to give me a ride somewhere and didn't arrive on time, I would guess there was a good reason for the delay.
7. I would be willing to lend _____ almost any amount of money, because he/she would pay me back as soon as he/she could.
8. If _____ couldn't get together with me as planned, I would believe his/her excuse that something important had come up.
9. I could talk freely to _____ and know that _____ would want to listen.
10. _____ would never intentionally misrepresent my point of view to others.
11. If _____ knew what kinds of things hurt my feelings, I would never worry that he/she would use them against me, evening if our relationship changed.
12. I would be able to confide in _____ and know that he/she would not discuss my concerns with others.
13. I would expect _____ to tell me the truth.

Scoring instructions for SITS-F:

1. Add the recorded numbers to get the total score. No items on SITS-F are reverse-keyed.

Appendix M

Larzelere and Huston (1980) dyadic trust scale

FINAL DYADIC TRUST SCALE ITEMS WITH DATA ON THE MAJOR SELECTION CRITERIA

1. My partner is primarily interested in his (her) own welfare.
2. There are times when my partner cannot be trusted.
3. My partner is perfectly honest and truthful with me.
4. I feel that I can trust my partner completely.
5. My partner is truly sincere in his (her) promises.
6. I feel that my partner does not show me enough consideration.
7. My partner treats me fairly and justly.
8. I feel that my partner can be counted on to help me.

Appendix N

Rempel et al. (1985) trust in close relationships scale.

	Item	Designated* Category
1.	When we encounter difficult and unfamiliar new circumstances I would not feel worried or threatened by letting my partner do what he/she wanted.	F
2.	I can count on my partner to be concerned about my welfare.	D
3.	In general, my partner does things in a variety of different ways. He/she almost never sticks to one way of doing things.	P
4.	My partner has proven to be trustworthy and I am willing to let him/her engage in activities which other partners find too threatening.	D
5.	I am familiar with the patterns of behaviour my partner has established and I can rely on him/her to behave in certain ways.	P
6.	Even when I don't know how my partner will react, I feel comfortable telling him/her anything about myself; even those things of which I am ashamed.	F
7.	Though times may change and the future is uncertain; I know my partner will always be ready and willing to offer me strength and support.	F
8.	I am never certain that my partner won't do something that I dislike or will embarrass me.	P
9.	My partner is very unpredictable. I never know how he/she is going to act from one day to the next.	P
10.	I feel very uncomfortable when my partner has to make decisions which will affect me personally.	D
11.	I have found that my partner is usually dependable, especially when it comes to things which are important to me.	D
12.	My partner behaves in a very consistent manner.	P
13.	In my relationship with my partner, the future is an unknown which I worry about.	F
14.	Whenever we have to make an important decision in a situation we have never encountered before, I know my partner will be concerned about my welfare.	F
15.	Even if I have no reason to expect my partner to share things with me, I still feel certain that he/she will.	F
16.	I can rely on my partner to react in a positive way when I expose my weakness to him/her.	F
17.	I usually know how my partner is going to act. He/she can be counted on.	P
18.	When I share my problems with my partner, I know he/she will respond in a loving way even before I say anything.	F
19.	In our relationship I have to keep alert or my partner might take advantage of me.	D
20.	I am certain that my partner would not cheat on me, even if the opportunity arouse and there was no chance that he/she would get caught.	D
21.	I sometimes avoid my partner because he/she is unpredictable and I fear of saying or doing something which might create conflict.	P
22.	I can rely on my partner to keep the promises he/she makes to me.	D
23.	I would never guarantee that my partner and I will still be together and not have decided to end our relationship 10 years from now.	F
24.	When I am with my partner I feel secure in facing unknown new situations.	F

25.	Even when my partner makes excuses which sound rather unlikely, I am confident that he/she is telling the truth.	D
26.	I am willing to let my partner make decisions for me.	D

*F = faith; D = dependability; P = predictability

Appendix O

Cummings and Bromiley (1996) Organizational Trust Inventory

SCALE						
1	2	3	4	5	6	7
Nearly zero	Very low	Low	50-50	High	Very high	Near 100%

Complete each of the following statements by reading in the name of your supervisor in the first blank space in the statement. After reading the statement select the number from the scale above that is closest to your opinion and write it in the second blank at the end of the statement.

1. My level of confidence that _______ is technically competent at the critical elements of his or her job is _____.
2. My level of confidence that _______ will make well thought out decisions about his or her job is _____.
3. My level of confidence that _______ will follow through on assignments is ______.

4. My level of confidence that _______ has an acceptable level of understanding of his/her job is ____.
5. My level of confidence that _______ will be able to do his or her job in an acceptable manner is _____.
6. When ______ tells me something, my level of confidence that I can rely on what they tell me is _____.
7. My confidence in _______ to do the job without causing other problems is _____.
8. My level of confidence that ______ will think through what he or she is doing on the job is ____.

Each of the following statements refers to your department.

9. My level of confidence that this organization will treat me fairly is ______.
10. The level of trust between supervisors and workers in this organization is ______.
11. The level of trust among the people I work on a regular basis is ______.
12. The degree to which we can depend on each other in this organization is ______.

Appendix P

McAllister's (1995) trust scale

Affect-based trust

1. We have a sharing relationship. We can both freely share our ideas, feelings, and hopes.
2. I can freely talk to this individual about difficulties I am having at work and know that s/he will want to listen.
3. We would both feel a sense of loss if one of us was transferred and we could no longer work together.
4. If I share my problems with this person, I know s/he would respond constructively and caringly.
5. I would have to say that we have both made considerable emotional investments in our working relationship.

Cognition-based trust

1. This person approaches his/her job with professionalism and dedication.
2. Given this person's track record, I see no reason to doubt his/her competence and preparation for the job.
3. I can rely on this person not to make my job more difficult by careless work.
4. Most people, even those who aren't close friends of this individual, trust and respect him/her as a co-worker.
5. Other work associates of mine who must interact with this individual consider him/her to be trustworthy.
6. If people knew more about this individual and his/her background, they would be more concerned and monitor his/her performance more closely. (reverse-coded)

Appendix Q

Butler's Conditions of Trust Inventory (CTI) (Butler Jr., 1991)

Scales and Items of the Conditions of Trust Inventory[1]

Here are some statements that describe how you might feel about _______________. Keep this person in mind as you respond to the following items. All your answers should refer to the same person. Please circle the letter at the right of each statement to show how you respond to that statement.

Please use this key:
SD = Strongly disagree
MD = Moderately disagree
N = Neither agree nor disagree
MA = Moderately agree
SA = Strongly agree

Availability					
1. ______ is usually around when I need him/her.	SD	MD	N	MA	SA
2. I can find ______ when I want to talk with him/her.	SD	MD	N	MA	SA
3. It's usually hard for me to get in touch with ______.	SD	MD	N	MA	SA
4. ______ is available when I need him/her.	SD	MD	N	MA	SA
Competence					
5. ______ does things competently.	SD	MD	N	MA	SA
6. Unfortunately, ______ does things poorly.	SD	MD	N	MA	SA
7. ______ performs his/her tasks with skill.	SD	MD	N	MA	SA
8. ______ does things in a capable manner.	SD	MD	N	MA	SA
Consistency					
9. ______ does things consistently from one time to the next.	SD	MD	N	MA	SA
10. ______ does the same thing every time the situation is the same.	SD	MD	N	MA	SA
11. ______ behaves in a consistent manner.	SD	MD	N	MA	SA
12. I seldom know what _____ will do next.	SD	MD	N	MA	SA
Discreteness					
13. ______ keeps secrets that I tell him/her.	SD	MD	N	MA	SA
14. ______ talks too much about sensitive information that I give him/her.	SD	MD	N	MA	SA
15. If I give ______ confidential information he/she keeps it confidential.	SD	MD	N	MA	SA
16. ______ does not tell others about things if I ask that they be kept secret.	SD	MD	N	MA	SA

<u>Fairness</u>					
17. ______ treats me fairly.	SD	MD	N	MA	SA
18. ______ treats others better than he/she treats me.	SD	MD	N	MA	SA
19. ______ always gives me a fair deal.	SD	MD	N	MA	SA
20. ______ treats me on an equal basis with others.	SD	MD	N	MA	SA
<u>Integrity</u>					
21. ______ always tells me the truth.	SD	MD	N	MA	SA
22. ______ would <u>not</u> lie to me.	SD	MD	N	MA	SA
23. ______ deals honestly with me.	SD	MD	N	MA	SA
24. Sometimes ______ does dishonest things.	SD	MD	N	MA	SA
<u>Loyalty</u>					
25. ______ would <u>not</u> do anything to make me look bad.	SD	MD	N	MA	SA
26. ______ is likely to take advantage of me.	SD	MD	N	MA	SA
27. If I make a mistake, ______ will <u>not</u> use it against me.	SD	MD	N	MA	SA
28. I can discuss problems with _____ without having the information used against me.	SD	MD	N	MA	SA
<u>Openness</u>					
29. ______ tells me what he/she is thinking.	SD	MD	N	MA	SA
30. ______ tells me what's on his/her mind.	SD	MD	N	MA	SA
31. ______ shares his/her thoughts with me.	SD	MD	N	MA	SA
32. ______ keeps information from me.	SD	MD	N	MA	SA
<u>Overall Trust</u>					
33. Sometimes I cannot trust ______.	SD	MD	N	MA	SA
34. I can count on ______ to be trustworthy.	SD	MD	N	MA	SA
35. I feel that ______ can be trusted.	SD	MD	N	MA	SA
36. I trust ______.	SD	MD	N	MA	SA
<u>Promise Fulfillment</u>					
37. ______ follows through on promises made to me.	SD	MD	N	MA	SA
38. Keeping promises is a problem for ______.	SD	MD	N	MA	SA
39. If _____ promises something to me, he/she will stick to it.	SD	MD	N	MA	SA
40. _____ does things that he/she promises to do for me.	SD	MD	N	MA	SA
<u>Receptivity</u>					
41. _____ readily takes in my ideas.	SD	MD	N	MA	SA
42. _____ really listens to me.	SD	MD	N	MA	SA
43. _____ often fails to listen to what I say.	SD	MD	N	MA	SA
44. _____ makes an effort to understand what I have to say.	SD	MD	N	MA	SA

Appendix R

Initial list of Trust antecedents and personality factors used in the QTAS

Table 31: List of trust antecedents and personality factors used in the card-sorting exercise to identify factors to be included in the QTAS along with the references that support each component.

Trust Cue	References
availability of information about abilities and competences	(Mclain & Hackman, 1999)
availability of information about risks	(Mclain & Hackman, 1999)
environment characteristics	(Mclain & Hackman, 1999; Weber et al., 2004)
institutional culture	(Mclain & Hackman, 1999; Six, 2007)
institutional goals	(Rosen & Jerdee, 1977)
institutional rules	(Beccerra & Gupta, 1999; McKnight et al., 1998; Mclain & Hackman, 1999; Six, 2007)
social rules	(Budesku, Erev, & Zwick, 1999; James, 2002; Kramer & Tyler, 1996; McKnight et al., 1998; Six et al., 2010)
ability to delegate	(Six et al., 2010)
accountability	(Sarker et al., 2011; Tetlock, 1985)
altruism	(Colombo & Merzoni, 2006; Frost et al., 1978)
appearance/personal attraction/affection/empathy (for the other)	(Budesku et al., 1999; Giffin, 1967)
awareness of the environment	(Six et al., 2010)
awareness of the situation or task	(Six et al., 2010)
behaviour	(Farris et al., 1973; Weber et al., 2004)
beliefs	(Kramer & Tyler, 1996; Lahno, 1995; McKnight et al., 1998; Six et al., 2010)

benevolence	(Beccerra & Gupta, 1999; Larzelere & Huston, 1980; Mayer et al., 1995; McKnight et al., 1998; Mclain & Hackman, 1999; Six, 2007; Solomon, 1960; Strickland, 1958)
care for the other	(Kramer & Tyler, 1996; Six, 2005, 2007)
Competences / abilities / expertise / knowledge / training	(Beccerra & Gupta, 1999; Butler Jr., 1991; J. Cook & Wall, 1980; Deutsch, 1960b; Giffin, 1967; Kramer & Tyler, 1996; Mayer et al., 1995; McKnight et al., 1998; Mclain & Hackman, 1999; Six et al., 2010; Six, 2007; P. Wilson, 1999)
consistency	(Butler Jr., 1991; P. Wilson, 1999)
convenience of the interaction	(Colombo & Merzoni, 2006)
cooperativeness	(Kramer, 1999)
dedication	(Six, 2007)
discreetness	(Butler Jr., 1991)
experiences (life experiences)	(Lahno, 1995; Weber et al., 2004)
experiences (work experiences)	(Budesku et al., 1999; Colombo & Merzoni, 2006; Kramer, 1999; Lahno, 1995; Mclain & Hackman, 1999)
fairness	(Butler Jr., 1991; Colombo & Merzoni, 2006)
feedback/information about previous experiences	(Six et al., 2010; Six, 2005, 2007)
fidelity/loyalty	(Bhattacharya et al., 1998)
general dispositions	(James, 2002)
general proclivities	(James, 2002)
goals	(Mayer et al., 1995; Rosen & Jerdee, 1977; Six et al., 2010; Weber et al., 2004)
history of collaborations	(Beccerra & Gupta, 1999; Budesku et al., 1999; Kramer & Tyler, 1996; Kramer, 1999; Lahno, 1995; Mayer et al., 1995; Mclain & Hackman, 1999; Morrow et al., 2004; Six, 2007)

honesty	(Kramer, 1999; Larzelere & Huston, 1980; McKnight et al., 1998; Six, 2005; P. Wilson, 1999)
information transmitted by other people in the group or team	(Kramer, 1999)
integrity	(Beccerra & Gupta, 1999; Butler Jr., 1991; Lieberman, 1981; Mayer et al., 1995; Ring & Van de Ven, 1992; P. Wilson, 1999)
intentions/goodwill	(Ring & Van de Ven, 1992)
interpersonal skills	(Six, 2007)
involvement in the task	(Mclain & Hackman, 1999)
knowledge about the institution	(Kramer, 1999)
motivation behind the interaction	(Kee & Knox, 2013; Kramer, 1999; Mclain & Hackman, 1999)
openness	(Beccerra & Gupta, 1999; Butler Jr., 1991; Farris et al., 1973; K. M. Hart & Capps, 1986; Kramer & Tyler, 1996; Mayer et al., 1995; Six et al., 2010; Six, 2005, 2007; P. Wilson, 1999)
perceived temptation of the other taking advantage	(Budesku et al., 1999; Hovland, Janis, & Kelley, 1953; James, 2002; Six et al., 2010; Six, 2007; Weber et al., 2004)
personal availability	(Butler Jr., 1991)
personal judgement	(Rosen & Jerdee, 1977)
predictability of behaviour/outcome	(Beccerra & Gupta, 1999; Bhattacharya et al., 1998; Budesku et al., 1999; Butler Jr., 1991; James, 2002; Kramer, 1999; Lahno, 1995; McKnight et al., 1998; Six et al., 2010; Six, 2007; Weber et al., 2004)
profession	(Kramer, 1999)
receptiveness	(Six et al., 2010)

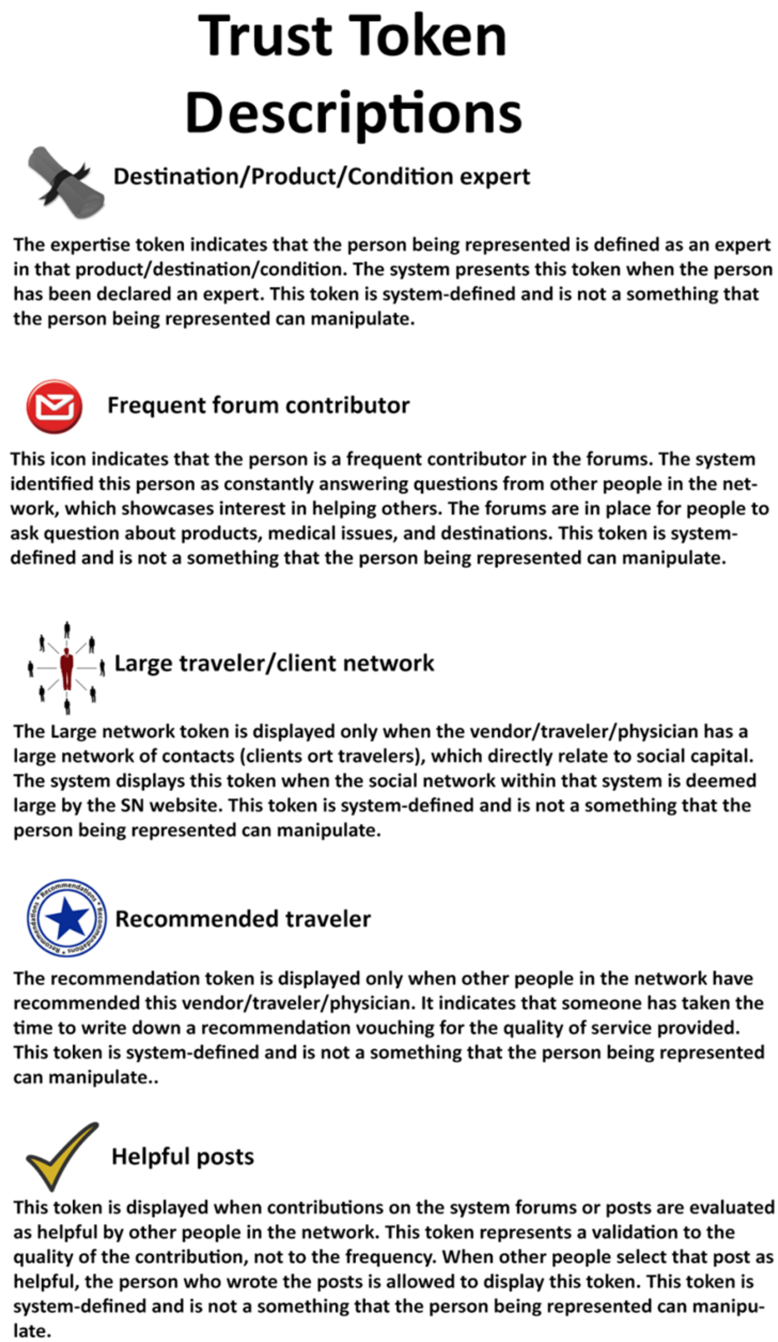
reciprocity	(Colombo & Merzoni, 2006; Weber et al., 2004)
reliability	(Bhattacharya et al., 1998; Giffin, 1967; Johnson-George & Swap, 1982; Kramer & Tyler, 1996; Mayer et al., 1995; P. Wilson, 1999)
reputation	(Colombo & Merzoni, 2006; Giffin, 1967; Lahno, 1995; Weber et al., 2004)
requirement of monitoring	(Beccerra & Gupta, 1999; James, 2002; Lahno, 1995)
requirement of supervision	(James, 2002)
responsibility	(Mclain & Hackman, 1999; Six et al., 2010; Six, 2005)
risks to the person being trusted	(Frost et al., 1978; Gambetta, 1988; James, 2002)
role in the institution	(Kramer, 1999)
role in the project	(Kramer, 1999)
self-confidence	(Six, 2007)
self-discipline	(Six, 2007)
sincerity	(Mclain & Hackman, 1999; Weber et al., 2004)
social capital (people the other individual knows and interacts with)	(Kramer, 1999; Six et al., 2010; Six, 2007; Weber et al., 2004)
solidarity	(Six et al., 2010)
	(Colombo & Merzoni, 2006)
stability	
take responsibility (don't pass the blame)	(Six et al., 2010; Six, 2005)
trustworthiness	
value similarity	(Beccerra & Gupta, 1999; K. M. Hart & Capps, 1986; McKnight et al., 1998; Sitkin & Roth, 1993)
willingness to help	(Six et al., 2010)
ability to delegate	(Six et al., 2010)
awareness of the environment	(Six et al., 2010)
awareness of the situation or task	(Six et al., 2010)

beliefs	(Kramer, 1999)
benefits from the expected behaviour of the other	(Deutsch et al., 2006; Virshup, Oppenberg, & Coleman, 1999; Weber et al., 2004)
Competences / abilities / expertise / knowledge / training / ability to handle responsibility	(Bachmann & Zaheer, 2006; Kramer & Tyler, 1996; Six et al., 2010; Six, 2007)
convenience of the interaction	(Colombo & Merzoni, 2006)
dependency on the other's actions	(Six et al., 2010; Weber et al., 2004)
disposition to trust	(Budesku et al., 1999; James, 2002; Mayer et al., 1995; Mclain & Hackman, 1999; Rotter, 1967)
guilt/regret from previous events	(Budesku et al., 1999)
gut feeling/instinct/intuition	(Morrow et al., 2004)
incentives for trusting	(Beccerra & Gupta, 1999; Lahno, 1995)
intention to experiment with new relationships	(Beccerra & Gupta, 1999; Farris et al., 1973; Mclain & Hackman, 1999)
interest in maintaining future relationships	(Six et al., 2010)
involvement in the task	(Mclain & Hackman, 1999)
knowledge about the institution	(Kramer, 1999)
perception of the trusting act by others - intention to look good by having trusted another person	(Weber et al., 2004)
risks in trusting/fear of embarrassment	(Weber et al., 2004)
length of the interaction	(Colombo & Merzoni, 2006)
risks in the task	(Bhattacharya et al., 1998; Budesku et al., 1999; Das & Teng, 2004; Kramer & Tyler, 1996; Kramer, 1999; Lahno, 1995; Mayer et al., 1995; Mclain & Hackman, 1999; Six et al., 2010; Six, 2007)
risks to others not involved in the interaction	(Colombo & Merzoni, 2006)
situation	(Bhattacharya et al., 1998; Kramer, 1999)

task characteristics	(Six et al., 2010; Weber et al., 2004)
team size	(Weber et al., 2004)

Appendix S

Description of Trust Tokens given to participants



Trust Token Descriptions

Destination/Product/Condition expert

The expertise token indicates that the person being represented is defined as an expert in that product/destination/condition. The system presents this token when the person has been declared an expert. This token is system-defined and is not a something that the person being represented can manipulate.

Frequent forum contributor

This icon indicates that the person is a frequent contributor in the forums. The system identified this person as constantly answering questions from other people in the network, which showcases interest in helping others. The forums are in place for people to ask question about products, medical issues, and destinations. This token is system-defined and is not a something that the person being represented can manipulate.

Large traveler/client network

The Large network token is displayed only when the vendor/traveler/physician has a large network of contacts (clients ort travelers), which directly relate to social capital. The system displays this token when the social network within that system is deemed large by the SN website. This token is system-defined and is not a something that the person being represented can manipulate.

Recommended traveler

The recommendation token is displayed only when other people in the network have recommended this vendor/traveler/physician. It indicates that someone has taken the time to write down a recommendation vouching for the quality of service provided. This token is system-defined and is not a something that the person being represented can manipulate..

Helpful posts

This token is displayed when contributions on the system forums or posts are evaluated as helpful by other people in the network. This token represents a validation to the quality of the contribution, not to the frequency. When other people select that post as helpful, the person who wrote the posts is allowed to display this token. This token is system-defined and is not a something that the person being represented can manipulate.

Figure 41: Description of Trust Tokens given to participants

Appendix T

Sample scenarios from the Trust Token study

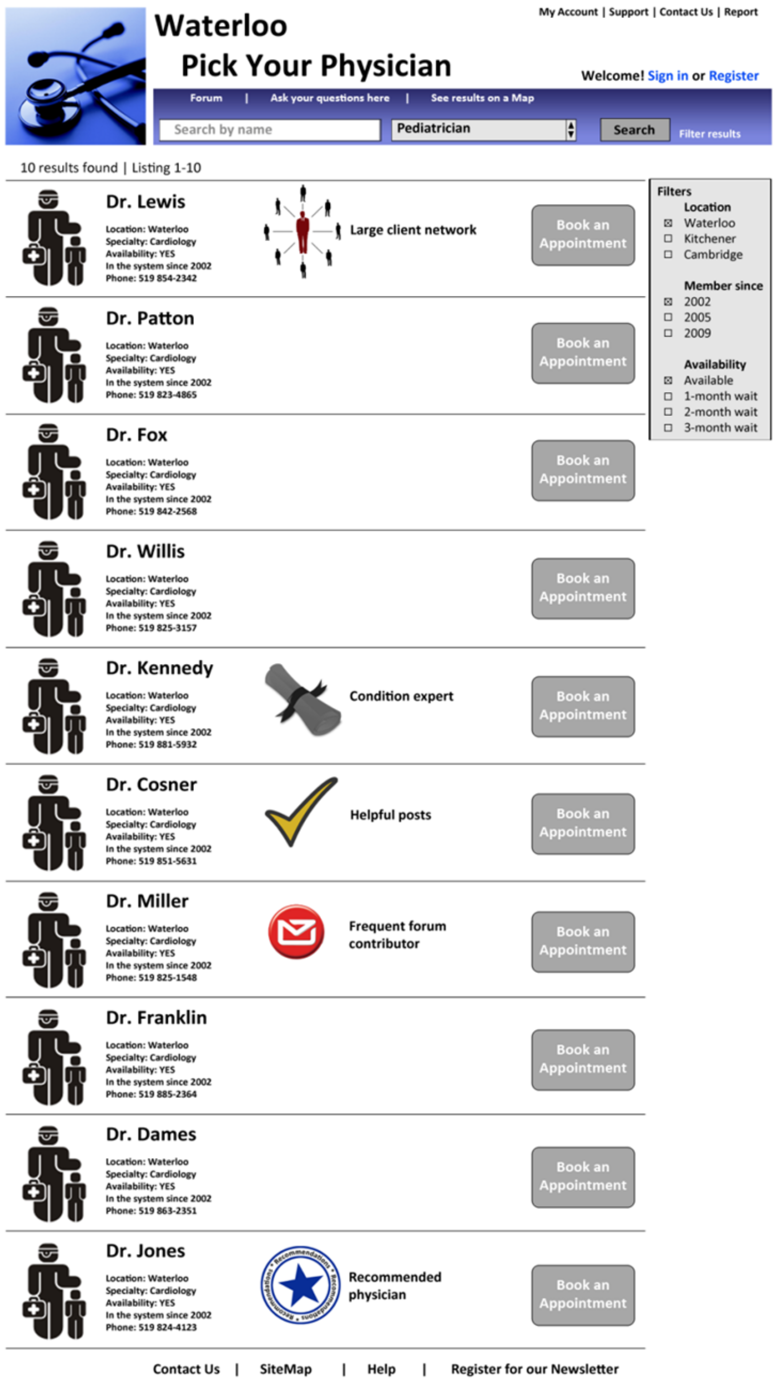


Figure 42: Sample PickYourPhisician scenario

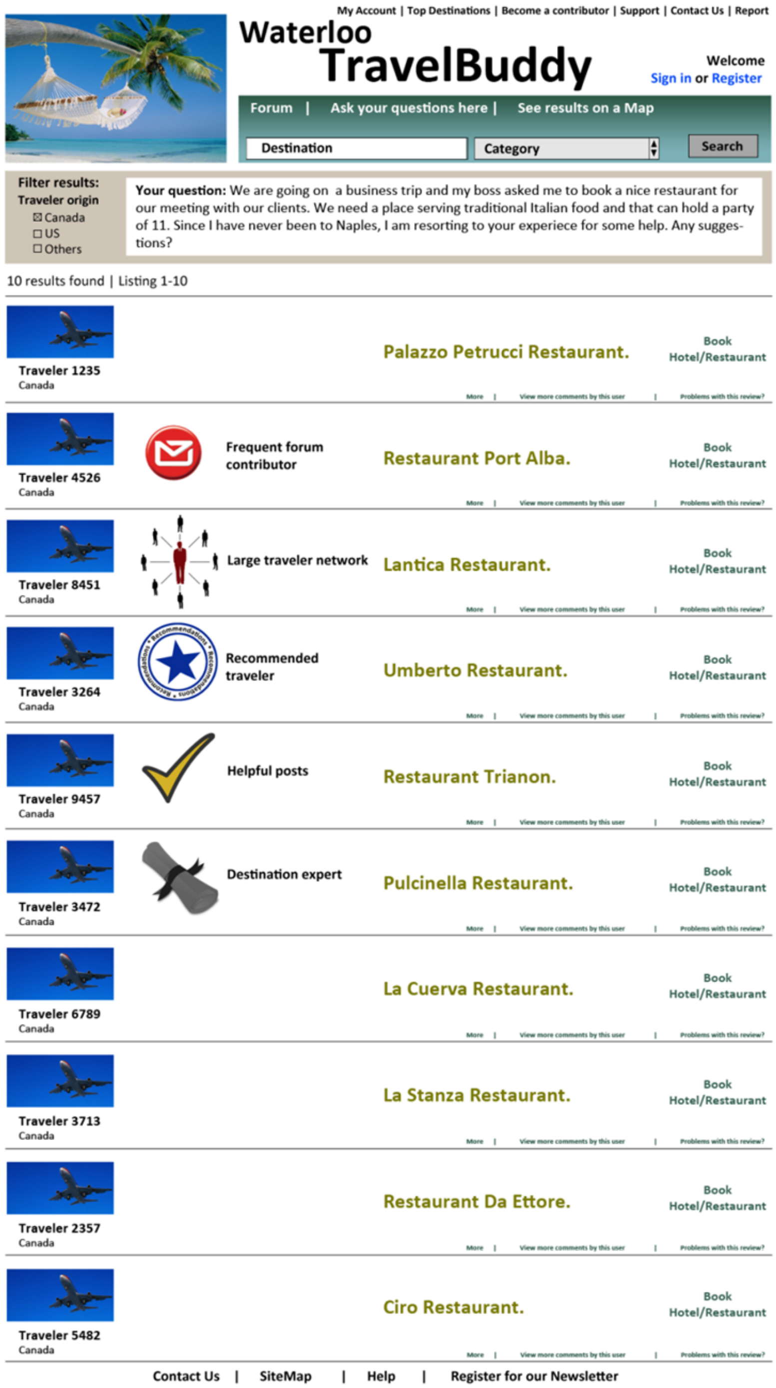


Figure 43: Sample TravelBuddy scenario

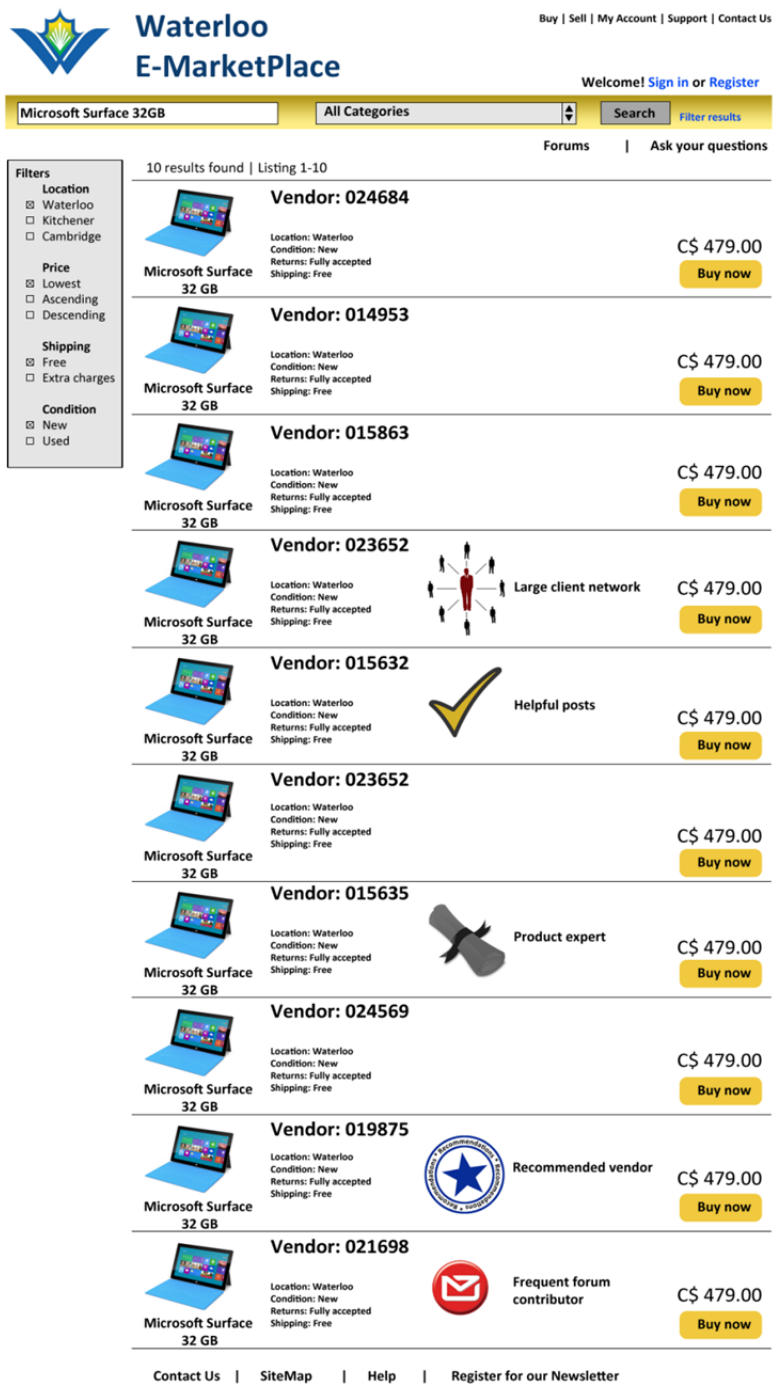
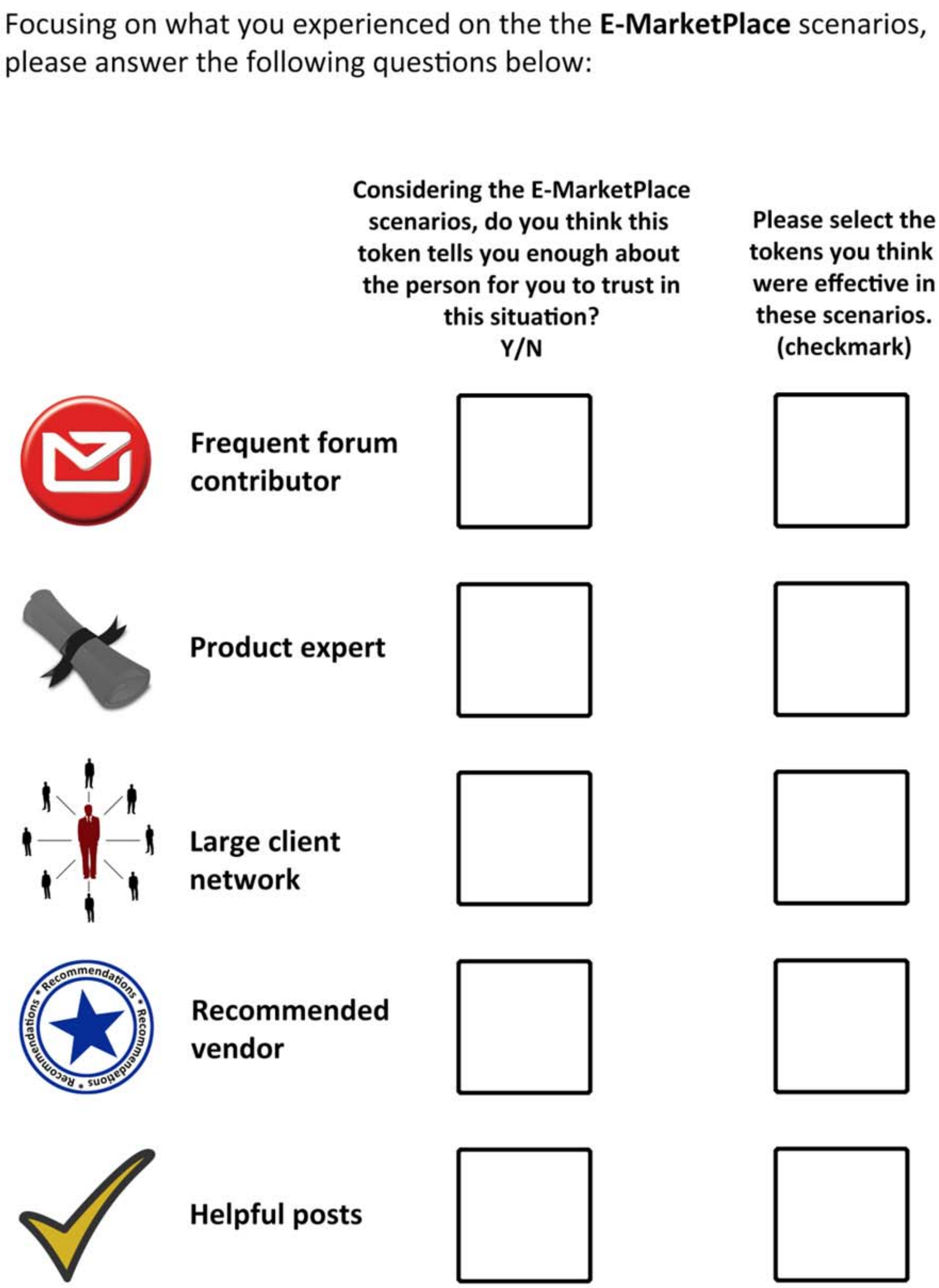


Figure 44: Sample E-MarketPlace scenario

Appendix U

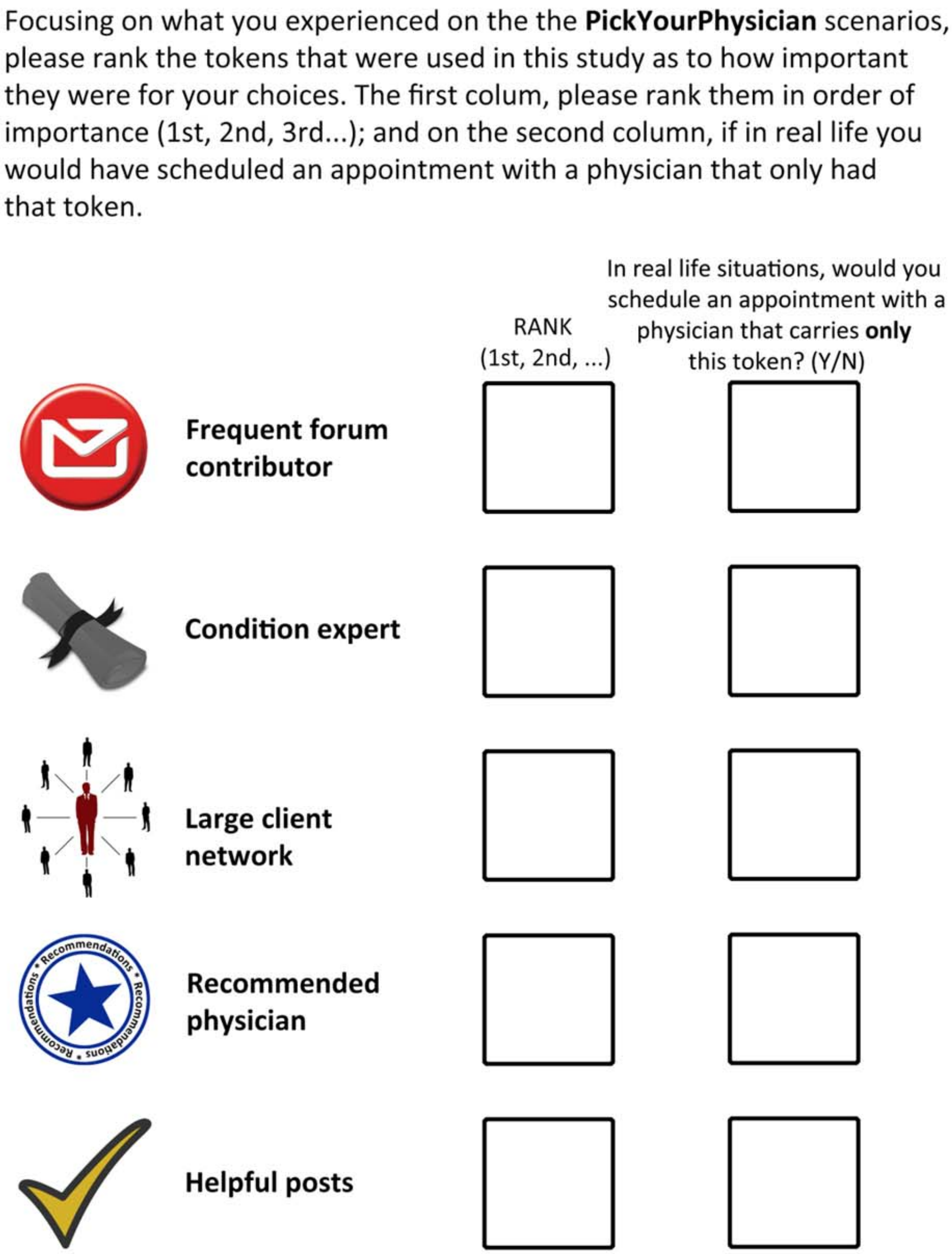
Sample questionnaires from the Trust Token study



Focusing on what you experienced on the the **E-MarketPlace** scenarios, please answer the following questions below:

	Considering the E-MarketPlace scenarios, do you think this token tells you enough about the person for you to trust in this situation? Y/N	Please select the tokens you think were effective in these scenarios. (checkmark)
Frequent forum contributor		
Product expert		
Large client network		
Recommended vendor		
Helpful posts		

Figure 45: Sample questionnaire from the Trust Token study.



Focusing on what you experienced on the the **PickYourPhysician** scenarios, please rank the tokens that were used in this study as to how important they were for your choices. The first colum, please rank them in order of importance (1st, 2nd, 3rd...); and on the second column, if in real life you would have scheduled an appointment with a physician that only had that token.

	RANK (1st, 2nd, ...)	In real life situations, would you schedule an appointment with a physician that carries **only** this token? (Y/N)
Frequent forum contributor		
Condition expert		
Large client network		
Recommended physician		
Helpful posts		

Figure 46: Sample questionnaire from the Trust Token study.

Scenario 1

Ratings for this scenario

How confident are you that you made a good decision?

Not confident Completely confident

How **comfortable** you are with your decision?

Not comfortable Completely comfortable

How much do you **trust** the suggestion or service provided?

Do not trust Completely trust

Do you think you had enough information to make this decision?

Yes No

Figure 47: Sample of the rating and ranking questionnaire from the trust token study

Appendix W
Consent form for the QTAS study 1 – Card sorting study

University of Waterloo, Canada

Title: Card sorting for filtering the number of trust regulating variables for the development of trust metrics.

Investigators: MSc. Plinio Morita, University of Waterloo

Prof. Catherine M. Burns, University of Waterloo

My name is Plinio Morita and I'm currently a PhD candidate at the University of Waterloo. I am currently supervised by Prof. Catherine M. Burns in my PhD project entitled "Use of Technological Tools for Supporting Trust in Collaborative Environments". My thesis project consists of developing quick and effective tools to measure trust in work collaborations (trust metrics), where the evolution of trust could be mapped and analysed. At a later stage, this information will also be used on the communication and interactive systems to be used in work collaboration to improve trust levels inside teams. Based on published literature on trust, I have developed a list of factors that regulate the development of trust. However, there are too many factors on the list, and as a result, the number must be reduced.

In order to reduce this number to a manageable subset, I am conducting a small card sorting experiment to reduce it to a number manageable by this research project. We need your input to sort the following terms that have been selected as important factors for trust.

You will receive a list of factors that are said to contribute to the decision of trusting another individual. You participation on this study would be to sort these words into groups that contain words with similar meaning when deciding to trust another person. For each group that you create, please name the group after the most salient word in your opinion that is inside that group.

I would appreciate if you would complete the brief experiment which is expected to take about 15-30 minutes of your time. Participation in this project is voluntary. Further, all information you provide will be considered confidential. The data collected through this study, with personal identifiers (e.g., name, email) removed, will be kept in the Advanced Interface Design Lab, which is a secured location. This data will only be accessible by the researchers involved in this project. There are no known or anticipated risks to participation in this study. If you are interested in continuing to participate in this study, please send us an e-mail and we'll make sure that you are added in the mailing list.

Please feel free to forward this e-mail to any other persons who may be interested in participating in this research project.

If you are interested in participating in this study, please access http://websort.net/s/9B54E8/ and conduct the requested sorting.

If you have any questions about this study, or would like additional information to assist you in reaching a decision about participation, please feel free to contact the researcher, Plinio Morita, at 1-519-888-4567 ext. (34904) or by e-mail at pmorita@uwaterloo.ca.

I would like to assure you that this study has been reviewed and received ethics clearance through the Office of Research Ethics at the University of Waterloo, Canada. However, the final decision about participation is yours. Should you have any comments or concerns resulting from your participation in this study, please contact this Office at 1-519-888-4567 Ext. 36005 or ssykes@uwaterloo.ca.

Thank you in advance for your interest in this project.

Yours sincerely,

Appendix X
Consent form for the QTAS study 2 – Selection of QTAS dimensions

University of Waterloo, Canada

Title: Development of the Quick Trust Assessment Scale - Data collection 1.

Investigators:

Plinio Morita, University of Waterloo (PhD Candidate and Student Investigator)

Prof. Catherine M. Burns, University of Waterloo (Faculty Supervisor)

Department of Systems Design Engineering, University of Waterloo

This PhD thesis project consists of developing quick and effective tools to measure trust in work collaborations (trust metrics), allowing the evolution of trust levels to be mapped and analyzed. At a later stage, the information collected through these metrics will also be used on communication and interactive systems to be used in work collaboration as a means to improve trust levels and effectiveness of collaborations.

Trust is a complex construct that can be based on the integration of several information sources. Each source is given different levels of importance based on the person making the decision or on the specific situation. Our intention is to develop a trust measuring tool that reduces personal and situational variability, being fit for use in any kind of environment or situation, and is easy and quick to use. Consequently, multiple measures could be made without interfering with the collaborations.

If you decide to volunteer, you will be asked to complete an anonymous online 30-minute survey. The survey is composed of three sections with questions concerning demographic characteristics, personality, and trust factors considered when trusting another person. If you prefer not to complete the survey on the web, please contact us and we will make arrangements to provide you another method of participation. You may decline to answer any questions that you do not wish to answer and you can withdraw your participation at any time by proceeding to the end of the survey, submit your responses and follow the instructions. There are no known or anticipated risks from participating in this study.

In appreciation to your time commitment, you will be entered in two draws for a 100 dollars gift card from Future Shop. Your approximate changes of winning are 1/100. The draw will take place after the study is completed (tentatively in December, 2011) and the winners will be notified by email.

It is important for you to know that any information that you provide will be confidential. All of the data will be summarized and no individual could be identified from these summarized results. Furthermore, the web site is programmed to collect responses alone and will not collect any information that could potentially identify you (such as machine identifiers).

The data, with no personal identifiers, collected from this study will be maintained on a password-protected computer database in a restricted access area of the university. As well, the data will be electronically archived after completion of the study and maintained for three years and then erased. Email addresses for the draws are maintained in a separate file and not linked to survey responses. The emails will be deleted after the draws.

This survey uses Survey Gizmo(TM) whose computer servers are located in the USA. Consequently, USA authorities under provisions of the Patriot Act may access this survey data. If you prefer not to submit your data through Survey Gizmo(TM), please contact one of the researchers so you can participate using an alternative method (such as through an email or paper-based questionnaire). The alternate method may decrease anonymity but confidentiality will be maintained.

Should you have any questions about the study, please Plinio Morita at pmorita@uwaterloo.ca or Professor Catherine M. Burns at catherine.burns@uwaterloo.ca. Further, if you would like to receive a copy of the results of this study, please contact either investigator.

I would like to assure you that this study has been reviewed and received ethics clearance through the Office of Research Ethics at the University of Waterloo. However, the final decision about participation is yours. If you have any comments or concerns resulting from your participation in this study, please feel free to contact Dr. Susan Sykes, Director, Office of Research Ethics, at ext. 36005 or by email at ssykes@uwaterloo.ca .

Thank you for considering participating in this study.

Appendix Y

Consent form for the QTAS study 3 – Evaluation of the QTAS

University of Waterloo, Canada

Title: Evaluation of the Quick Trust Assessment Scale

Investigators: Plinio Morita, University of Waterloo (PhD Candidate and Student Investigator)

Prof. Catherine M. Burns, University of Waterloo (Faculty Supervisor)

Department of Systems Design Engineering, University of Waterloo

Thank you for your interest in participating in this survey. Your time and effort to help refine our quick trust assessment scale will greatly benefit future research in the field. Your contribution will not only help to determine the validity of the trust assessment scale, but also on the support of future projects in applied trust research.

This PhD thesis project consists of developing quick and effective tools to measure trust in work collaborations (trust metrics), allowing the evolution of trust to be mapped and analyzed. At a later stage, the information collected through these metrics will also be used on communication and interactive systems to be used in work collaboration as a means to improve trust levels and effectiveness of collaborations.

Trust is a complex construct that can be based on the integration of several information sources. Each source is given different levels of importance based on the person making the decision or on the specific situation. Our intention is to develop a trust measuring tool that reduces personal and situational variability, being fit for use in any kind of environment or situation, and is easy and quick to use. Consequently, multiple measures could be made without interfering with the collaborations.

I would like to introduce you to the topic and procedures of this study. You will be evaluating how much you trust people that you have collaborated in the past, based on a set of questions. You will be asked to evaluate a person you trust and a person you do not trust. Each set of questions will be used to evaluate the validity and benefit of different approaches to measuring trust. This study will take approximately 30 minutes and will be done in its entirety on your computer via some online questionnaires. You participation will be anonymous and will not identify your participation on this study.

If you decide to volunteer for this study, you will be asked to complete an anonymous online 30-minute set of questionnaires.

If you prefer not to complete the survey on the web, please contact us and we will make arrangements to provide you another method of participation. You may decline to answer any questions that you do not wish to answer and you can withdraw your participation at any time by proceeding to the end of the survey, submit your responses and follow the instructions. There are no known or anticipated risks from participating in this study.

It is important for you to know that any information that you provide will be confidential. All of the data will be summarized and no individual could be identified from these summarized results. Furthermore, the web site is programmed to collect responses alone and will not collect any information that could potentially identify you (such as machine identifiers).

The data, with no personal identifiers, collected from this study will be maintained on a password-protected computer database in a restricted access area of the university. As well, the data will be electronically archived after completion of the study and maintained for three years and then erased.

This survey uses Survey Gizmo(TM) whose computer servers are located in the USA. Consequently, USA authorities under provisions of the Patriot Act may access this survey data. If you prefer not to submit your data through Survey Gizmo(TM), please contact one of the researchers so you can participate using an alternative method (such as through an email or paper-based questionnaire). The alternate method may decrease anonymity but confidentiality will be maintained.

Should you have any questions about the study, please contact Plinio Morita at pmorita@uwaterloo.ca or Professor Catherine M. Burns at catherine.burns@uwaterloo.ca. Further, if you would like to receive a copy of the results of this study, please contact either investigator.

I would like to assure you that this study has been reviewed and received ethics clearance through the Office of Research Ethics at the University of Waterloo. However, the final decision about participation is yours. If you have any comments or concerns resulting from your participation in this study, please feel free to contact the Director, Office of Research Ethics, at ext. 36005.

Thank you for considering participating in this study.

Appendix Z

Consent form for the Trust Token study

CONSENT FORM

By signing this consent form, you are not waiving your legal rights or releasing the investigator(s) or involved institution(s) from their legal and professional responsibilities.

Research Project Title:	**Evaluation of trust tokens on the decision to trust in a simulated social network environment.**
Investigators:	Plinio Morita, ***University of Waterloo***
	Catherine Burns, ***University of Waterloo***

I have read the information presented in the information letter about a study being conducted ***Plinio Morita*** of the Department of ***Systems Design Engineering***, under the supervision of Professor ***Catherine M. Burns.*** I have had the opportunity to ask any questions related to this study, to receive satisfactory answers to my questions, and any additional details I wanted.

I am aware that I may allow excerpts from the conversational data collected for this study to be included in teaching, scientific presentations and/or publications, with the understanding that any quotations will be anonymous.

I am aware that I may withdraw my consent for any of the above statements or withdraw my study participation at any time without penalty by advising the researcher.

This project has been reviewed by, and received ethics clearance through, the Office of Research Ethics at the University of Waterloo. I was informed that if I have any comments or concerns resulting from my participation in this study, I may contact the Director, Office of Research Ethics at (519) 888-4567 ext. 36005.

	Please Circle One	**Please initial Your Choice**
With full knowledge of all foregoing, I agree, of my own free will to participate in this study.	YESNO	________
I agree to be video and audio recorded.	YESNO	________
I agree to let my conversation during the study be directly quoted, anonymously, in presentations of research results	YESNO	________

Participant Name: ____
(Please print)
Participant Signature: ____________________________________

Witness Name: ____
(Please print)
Witness Signature: _____________________________________

Date: ______________________________

Appendix AA

Ethics approval for the ethnographic study

Tuesday, November 12, 2013 at 1:05:35 AM Eastern Standard Time

Subject: Ethics Clearance (ORE # 17703)
Date: Wednesday, December 14, 2011 at 9:05:02 AM Eastern Standard Time
From: ORE Ethics Application System
To: Catherine Burns
CC: Plinio Morita

Dear Researcher:

The recommended revisions/additional information requested in the ethics review of your ORE application:

Title: Field observation of trust dynamics and evaluation of Quick Trust Assessment Tool (QTAS)
ORE #: 17703
Faculty Supervisor: Catherine M. Burns (catherine.burns@uwaterloo.ca)
Student Investigator: Plinio Morita (pmorita@uwaterloo.ca)

have been reviewed and are considered acceptable. As a result, your application now has received full ethics clearance.

A signed copy of the Notification of Full Ethics Clearance will be sent to the Principal Investigator or Faculty Supervisor in the case of student research.

****
Note 1: This ethics clearance from the Office of Research Ethics (ORE) is valid for one year from the date shown on the certificate and is renewable annually, for four consecutive years. Renewal is through completion and ethics clearance of the Annual Progress Report for Continuing Research (ORE Form 105). A new ORE Form 101 application must be submitted for a project continuing beyond five years.

Note 2: This project must be conducted according to the application description and revised materials for which ethics clearance has been granted. All subsequent modifications to the project also must receive prior ethics clearance (i.e., Request for Ethics Clearance of a Modification, ORE Form 104) through the Office of Research Ethics and must not begin until notification has been received by the investigators.

Note 3: Researchers must submit a Progress Report on Continuing Human Research Projects (ORE Form 105) annually for all ongoing research projects or on the completion of the project. The Office of Research Ethics sends the ORE Form 105 for a project to the Principal Investigator or Faculty Supervisor for completion. If ethics clearance of an ongoing project is not renewed and consequently expires, the Office of Research Ethics may be obliged to notify Research Finance for their action in accordance with university and funding agency regulations.

Note 4: Any unanticipated event involving a participant that adversely affected the participant(s) must be reported immediately (i.e., within 1 business day of becoming aware of the event) to the ORE using ORE Form 106.

Best wishes for success with this study.

Susanne Santi, M. Math.,
Senior Manager
Office of Research Ethics
NH 1027
519.888.4567 x 37163
ssanti@uwaterloo.ca

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Figure 48: Ethics approval for the ethnographic study

Appendix BB

Ethics approval for the QTAS card-sorting exercise (QTAS study 1)

Tuesday, November 12, 2013 at 1:02:43 AM Eastern Standard Time

Subject: Ethics Clearance (ORE # 17213)
Date: Wednesday, May 18, 2011 at 9:58:11 AM Eastern Daylight Time
From: ORE Ethics Application System
To: c4burns@engmail.uwaterloo.ca
CC: Plinio Morita Morita

Dear Researcher:

The recommended revisions/additional information requested in the ethics review of your ORE application:

Title: Card sorting for filtering the number of trust regulating variables for the development of trust metrics
ORE #: 17213
Faculty Supervisor: Catherine M. Burns (c4burns@engmail.uwaterloo.ca)
Student Investigator: Plinio Morita (pmorita@uwaterloo.ca)

have been reviewed and are considered acceptable. As a result, your application now has received full ethics clearance.

A signed copy of the Notification of Full Ethics Clearance will be sent to the Principal Investigator or Faculty Supervisor in the case of student research.

****

Note 1: This clearance is valid for five years from the date shown on the certificate and a new application must be submitted for on-going projects continuing beyond five years.

Note 2: This project must be conducted according to the application description and revised materials for which ethics clearance have been granted. All subsequent modifications to the protocol must receive prior ethics clearance through our office and must not begin until notification has been received.

Note 3: Researchers must submit a Progress Report on Continuing Human Research Projects (ORE Form 105) annually for all ongoing research projects. In addition, researchers must submit a Form 105 at the conclusion of the project if it continues for less than a year.

Note 4: Any events related to the procedures used that adversely affect participants must be reported immediately to the ORE using ORE Form 106.

Best wishes for success with this study.

Susan E. Sykes, Ph.D., C. Psych.
Director, Office of Research Ethics
519.888.4567 x 36005
ssykes@uwaterloo.ca

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Figure 49: Ethics approval for the card-sorting study

Appendix CC

Ethics approval for the QTAS study identifying the dimensions of the QTAS (QTAS study 2)

Tuesday, November 12, 2013 at 1:04:49 AM Eastern Standard Time

Subject: Ethics Clearance (ORE # 17342)
Date: Monday, June 27, 2011 at 9:50:16 AM Eastern Daylight Time
From: ORE Ethics Application System
To: c4burns@engmail.uwaterloo.ca
CC: Plinio Morita

Dear Researcher:

The recommended revisions/additional information requested in the ethics review of your ORE application:

Title: Development of the Quick Trust Assessment Scale - Data collection 1_copy
ORE #: 17342
Faculty Supervisor: Catherine M. Burns (c4burns@engmail.uwaterloo.ca)
Student Investigator: Plinio Morita (pmorita@uwaterloo.ca)

have been reviewed and are considered acceptable. As a result, your application now has received full ethics clearance.

A signed copy of the Notification of Full Ethics Clearance will be sent to the Principal Investigator or Faculty Supervisor in the case of student research.

****
Note 1: This clearance is valid for five years from the date shown on the certificate and a new application must be submitted for on-going projects continuing beyond five years.

Note 2: This project must be conducted according to the application description and revised materials for which ethics clearance have been granted. All subsequent modifications to the protocol must receive prior ethics clearance through our office and must not begin until notification has been received.

Note 3: Researchers must submit a Progress Report on Continuing Human Research Projects (ORE Form 105) annually for all ongoing research projects. In addition, researchers must submit a Form 105 at the conclusion of the project if it continues for less than a year.

Note 4: Any events related to the procedures used that adversely affect participants must be reported immediately to the ORE using ORE Form 106.

Best wishes for success with this study.

Susanne Santi, M. Math.,
Senior Manager
Office of Research Ethics
NH 1027
519.888.4567 x 37163
ssanti@uwaterloo.ca

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Figure 50: Ethics approval for the QTAS development study

Appendix DD

Ethics approval for the evaluation of the QTAS study (QTAS study 3)

Tuesday, November 12, 2013 at 1:06:04 AM Eastern Standard Time

Subject: Ethics Clearance (ORE # 18096)
Date: Friday, May 25, 2012 at 3:27:46 PM Eastern Daylight Time
From: ORE Ethics Application System
To: Catherine Burns
CC: pmorita@uwaterloo.ca

Dear Researcher:

The recommended revisions/additional information requested in the ethics review of your ORE application:

Title: Evaluation of the Quick Trust Assessment Scale
ORE #: 18096
Faculty Supervisor: Catherine M. Burns (catherine.burns@uwaterloo.ca)
Student Investigator: Plinio Morita (pmorita@uwaterloo.ca)

have been reviewed and are considered acceptable. As a result, your application now has received full ethics clearance.

A signed copy of the Notification of Full Ethics Clearance will be sent to the Principal Investigator or Faculty Supervisor in the case of student research.

****

Note 1: This ethics clearance from the Office of Research Ethics (ORE) is valid for one year from the date shown on the certificate and is renewable annually, for four consecutive years. Renewal is through completion and ethics clearance of the Annual Progress Report for Continuing Research (ORE Form 105). A new ORE Form 101 application must be submitted for a project continuing beyond five years.

Note 2: This project must be conducted according to the application description and revised materials for which ethics clearance has been granted. All subsequent modifications to the project also must receive prior ethics clearance (i.e., Request for Ethics Clearance of a Modification, ORE Form 104) through the Office of Research Ethics and must not begin until notification has been received by the investigators.

Note 3: Researchers must submit a Progress Report on Continuing Human Research Projects (ORE Form 105) annually for all ongoing research projects or on the completion of the project. The Office of Research Ethics sends the ORE Form 105 for a project to the Principal Investigator or Faculty Supervisor for completion. If ethics clearance of an ongoing project is not renewed and consequently expires, the Office of Research Ethics may be obliged to notify Research Finance for their action in accordance with university and funding agency regulations.

Note 4: Any unanticipated event involving a participant that adversely affected the participant(s) must be reported immediately (i.e., within 1 business day of becoming aware of the event) to the ORE using ORE Form 106.

Best wishes for success with this study.

Susanne Santi, M. Math.,
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Figure 51: Ethics approval for the QTAS evaluation study

Appendix EE

Ethics approval for the Trust Token Study at the University of Waterloo

Tuesday, November 12, 2013 at 1:06:23 AM Eastern Standard Time

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Subject: Ethics Clearance (ORE # 18565)
Date: Tuesday, December 11, 2012 at 4:03:48 PM Eastern Standard Time
From: ORE Ethics Application System
To: Catherine Burns
CC: Plinio Morita

Dear Researcher:

The recommended revisions/additional information requested in the ethics review of your ORE application:

Title: Evaluation of trust tokens on social network interfaces
ORE #: 18565
Faculty Supervisor: Catherine Burns (catherine.burns@uwaterloo.ca)
Student Investigator: Plinio Morita (plinio.morita@uwaterloo.ca)

have been reviewed and are considered acceptable. As a result, your application now has received full ethics clearance.

A signed copy of the Notification of Full Ethics Clearance will be sent to the Principal Investigator or Faculty Supervisor in the case of student research.

****

Note 1: This ethics clearance from the Office of Research Ethics (ORE) is valid for one year from the date shown on the certificate and is renewable annually, for four consecutive years. Renewal is through completion and ethics clearance of the Annual Progress Report for Continuing Research (ORE Form 105). A new ORE Form 101 application must be submitted for a project continuing beyond five years.

Note 2: This project must be conducted according to the application description and revised materials for which ethics clearance has been granted. All subsequent modifications to the project also must receive prior ethics clearance (i.e., Request for Ethics Clearance of a Modification, ORE Form 104) through the Office of Research Ethics and must not begin until notification has been received by the investigators.

Note 3: Researchers must submit a Progress Report on Continuing Human Research Projects (ORE Form 105) annually for all ongoing research projects or on the completion of the project. The Office of Research Ethics sends the ORE Form 105 for a project to the Principal Investigator or Faculty Supervisor for completion. If ethics clearance of an ongoing project is not renewed and consequently expires, the Office of Research Ethics may be obliged to notify Research Finance for their action in accordance with university and funding agency regulations.

Note 4: Any unanticipated event involving a participant that adversely affected the participant(s) must be reported immediately (i.e., within 1 business day of becoming aware of the event) to the ORE using ORE Form 106.

Best wishes for success with this study.

Susanne Santi, M. Math.,
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Figure 52: Ethics approval for the trust token study

Appendix FF

Ethics approval for the studies conducted at Kyoto University

（様式3）

審査結果通知書

平成25年3月22日

機械理工学専攻長　殿

京都大学大学院
工学研究科長
北　野　正　雄

平成25年2月1日付けで申請のありました研究計画の審査結果について、下記のとおり通知します。

記

1. 課題名	チーム活動を特徴づける信頼統制因子の抽出（受付番号：２０１３０５）
2. 研究責任者	所属：　機械理工学専攻 職名：　教授 氏名：　椹木　哲夫
3. 審査結果	■承認 □条件付承認 □変更の勧告 □不承認 □非該当
条件付承認、変更の勧告、不承認、非該当の場合の理由等	

※審査の結果に異議がある場合は、審査結果通知書を受領した日の翌日から起算して2週間以内に再審査を求めることができる。（要項第6）

Figure 53: Ethics approval for the studies at Kyoto University

Appendix GG
Publications during candidature

Submitted Manuscripts

Morita, P. P., Horiguchi, Y., Sawaragi, T., & Burns, C. M. (submitted). Designing for cross-cultural trust: What are the real differences when trusting? Submitted to *Computers in Human Behaviour*.

Morita, P. P., & Burns, C. M. (submitted). Trust Tokens: Insights for fostering interpersonal trust through interface design. Submitted to *IEEE Transactions on Human-Machines Systems*.

Morita, P. P., & Burns, C. M. (submitted, in revision). Towards a Quick Trust Assessment Scale (QTAS) – Measuring Trust in Collaborative Environments. Submitted to *Ergonomics*.

Journal Articles

Morita, P. P., & Burns, C. M. (2014). Trust Tokens in Team Development. *Team Performance Management*, 20(1/2), 39-64.

Morita, P. P., & Burns, C. M. (2012). Understanding “interpersonal trust” from a human factors perspective: insights from situation awareness and the lens model. *Theoretical Issues in Ergonomics Science*, *15*(1), 88–110.

Conference Papers

Görges, M., Morita, P. P., Burns, C. M., & Ansermino, M. (2013). Mobile patient monitoring for the pediatric intensive care unit - Work domain analysis and rapid prototyping results. In *SMC 2013: The International Conference on Systems, Man and Cybernetics* (pp. 3765-3770).

Morita, P. P., & Burns, C. M. (2013). Designing for Interpersonal Trust – The Power of Trust Tokens. In *Proceedings of the Human Factors and Ergonomics Society Annual Meeting* (pp. 339–343).

Morita, P. P., & Burns, C. M. (2013). Development of Technologies for Supporting “Trust” in an ICU Environment. In *2012 Canadian Student Health Research Forum (CSHRF)*. Winnipeg, Manitoba: June 12-14. [Poster].

Morita, P. P., & Burns, C. M. (2011). Occurrence detection and selection procedures in healthcare facilities: a comparison across Canada and Brazil. In *Studies in health technology and informatics* (pp. 232-237).

Morita, P. P., & Burns, C. M. (2011). Situation awareness and risk management understanding the notification issues. In *Studies in health technology and informatics* (pp. 372-376).

Morita, P. P., & Burns, C. M. (2010). Adverse events investigation – Importance of conducting a thorough, complete investigation process. In *Halifax 10: The Canadian Healthcare Safety Symposium: Halifax, Nova Scotia. October 21-23.*[Poster].

Morita, P. P., Burns, C. M. & Calil, S. J. (2009). The Influence of Strong Recommendations, Good Incident Reports and a Monitoring System over an Incident Investigation System for Healthcare Facilities. In *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, *53*(22), 1679–1683.