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The Trust Game: The Influence of Trust on Collaboration in the Light of Technological Innovations

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Abstract. Adopting innovations is key for organizations to compete in a complex system, such as the transportation system. In a complex system where social (e.g. organizations) and technical (e.g. information systems) interact with each other, collaboration can be challenging. One of the barriers identified that hampers collaboration is trust. To understand the influence of trust on collaboration, enabled by technological innovations, simulation games in our perspective are a suitable method for our study. First, we introduce the results of a literature study that was carried out to identify related work regarding trust and simulation games. Subsequently, a case from the transport sector is defined to serve as a basis for the trust game. To conclude, we illustrate our simulation gaming approach and discuss the first initial results of a playtest session with the Trust Game.

Keywords: Trust · Collaboration · Technological innovations · Simulation games · The Trust Game

1 Introduction

Understood as competitive advantage, socio-technical innovations are becoming more and more interwoven within and between organizations [1]. The implementation of an innovation usually has large impacts on any organization. In a complex system where social (e.g. organizations) and technical (e.g. inter-organizational information) systems interact with each other [2], the adoption of innovations can lead to changes in business structures. While socio-technological innovations provide advantages for organizations, they can also increase the complexity of the system, i.e. technological innovations often transcend organizational boundaries [3]. The implementation of an innovation is a risky undertaking, yet could lead to a competitive advantage. Organizations are facing the dilemma as to use an innovation for competition yet at the same time needing the collaboration with actors that could be competitors. Different to traditional, simple technical innovations, the implementation of socio-technical innovations in complex systems requires actors to collaborate in an innovation network.

In our study, we work with the example of the innovation truck platooning that is currently tested in the Netherlands. We use this case to illustrate the challenges that are

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related to the implementation of a socio-technical innovation within a complex system such as the system of transportation and mobility. The concept of truck platooning can be described as trucks that drive closely together, supported by communicating technologies [4]. Truck platooning provides advantages for the transportation sector, as it allows truck operators to react on future truck driver shortages and reduce fuel consumption. Its contribution can be seen in an increased safety on the road and the decrease of carbon emission. To be able to platoon, different organizations need to collaborate. Truck operators need to share travel speeds, departure times and destinations [5]. The sharing of this information means a huge difference to traditional ways of working together in a supply chain, where information sharing is scarce, and seen as possible threat to competitive advantage. To take advantage of the positive effects of truck platooning, collaboration within the transportation system becomes vital. On the other hand, we see that in complex systems, collaboration can be challenging and is hampered by a lack of trust. The importance of trust in the transportation sector is slowly becoming emergent, however, is not self-evident.

The transportation domain is a sector where simulations and games represent accepted instruments of decision-support [6], training, and exploration [7, 8]. Games can be used to investigate individual choices of actors. They enable both actors and researchers to explore possible actions as well as observing the consequences of actions and decisions in different scenarios. Transportation is a complex, dynamic system, and games are able to represent this socio-technical system [9] and make it explorable.

The aim of this paper is to show a simulation gaming approach to translate the concept of trust and to increase the awareness of the influence of trust on collaboration when using technological innovations. By using a simulation gaming approach, we will a) qualitatively conceptualize the concept of trust in socio-technical systems, based on the transportation related case of truck platooning, and b) create awareness on the role of trust amongst actors within the transportation domain.

The remainder of this paper is structured as follows. First, the importance of trust in complex socio-technical systems is introduced together with the case study of truck platooning. Subsequently, we discuss and analyze previous simulation gaming studies on trust to identify the knowledge gap we address, and to locate our study in the light of related work. The theory and design of the Trust Game are discussed in Sect. 3, following by the first initial results. Following from these results we discuss the limitations of certain game mechanics, e.g. strategy cards and the balance of the game environment, as well as the role of researchers as players in the game. We conclude with a discussion and a future outlook based on the first initial results of game play session with the Trust Game.

2 Trust, Innovation and Complex Systems

Adoption of innovations can provide advantages for organizations, such as increased efficiency. However, it can also increase the complexity, as innovations can have a certain impact on the structure of an organization. Thus, the role of trust with regard to complex, socio-technical systems is an ambivalent one. On the one hand, trust can reduce complexity for organizations [10, 11], can decrease transactions costs and limit

uncertainties regarding innovations [12]. For example, truck operators have an expectancy that other actors will be reliable and behave in a good-faith effort when collabo rating. By this expectancy truck operators can partially predict how others will behave and this can reduce complexity as well as the negotiation time, i.e. not every detail needs to be discussed. One the other hand, a certain level of risk is involved when trusting an organization [10, 14]. Risk in this context is related to the other party [15]. Organizations might need to collaborate and share sensitive information with competitors. Competitors might act opportunistically and misuse information; trust in the actor is then misplaced.

The ambivalence of the concept of trust can also be illustrated by its relationship to distinct elements of a system. According to McKnight et al. [13], trust can for example be characterized on two levels, which are trust in people and trust in technology. Following this dichotomy, trust in people can be described as the expectation in the behavior of other individuals, groups or organizations. Trust in technology can be defined as the expectation that an IT artifact will operate as intended. Another approach describes trust as an actor's expectancy [14, 15], meaning that one actor has certain expectations towards the actions of another actor. Trust can be built in case these expectations are confirmed. Not every relationship requires the same amount of trust [14]. Trust is a dynamic phenomenon and is not necessarily reciprocal, i.e. organization A can trust organization B, not necessarily meaning that B needs to trust organization A. Additionally, trust is context dependent [16, 17] and occurs in environments where risks and uncertainties exist.

In summary, we will apply following definition of trust in socio-technical systems: trust is an expectation of an organization that fulfills its obligations, behave in a predictable manner, and will act and negotiate fairly [18]. In our study, we focus on the influence of trust when organizations collaborate by the means of technological innovations. One of the technological innovations that is currently tested in the transportation sector is truck platooning. Truck platooning, as already mentioned, can be described as multiple trucks that drive with a fixed inter vehicle distance via communication technology. Truck platooning promises to come with advantages with regard to CO2 emission, congestion, and travel times [4]. In order to form and drive in a platoon, organizations, such as truck operators, need to collaborate.

To illustrate the process of platooning, we will briefly describe a possible scenario, in which truck operator A needs to transport valuable goods from Rotterdam to Duisburg. Via a service provider, truck operator A checks whether other organizations need to go into this direction too. As it turns out, organization B and C also need to go to Duisburg. To form a platoon, all actors would need to collaborate, and trust each other. Questions that arise are for example whether organization A trusts organization B and C, whether all organizations provide the correct information to each other, and whether all organizations will show up on time in order to platoon. As aforementioned, the importance of trust in the transportation system is not self-evident. It is based on a number of factors that could influence the level of trust between the parties, such as earlier experiences with each other. To show the importance of trust on collaboration when transportation experts are using technological innovation, simulation games are chosen as method.

2.1 Simulation Games on Trust

Simulation gaming is a powerful research tool that can make complexity of systems more understandable for actors as well as for researchers [19, 20]. Simulation games allow us to establish a safe environment where we can experiment, e.g. with low trust and high trust environments when actors need to collaborate by means of technological innovations. Moreover, simulation games are an appropriate tool to study a social, dynamic phenomenon in a complex system [20]. They enable us to represent a phenomenon like trust in an interactive and more understandable manner for (transportation) experts.

The concept of trust has already been addressed by different types of simulation games. Table 1 illustrates a brief overview of related simulation games that address the concept of trust. As one can see from the table, most of these studies use the prisoner's dilemma as the basis of their games. The prisoner's dilemma allows scholars to study the decision making on whether or not to collaborate. As argued in these studies, trust can be of influence when deciding to collaborate. However, in our perspective, the influence of trust on the interaction patterns when collaborating by means of technological innovations is not studied yet. Nonetheless, from these studies certain mechanisms can be derived that are interesting to create a trusted-distrusted environment. For instance, as shown by Meijer et al. [21], non-visible transactions and a reward system for cheating can already create a distrusted environment or an environment where trust can be decreased.

Table 1. Overview of simulation games that address trust

Study	Goal of the simulation game	Theory/Concepts	Game mechanisms
Berg et al. (1995)*	*The investment game.* To study trust and reciprocity in an investment setting	Prisoner's dilemma	Non-cooperative environment, anonymity
Meijer et al. (2006)	*Trust and Tracing game.* Learn about the influence of social structures on transaction in a trade network	Netchains, governance mechanism, value creation, social structure	Cheating behavior is rewarded, non-visible transactions, Misaligned information, Reputation
Ebner & Winkler (2008)	*PASTA WARS.* Players can experience the key obstacles while cooperating	Four way prisoner's dilemma	Role descriptions, No communication between participants, Single player strategy
Oertig (2010)	*Knowledge sharing simulation game.* Players can experience the fragility of trust when sharing knowledge in a global virtual team	Prisoner's dilemma	Non-cooperative game, Company description, Conflicting goals, Reward system

*Note: Multiple simulation games are grounded on this study (see for an overview Johnson & Mislin, 2011)

Nevertheless, the translation of an ambivalent concept as trust into a simulation or a simulation game can be challenging, and is context depended. As shown, trust can occur in different interactions and is not necessarily reciprocal. In our study, we only focus on inter-organizational trust, i.e. an organization's expectancy that another organization behaves in a reliable and in good-faith effort during collaboration.

3 The Trust Game: A Simulation Gaming Approach

3.1 Design Considerations of the Trust Game

To create awareness among practitioners from the transportation and logistics domain on the role of trust regarding collaboration and innovation, we adopt the Triadic Game Design philosophy of Harteveld [22]. This approach is based on the balancing of three worlds; reality, meaning and play. The 'real' system, in this case the transport system, and the case of truck platooning, is represented in the world of reality. The purpose, or meaning, of the game, is defined as creating awareness for the role of trust in such complex system, and when collaboration has to be established based on a socio-technical innovation (in this case, truck platooning). The aspect of play is focused on the game world, such as the game mechanics and elements.

Developing a simulation game where the concept of trust is central, we started from the reality aspect. As aforementioned, we focus our research on the transportation sector. To create a deeper understanding of the characteristics of the transportation sector, we first conducted a system analysis. Derived from scientific and grey literature, information streams, business processes and actors in the systems could be identified. Based on the business process modelling approach, the actors and their processes are visualized through swimming lanes. Our analysis shows that business processes are highly interdependent and aligning processes and decisions can be challenging. Based on the system analysis, we can decide which roles in the game should be represented. As truck platooning serves as the technological innovation where we can study the role of trust on collaboration, we also looked into this innovation in particular. Truck platooning is not yet implemented in reality. To let transportation experts experience the influence of trust while truck platooning, we defined a future scenario where truck platooning is implemented as transport mode for the distribution of goods via the road. The purpose of this game is not only to study the role of trust on collaboration but also to create awareness among practitioners.

In its current state, the Trust Game is a physical game (Fig. 1). From a meaning and play perspective, a physical game allows us to study trust by observing the communication and discussion of the players. Certain game mechanics are used, such as strategy cards, shielding of the resources and assets of the players. The game material relates to the real system and creates an environment where trust can be explored.

The Trust Game is part of a game session consisting of an introduction to the new socio-technical innovation of truck platooning, the game play itself, and a debriefing phase. It is a round-based game, where goods from Rotterdam to different hinterland locations (i.e. Bremen, Hannover, and Frankfurt am Main) need to be transported. The overall goal of the game is to match trucks to form a platoon in order to transport goods

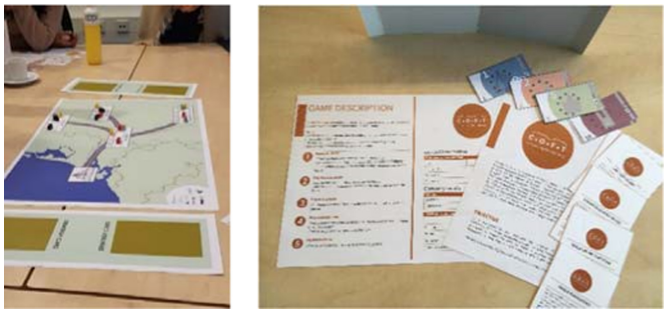

Fig. 1. Prototype of the Trust Game

from Rotterdam to the hinterland locations. As a result of the system analysis, we defined four roles of -small to medium sized-truck operators to be played by one player respectively. Each of the four players receives information of the company, e.g. a description of the company, the particular company assets, individual goals, and the experiences reputation of other player's roles. Especially the latter is to create a situation where relations to trusted as well as distrusted parties are already established. In that sense, the game starts from a predefined situation that supports the research aim. In the game a differentiation in truck types and positions, i.e. lead and follow trucks, is made. At the beginning of the game, each of the players receives his/her own amount of follow and lead trucks. Lead trucks earn a higher income, while the revenue for the follow trucks decreases with their position in the platoon. The last truck earns the least amount of money. Trucks can be used throughout the whole game, but only within the limitations of the given number for each truck type. Thus, players face the dilemma of choosing between costs and revenue, and have to evaluate the most beneficial situation between lead and follow trucks throughout the whole network. During each round, more than one platoon can be formed by the players. Players receive their own personal goal, i.e. distribute the goods from origin to destination with the highest profit possible. To be successful in the game as a player, you need to transport all the goods by means of a platoon and have the highest profit. One facilitator accompanies the game play. The function of the facilitator is to manage the time and resources, and to observe the players' actions and decisions for the debriefing phase.

Fig. 2. Game sequence of the Trust Game

The Trust Game consists of 5 phases, each with its own processes, as illustrated in Fig. 2. A game round starts with the Decision phase. During this phase, players can check to which city they need to transport goods to. Additionally, players need to

decide whether they want to be a lead truck or follow truck to the specific locations and players need to select one of their strategies that they want to play. The strategy cards in the game represent issues such as truck driver shortages, takeover of truck drivers, or changing the platoon spot. The information that is represented on the strategy cards is based on scientific and grey literature, thus strongly relating to the reality aspect of the game. Secondly, players engage with each other in the Negotiation phase. To form a platoon there needs to be a lead truck, i.e. a truck with a certified truck driver, and follower trucks, i.e. trucks that have uncertified truck drivers. To arrange the order of a platoon, players in the game need to negotiate and make an agreement. Next follows the Payment phase. During this phase, players get paid according to their spot in a platoon. The player who is a lead truck receives more compared to a player who is a follower truck. The fourth phase in a game round is the Strategy phase. During this phase, players can play their strategy card. On these cards the actions are described including their possible consequences for other players. After all strategy cards are played, and all consequences are administered, the round concludes with the fifth and final phase, the Payment phase. Based on the action cards played, players need to pay other players a certain amount as stated on the respective strategy card.

3.2 Set Up of the Game Play Sessions

The Trust Game has been played during a session with six game design and transportation experts to validate the design of the game with regard to its playability and relation to the concept of trust. The experts were invited to a game play session consisting of two games, both focused on truck platooning as innovation. While the first game focuses on the challenges of a technical innovation itself, the Trust Game aims at exploring and creating awareness for the role of trust in such innovation process in particular. The participants first received a brief introduction on the technology of truck platooning, after which the first game was played for about one hour. After a short break, the Trust Game was introduced. After the game play, which took about one and a half hours and consisted of three rounds with sub-steps as described above, a debriefing was held on the game experience, and on aspects that could be improved in the light of the meaning of the game. The first round of the game was played as a tutorial round, to learn about the game play. After three rounds, the player with the largest amount of money was announced as winner of the game. The debriefing after the game play was prepared with questions on the mechanics in the game related to the concept of trust. Two researchers involved in this study participated in the game play. One took over the role of the facilitator, the other joined the game play, without knowing the game beforehand. Both also observed the actions and decisions of all players, and took notes.

3.3 Initial Results of the Playtest

While during the design of the game, we encountered that capturing trust as a concept in a game is challenging, the qualitative analysis of both game play and debriefing revealed that the players were able to identify trustworthy and untrustworthy situations, and what mechanics lead to higher or lower trust. The Trust Game aims to study the

influence of trust on collaboration by using technological innovations. Following from the feedback of the playtest session, the assessment whether or not to collaborate in the negotiation phase could be more addressed in the game. The players identified that the strategy cards and the information (i.e. reputation of other players) they received had an impact whether or not they trusted another player during negotiations. However, the strategy cards created in some circumstances a locked-in situation that influenced negotiations. For example, information was given about preferred parties to collaborate with, and others not to work with. As some players followed this information very strictly, others were excluded from certain negotiations, without having any action available to change this situation. To overcome this issue a narrative, trade-offs and consequences of a decision could be provided. By stipulating a more complex environment for decision-making, the collaborative assessment during the negotiation phase could be more substantiate to players.

From the game play session, we see that a game with a low trusted can get demanding, especially for players who are locked in a less preferable situation. During game play this was also expressed by the players as somehow frustrating experience. On the other hand, we could observe that the game was able to evoke strong situations that can be used in a debriefing phase. For less frustrating game play and for studying the influence of trust in an innovation process, an updated version of the game will represent a more balanced trust environment. For instance, the first three rounds can be a low trusted environment whereas the last two rounds can be a high trusted environment. The transitions between the low trusted environment and high trusted environment can be established by positive and negative strategy cards. This will enable us to even better identify trust mechanisms that play a role in collaboration supported by technological innovation.

4 Conclusion and Future Research

The concept of trust is a hard to capture in a simulation game because of its stratification. As shown in this paper, various simulation games have been designed that represent trust as an (central) element. Most of these games use the prisoner's dilemma game approach that is grounded on rational decision making. However, trust is not only based on rational decision making as it can emerge at different stages and is influenced by emotional, cognitive and behavioral elements [14]. In our perspective, a simulation gaming approach that is based on the TGD philosophy allows us to explore and create awareness for the role of trust in a complex, socio-technical system. Additionally, it allows us to study the influence of trust, as a whole, on the interaction patterns in an innovation process.

The first results of the Trust Game showed that a low trusted environment could be created, in which it is difficult to establish collaboration. The playtest session gave us valuable insights how trust can be addressed in a simulation game and how the different game mechanics should be balanced. One of the limitations of the playtest session was that the researchers of this study took over the role of the facilitator in the game play as well as the role of one of the players in the game. For instance, the facilitator and researcher as player could influence the game play. Yet, as the Trust Game is still under

development, we took over these roles with the purpose to being able to directly observe the game mechanics and playability of the game. In future sessions, researchers will not take over in-game roles anymore, but observe what happens during game play. Yet, the role of facilitator can still be of value for research, as this role provides control over the quasi-experimental situation of the game play.

In the future development of the game, we will adjust the Trust Game based on the feedback that we received from the playtest session. In its current state, trust is qualitatively measured by observations and a debriefing. In future work we will design quantitative measurement mechanisms based on trust characteristics, such as fulfillment of obligations, reliability and opportunistic behavior. Subsequently, game experiments will be designed grounded on a conceptual model of trust in a complex, socio-technical system. According to the results of the various experiments that will be conducted with transport experts, the conceptual model of trust will be adjusted.

The final aim of the research, of which this study represents a vital corner stone, is to create a better understanding of trust in a socio-technical system in the context of trust on collaboration in an innovation process.

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