The organization of transactions: research with the Trust and Tracing Game

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Abstract
This paper presents empirical results of research on the influence of social aspects on the organization of transactions in the domain of chains and networks. The research method used was a gaming simulation called the Trust and Tracing game in which participants trade commodity goods with a hidden quality attribute. Previous sessions of this gaming simulation identified a list of variables for further investigation (Meijer *et al*, 2006). The use of gaming simulation as data gathering tool for quantitative research in supply chains and networks is a proof-of-principle. This paper shows results from 27 newly conducted sessions and previously unused data from 3 older sessions. Tests confirmed the use of network and market modes of organization. Pre-existing social relations influenced the course of the action in the sessions. Being socially embedded was not beneficial for the score on the performance indicators money and points. The hypothesized reduction in measurable transaction costs when there was high trust between the participants could not be found. Further analysis revealed that participants are able to suspect cheats in a session based on other factors than tracing. Testing hypotheses with data gathered in a gaming simulation proved feasible. Experiences with the methodology used are discussed.

Keywords: gaming simulation, social relations, trust, transactions, supply networks

1. Introduction

Chain and network sciences is a stream of research that focuses on an application domain rather than on an aspect domain. Aspects to be investigated range from pure technology to social relationships. A typical consumer good has been traded in a series of transactions before it reaches the consumer. The sequential businesses involved in the supply of the good can be viewed as one *supply network*. Focusing on the actual route of a particular product through the network identifies the *supply chain* of this good. Typically, the aspects are not investigated independently but in an interdisciplinary approach. Interdisciplinary research requires research methods suited for studying multiple aspects simultaneously. Meijer *et al* (2006) presented a gaming simulation that made participants learn about transactions and embeddedness in a trade network. In the discussion the authors identified a need to collect more data to answer specific questions about what drives the course of the game sessions. They listed a series of variables that could be of value for research in the simulated supply network. The current paper is the result of continued research into the variables identified using the Trust and Tracing game (T&T game) by playing 27 additional sessions and using quantitative data analysis.

The next section describes the methodological contribution. The current paper is showing a proof-of-principle of using a gaming simulation for quantitative research in the chain and network domain. Section 3 introduces the theoretical framework and hypotheses, based on New Institutional Economics. Materials and methods are in Section 4. Section 5 analyses the data gathered and Section 6 provides a discussion of the results and methodology used. Finally, Section 7 draws conclusions.

2. Methodological contribution

In the present study, gaming simulation is used as a quantitative research method. Although gaming simulation is widely used as a training instrument, its application as a data-gathering tool is relatively new. The incorporation of social variables and the application in the domain of chains and networks are contributions of this paper. The objective is to test if the method works for quantitative testing of hypotheses in this domain.

Duke and Geurts (2004) emphasize that the gaming simulation approach is relevant for strategic problem solving. It enables decision makers to analyse a multi-agent, multi-faceted real-world problem. In the approach of Duke and Geurts the decision makers are most often participants in the gaming simulation themselves. The effectiveness of gaming simulation for learning has been demonstrated in different settings, though it lacks a shared evaluation structure amongst them (Gosen and Washbush, 2004). The most prominent application has been for learning insights in complex problems (Druckmann, 1994). Authors that document cases of using the method, e.g. Duke and Geurts (2004), and Wenzler (2003), received good results for the problems at hand.
Gaming simulation as a data gathering tool for research is a logical extension, since it does not require any adaptations to the practices of Duke and Geurts (2004). In their *27-step guide to a successful gaming simulation* they emphasize the importance of operationalizing the key concepts used in a gaming simulation. Operational (and measurable) concepts are therefore required. Few authors recognized this opportunity to analyse behavioural change with a gaming simulation. Roelofs (2000) tested a mapping technique for structuring policy issues using a gaming simulation as a test bed. The approach is similar to the one used in the present paper as she explains behaviour within a session with data gathered in a gaming simulation, but she differs in the nature of the data (qualitative), the study domain (policy research) and the absence of explanatory models about why something happened. The methodology of Roelofs (2000) can be seen as the qualitative predecessor of the one used in the present paper. Kuit *et al* (2005) used a computer supported gaming simulation to investigate strategic behaviour in a deregulating energy market. Their model is numeric but their data collection, results and conclusions are based on qualitative observations of participants' behaviour. De Caluwe (1997) researched an organizational culture intervention using a gaming simulation as an intervention tool. The data used were not collected from within the sessions but from interviews and questionnaires ex ante and ex post the intervention. The CIRAD institute uses combinations of participative development of multi-agent (computer) models and role-playing games (Barreteau, 2003). They do not use raw data from the role-playing games directly, but only the (qualitative) reactions of participants to help modelling the computer models.
Within the domain of chains and networks a few gaming simulation approaches come close to the method used in the current paper as there is a growing amount of computer based chain simulations used for training (Meijer and Hofstede (2003a, Van Liere, 2006). The computer based gaming environment facilitates quantitative data collection about behaviour in a gaming simulation. The authors do not know about any gaming simulation that tries to explain why participants act like they do in a session with quantitative data collected in the same session. Hofstede *et al* (2003) developed a computer-based chain game for distributed trading and negotiation. This tool promised to facilitate data-gathering from actual sessions but has not been applied in actual research projects. A second difference is the absence of face-to-face negotiation in a computer environment inhibiting the emergence of real-world social relations in a session.

3. Theory

The variables mentioned in Meijer *et al* (2006) have different meanings depending on the theory used, as they stem from different bodies of knowledge, like economics, sociology and psychology. Section 4.4 lists the variables in detail and the way they are measured in this paper. There is no single theory that explains the relation between these variables. Focussing on one or two variables opens disciplinary discussions that are valuable, but prohibits an integrative approach explaining the behaviour in the (simulated) supply chain. Therefore a framework is needed to link theories.

Williamson (2000) introduced a four-level framework linking theories with a very different scope as the framework for analysis of New Institutional Economics (NIE) (Figure 1). Each of the levels changes about ten times as fast as the level above. Williamson calls the top level "social embeddedness", though this term is used differently from its use in other theory. As he lists customs, traditions, norms and informal institutions this level can be called 'culture'. Culture can be defined as "the collective programming of the mind that distinguishes the members of one group or category of people from others" (Hofstede and Hofstede, 2005, pp 4). Culture in this sense is acquired in the early years of a person's life. Culture changes in centuries or even longer. Williamson (2000) calls the theory used on this level 'social theory'. Culture influences the second level, the institutional environment. At this level the formal rules of a trade community appear, often as the legislative environment of a country. Hence the theories used on this level are economics of property right and positive political theory. Changes occur in times of tens to one hundred years.

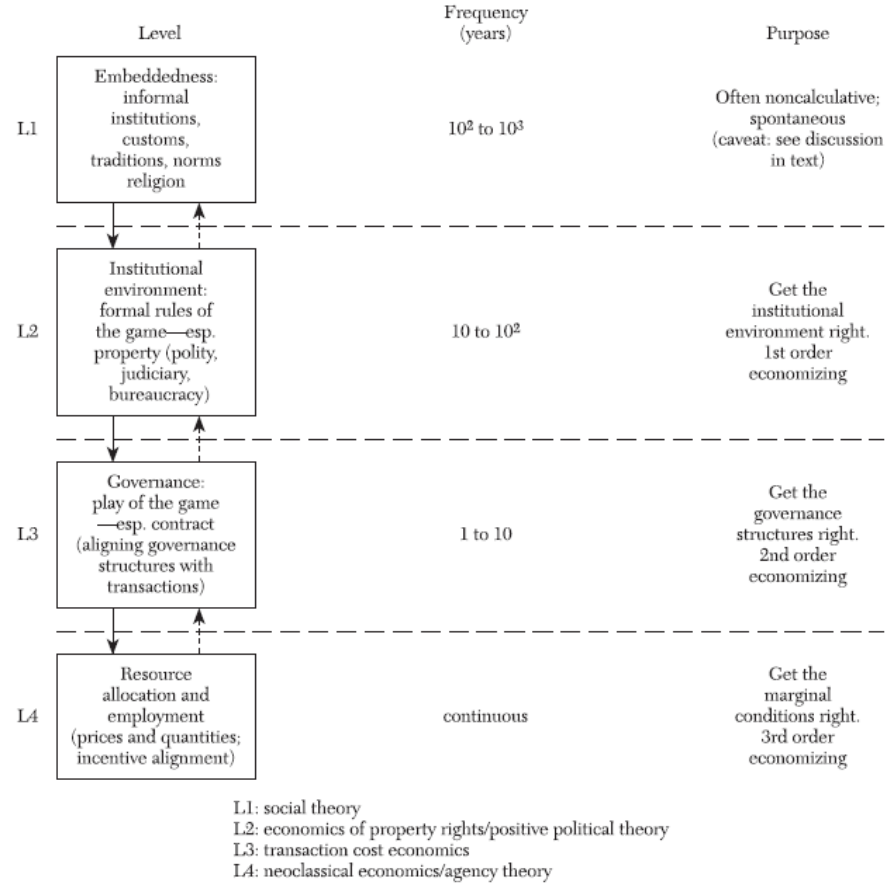

Figure 1: Four-level model of Williamson (2000)

Level 3 consists of the governance structure. Williamson (1996, p. 12) defines governance structures as ways to implement order for facing potential conflicts that could threaten opportunities to realize mutual gains. Hendrikse (2003) is more concrete in his definition as a

collection of rules, institutions and constraints structuring the transactions between the various stakeholders. Coase (1937) grouped arrangements of a structure under the expression “institutional structure of production”, while Williamson speaks of “mechanisms of governance”. Menard captures the same ideas under the generic expression “modes of organization”. Menards term will be used here, as it makes clear the focus on the organization of transactions researched using the T&T game.
There are three archetypical modes of organization: market, hierarchy and network (Powell, 1990, Figure 2). The market mechanism is characterized by single-term transactions. Buyers and sellers constantly seek for the best product for the best price and move to another trade partner if that is financially attractive. Costs and benefits are determined by the supply and demand curve and result in an optimal equilibrium price in case of a perfect market. The hierarchy mechanism uses contracts of some duration in which one party purchases production capacity from the other. Ultimately this means that the seller becomes an employee of the buyer. The network mechanism uses repeated transactions between independent companies or, more likely, between people in those companies. These business relations transcend the immediate business context, and shape mutual expectations on behaviour that will not harm the trade partner. The triangle shape of figure 2 indicates that a real-world mode of organization will be a mixture of the three archetypical modes, represented as a dot somewhere in the triangle.

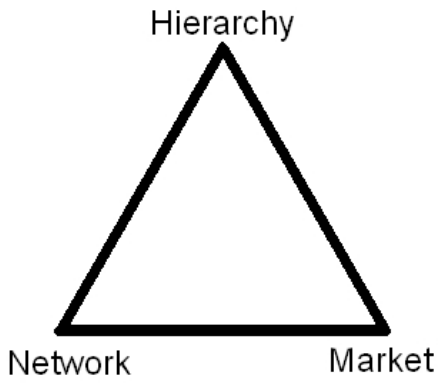

Figure 2: Modes of organization (Diederen and Jonkers, 2001, after Powell, 1990). The corners are pure forms. The triangle spans a space of possible mixed forms.

Menard (2005) uses the name 'hybrid arrangements' as the third term instead of network, but mentions this term is not fully satisfying. He sees hybrids as a range where “*at one end of the spectrum, close to market arrangements, hybrids rely primarily on trust: decisions are decentralized and coordination relies on mutual 'influence' and reciprocity. At the other end, hybrids come close to integration, with tight coordination through quasi-autonomous governing bodies or 'bureaus' sharing some attributes of a hierarchy.(...) Between these polar cases, mild forms of 'authority' develop, based on relational networks or on leadership. Relational networks (...) rely on tighter coordination than trust, with formal rules and conventions based on long-term relationships, on complementary competences, and/or on social 'connivance' (Powell et al., 1996).*” This paper uses the term 'network' as the T&T game allows for appearance of trust-based and relational network-based hybrid arrangements only, staying away from added complexity of trader-external institutions.

On this level 3 the embeddedness takes place that is discussed by Granovetter (1985). Granovetter distinguishes between theories that use under-socialized and over-socialized explanations of economic action within social theory. Embeddedness theory, instead, acknowledges that ongoing networks of social relations between people discourage

malfeasance. People guide their choices based on past interactions with people and continue to deal with those they trust.

At level 4 the actual business happens. Here is a constant flow of contracts and transactions going on. On this level the actual transaction costs are made, as (medium to short-term) contract negotiations and transactions cause the spending of time and money. The mode of organization determines the structure of the transaction costs. For each contract between traders in a supply chain involving one or many transactions there are costs of searching, bargaining, monitoring and enforcing (Williamson, 1985; Coase, 1937). These transaction costs do not add value to a product and should be minimized through an appropriate mode of organization. Williamson (1985) linked transaction costs and the mode of organization through what he called the “discrete alignment principle”: traders will adopt the mode of organization that fits better with the attributes of the transaction at stake. In doing so, Williamson provided a way for empirical studies to go around the difficulty of measuring transaction costs directly, making organizational form the dependent variable (Menard, 2005).

New Institutional Economics is principally concerned with levels 2 and 3 of figure 1. But Williamson recognizes that NIE cannot ignore level 1, although '*level 1 is taken as given by most institutional economists*'.

From observations of sample 1, Meijer *et al* (2006) concluded that in T&T sessions the dominant mode of organization is Network. Transactions were organized through repeated transactions with the same business partners, and sessions had been observed where trade was divided in language groups. To check this quantitatively in the new session, hypothesis 1 is formulated:

> Hypothesis 1: The dominant mode of organization in the T&T game is network, not market.

The design of the T&T game makes that every session by default starts with the market mode. Actual trade between people with possibly pre-existing relationships makes that the network mode can emerge from subsequent transactions. The hierarchy mode is not accounted for in the design of the T&T game, and can only manifest itself via pre-existing dominance relationships. The experimental session set-up (Section 4.2) avoided hierarchy through selection of the participants.

What indicators can be used to indicate whether the mode of organization is network or market? Menard (2005) mentions trust and relational contracting as two drivers for the network mode.
Assumptions of a (perfect) market mode are:
- perfect information about supply and demand at no cost;
- a product that can be compared to any other item in the same market, i.e. a commodity;
- buyers will prefer the lowest priced item of two comparable products;
- no preference for a trade partner.

Contrasting these assumptions are the following assumptions of a trust and/or relational contracting-based mode:
- there are preferred trade partners for other reasons than price;
- trade depends on economic AND relational factors.

The assumptions lead to two tests that can confirm or reject hypothesis 1:

a. there will be no preference for a trade partner;
b. the results at the end of a session depend on economic and relational factors.

Section 5 describes the tests and the outcomes.

Lazzarini *et al* (2001) introduced six sources of value improvement for supply chains and networks. Meijer *et al* (2006) state that the 'social structure' category was most manifest in the T&T game in six variables: number of participants, language, group identity, culture, professional relationships and personal relationships. The social structure in a chain consists of many relations between agents. There is a multitude of aspects involved in judging the quality of the relations. As said before, the professional and personal relationships are two viewpoints, but also language and group identity, e.g. different studies, can divide people into groups. Culture (Hofstede and Hofstede, 2005), and more specifically the uncertainty avoidance factor, moderates the attitude of groups towards people from a different group. Do you trust people you don't know? And does it matter if somebody is from a different group? Rousseau *et al* (1998) show that economists, psychologists and sociologists tend to work with different conceptions of trust. This paper adopts the compromise definition presented by Rousseau *et al.* (1998, p.395): *Trust is a psychological state comprising the intention to accept vulnerability based upon positive expectations of the intentions or behaviour of another.*

The keyword in this definition is *vulnerability*. Trusting people means that you do not need to take the trouble of checking on them, accepting the chance that they might cheat on you. Trust without vulnerability is gratuitous. This implies trust can only increase gradually through being tested in situations of reciprocal interdependency (Hofstede, 2003).

The importance of trust for supply chains and networks is widely accepted (Harland, 1999). Camps *et al* (2004) show that absence of trust is a reason for failure for supply chain projects. Trust is a key concept to be able to have a relationship (Pimentel Claro *et al*, 2004). Nooteboom *et al* (1997) stress that trust enables partners to manage risk and opportunism in transactions. Powell (1990) says that trust helps to reduce complexity in transaction making. Anderson and Narus (1990) explain that trust reflects the extent to which negotiations are fair and commitments are sustained. Uzzi (1997) shows that close relations (embedded relations as he calls it after Granovetter, 1985) with high trust are of key importance in the New York fashion industry. In New Institutional Economics trust becomes operational via the transaction costs. Uzzi (1997) showed that searching and monitoring of complex transactions was less needed with trusted partners. Being over-embedded however caused lock-in situations where it was impossible to do business or exchange information with new business partners. This leads to the formulation of hypothesis 2:

Hypothesis 2: High trust between traders in a network reduces transaction costs.

Both Menard (2005) and Williamson (2000) believe that transaction costs are notoriously hard to measure. In the T&T game one form of transaction costs (the checking costs) are modelled in a measurable way. The other forms of transaction costs are emergent and express themselves in the mode of organization. To confirm the hypothesis while overcoming the measurement obstacle, three tests will be done.

a. Test for correlation between (stated) trust and measurable transaction costs (Checking costs in the T&T game)
b. Test for correlation between (stated) trust and stated preferences for business partners.
c. Test whether tracing was the only way to reveal cheats.

4. Materials and methods

4.1 The Trust and Tracing game

Meijer *et al* (2006) describe the T&T game in detail. For sake of readability this paper summarizes the design and highlights aspects important for the analysis.

The T&T game is a role-playing gaming simulation modelling a supply network of a good with a hidden quality attribute. There are four roles for participants: producer, middlemen, retailer and consumer. Producers get their produce for free and know exactly what they have in stock at the start of a session. Middlemen and retailers should buy and sell products to make profit. Producers, middlemen and retailers (traders) compete for a price per role where the person who earned the most money takes it all. Consumers have a large amount of money and should acquire as many points as possible with this money. There is a price for the consumer with the most points too.

There is one role for the game leader: the tracing agency. Middlemen, retailers and consumers can come to the tracing agency to ask for a trace, revealing the hidden attribute of the product and if anybody upstream lied about it. Tracing costs money if no cheat is found. If a cheat is found, the cheater will be punished financially. Table 2A lists the punishments among other variables. The tracing agency keeps the money collected.

The product used is a sealed envelope that contains a high or low quality mark. The product comes in three different types, each with two qualities worth different amounts of points (Table 1). Traders are never allowed to open the envelopes. If they want to know the real quality they must ask the tracing agency for a trace.

Table 1: Points per envelope for consumers.

Quality\ Type	Red	Yellow	Blue
Low	1	2	3
High	2	6	12
High : Low ratio	2:1	3:1	4:1

A transaction in the Trust and Tracing game is an oral agreement between two participants about the trade of one or more products. Negotiated properties of a transaction are: the total price paid by the buyer and the amount, type and quality of the products delivered by the seller. The price is the result of open negotiation. To help the start-up every trader receives suggested start prices. Table 2A lists the prices among other variables. The giant differences helped to open negotiations at the beginning of a session, though are neglected as soon as the real negotiations start.

Every trader must stick a label onto every envelope sold either from the high or low quality set of labels he has. It needs to be the label for stated quality, i.e. the quality that he tells his customer. There are no other rules in the gaming simulation. Anybody is allowed to do business with anybody, although the physical setting (similar to the trade structure in Figure 3 suggests doing business with the adjacent traders in the chain.

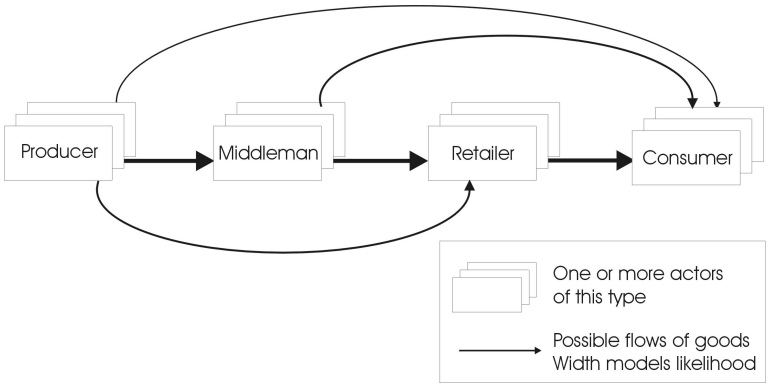

Figure 3: Possible flows of goods in the Trust and Tracing Game (Meijer and Hofstede, 2003b)

4.2 Experimental Session Setup

The load of a gaming simulation is the value of the initial configuration parameters a gaming simulation has. The situation of sessions are the characterizing variables that are not part of the gaming simulation but can help interpret why sessions with similar people and a similar load may go differently. The load and situation of the sessions presented in this paper can be found in tables 2A and 2B.

Table 2A: Load of experimental sessions (P=producer, M=middleman, R=retailer, C=consumer)

Variable	Load A (sample 2 and 3)	Load B (sample 4)
Participants	8 - 24	
Division of roles	1P:1M:1R:2C. When perfect ratio is not possible: first add a consumer, than a producer, than a middleman.	
Rounds	3	1
Product	Sealed envelopes with different colour codings for type	
Start quantities of money	P: 5 / M: 10 / R: 15 / C: 200	
Start quantities of products	P: 6 for every type and every quality (36 total) M: 2 low quality Yellow R: 2 high quality Blue	P: same M: none R: none
Tracing costs	M: 2 / R: 5 / C: 10, to be paid only when no cheat was found	
Cheat punishments	P: 2 / M: 5 / R: 10 plus public announcement	
Suggested prices	P: equal to the amount of points worth for consumers M: 2.5 * prices for P R: 6 * prices for P	

Table 2B: Situation of experimental sessions.

Variable	
Selection of participants	Students in higher education, except for session 20, which still was in a classroom setting. Participation was part of a course.
Real-world implications of participation	None. It was ensured by the game leaders that course teachers would not use results from a session in a grade.
Game leader	1, Sebastiaan Meijer for all session except 29 (sample 1)
Duration of session	30 to 45 minutes of playing time. 2 hours max. including debriefing
Location	Classrooms of participating education institute or similar venues in a conference centre

The data collection methods used consisted of a pre- and a post-questionnaire with questions using 5-point Likert scales. The questions are listed in Appendix B. Furthermore, the participants themselves counted game money and points at the end of a session and put their products (envelopes with labels marking transactions) and money in a participant-specific

large envelope. The game leader made structured session transcripts during the sessions as a third source of data. His data is from a qualitative character and is used here in the discussion.

As the empirical cycle is of an iterative nature, better insights can lead to new ways of data collection or different loads or situations of sessions. In the case of the T&T game the data collection of money and products hasn't changed. After a first iteration some questions were added to the pre- and post-questionnaire. The last series of sessions had a different load as a session consisted of only 1 round instead of 3. Appendix A lists the sessions conducted with the T&T game. The *sample* column gives insight in changes between sessions. Sample 1 consists of all sessions used in Meijer *et al* (2006). Three of them could be used in other samples too as the experimental session setup coincidentally appeared to be the same. Sample 2 consists of all sessions with load A and a complete data collection. Sample 4 consists of all sessions with load B and a full data collection. Sample 3 consists of sessions that had load A but failed in data collection on one or more points due to external influences like no time for questionnaires, overly chaotic groups or inappropriateness of asking certain questions in a situation. The addition of extra questions in the questionnaires cannot be seen from the samples but expresses itself in item non-response when analysing sample 2. As this appears to play a very small role in the analyses in this paper sample 2 has been treated as one group.

4.3 Operationalization of variables

Meijer *et al* (2006) list variables to be taken into account when conducting research into factors that drive the course of action in sessions of the T&T game. The results of their learning sessions (Sample 1 in Appendix A) gave some pointers about which elements of social structure to take into account in order to answer these questions. "*Possibly relevant variables to measure a priori are: number of participants per session; number of participants per role, and for each participant: gender; nationality; age; profession; and for each dyad: degree of mutual acquaintance. During the session, (the following) behavioural variables per participant X are relevant: with how many other has X traded; how trustworthy was X; if X requested a trace, why was that; what happened after a trace. After a session, output variables can be collected. Per session: what was the price level? What was the speed? What was the quality level (as % false High-quality products)? Per participant: what financial result did X achieve, and what is X's reputation with trade partners?*"

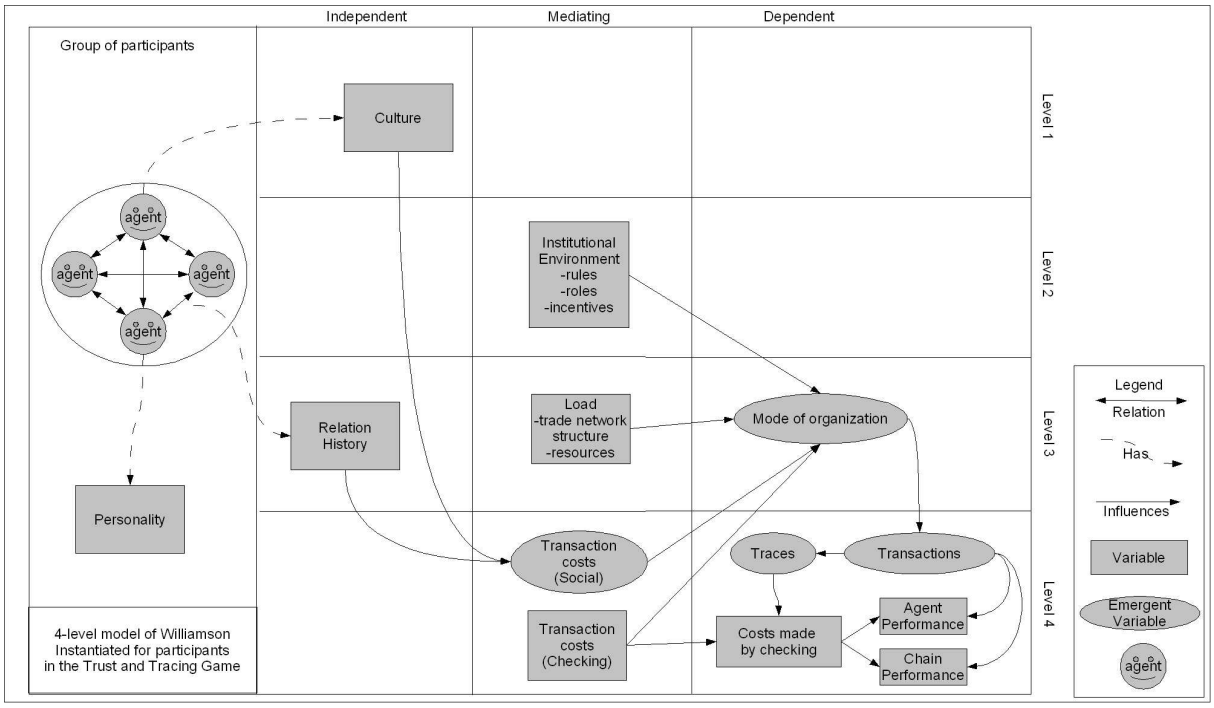

Figure 4: Analytical model for T&T game, modelled after Figure 1.

To be able to couple concepts of the theory and hypotheses to actual measurements this paper uses the analytical model in figure 4 following the 4-level model of Williamson (2000) in figure 1. Table 2 lists for each of the items in the analytical model how they are measured and using what tool.

Table 2: Operationalization of variables for the Trust and Tracing Game.(P=producer, M=middleman, R=retailer, C=consumer)

Variable	Measurement	Tool
Culture	Nationality as a proxy	Pre Questionnaire
Relation History	Likert scale: average knowledge, difference in knowledge, and trust of other participants.	Pre Questionnaire
Institutional Environment	Rules and Roles enforced via game design. Incentives via orally announced award for best P, M, R and C.	Game design
Load	Structure: predetermined ratio between roles. Resources: amount of money given in advance, amount of envelopes given in advance. Prices: via instructions	Game load: office preparation
Transaction costs (social)	Emergent, not measured. Expresses itself in mode of organization.	Post Questionnaire
Transaction costs (checking)	Price per check	Instructions
Mode of organization	Share of buying and selling with each possible trade partner summed over all participants	Constructed from transactions
Transactions	For each product a list of sell-actions with the quality it has been sold for plus a mark for who ended up with the product.	Envelopes with labels.
Traces	For each envelope: has it been traced? If so: who traced?	Envelopes with manual trace marks
Costs made by checking	The number of traces multiplied by the trace fee per role of the tracer.	In the session: paid by tracer. Afterwards: calculated from traces.
Agent Performance	For P / M / R: money left at the end. For C: number of points and amount of money left at the end.	Counted by participants and counted by game leaders afterwards. Game leader count was more accurate.
Chain Performance	Money per point, Percentage of cheated envelopes.	Constructed from transactions

	Percentage of product that reached the consumers. Distribution of profits over the chain.	and performance agents.

5. Tests of hypotheses

From 27 newly conducted sessions and previously unused data from 3 older sessions a data set has been derived with 430 unique participants trading over 2500 product items in more than 5000 transactions. Appendix A lists the sessions. Sample 1-sessions are the older sessions used as empirical material for Meijer *et al* (2006). Samples 2, 3 and 4 are new. Sample 2 and 3 share load A, while sample 4 used load B (Table 2A).

5.1 The dominant mode of organization used in the T&T game is Network, not Market.

Test 1A: There will be no preference for a trade partner

In the Trust and Tracing game every product can be expressed as an amount of points worth for the consumers, and thus is a commodity. It is rational to assume that in the session where practical barriers between traders are absent commodities will be bought from all available suppliers equally. For every actor in a session the 'selectiveness'-score has been calculated. The 'selectiveness'-score (SS) is defined as:

$$SS(Ym) = \text{for } i=1 \text{ to } N \; \Sigma \; (\% \text{ of all sales with possible buyer } Xn)^2$$

Where: % of all sales with possible buyer = [0 .. 1]
Xn = each agent that possible could buy from Ym
Ym = selling agent

Similarly the SS can be calculated for a buyer.
The theoretical SS for every actor can be calculated assuming equal trade with every trade partner possible. Assumptions have to be made who can be regarded as a possible trade partner. In the case of a producer there have been sessions in which the middlemen were the only trade partners, thus sticking to a strict chain sequence, and there have been (many) sessions in which the consumers bought from producers directly. If the participants do not consider bypassing a node in the chain is appropriate behaviour, the number of possible trade partners reduces. The rules of the T&T game do not suggest nor prohibit any bypassing.

In this analysis only the selectiveness scores for producers and consumers are calculated for two reasons. First the amount of consumers in the sessions was largest and from all traders the producers were the first role to get one person extra in case of asymmetric chain configurations, therefore N is highest for these two roles. Second, being the start and the end of the chain respectively, the SS is only one-sided. The structure of the data did not allow two-sided SS to be disentangled for supply and demand.

The theoretical minimum SS for producers assuming middlemen as possible trade partners is:

$$SS(P) = \#M * (\text{for } i=1 \text{ to } \#M \; \Sigma \; (1/\#M)^2)$$

The theoretical minimum SS for consumers assuming retailers as possible trade partners is:

$$SS(C) = \#R * (\text{for } i=1 \text{ to } \#R \; \Sigma \; (1/\#R)^2)$$

In figure 5 the outcome can be found for the non-parametric test for differences between the theoretical minimum score and the actual SS. The ranks table shows a majority of positive ranks for MiminumSelectiveness(M) – ActualSelectiveness, which means that the majority of

the producers had an SS lower than the theoretical minimum. This indicates that not only the middlemen were a possible trade partner, but all downstream agents can be regarded. The MinimumSelectiveness(MRC) is the theoretical minimum SS for middlemen, retailers and consumers available in the session of the particular producer. The ranks table shows only 4 positive ranks for MinimumSelectiveness(MRC) - ActualSelectiveness, and they stem from producers who did not trade at all. (ActualSelectiveness = 0). The test statistics show a .000 significance for ActualSelectiveness being smaller than the theoretical minimum. This rejects the proposition that there will be no preference for trade partners.

Figure 5: Wilcoxon Signed Ranks Test for Selectiveness Score (Producers)

		N	Mean Rank	Sum of Ranks
MinimumSelectiveness (MRC) - ActualSelectiveness	Negative Ranks	80	43.86	3509.00
	Positive Ranks	4	15.25	61.00
	Ties	0		
	Total	84		
MinimumSelectiveness (M) - ActualSelectiveness	Negative Ranks	24	30.96	743.00
	Positive Ranks	57	45.23	2578.00
	Ties	3		
	Total	84		

Test Statistics(c)

	MinimumSelectiveness (MRC) - ActualSelectiveness	MinimumSelectiveness (M) - ActualSelectiveness
Z	-7.689(a)	-4.320(b)
Asymp. Sig. (2-tailed)	.000	.000

a Based on positive ranks.
b Based on negative ranks.
c Wilcoxon Signed Ranks Test

In figure 6 the outcome can be found for the non-parametric test for differences between the theoretical score (MinimumSelectiveness(R) and MinimumSelectiveness(PMR), respectively) and the ActualSelectiveness. The ranks table shows about 1/3 of positive ranks for MinimumSelectiveness(R) – ActualSelectiveness, revealing consumers who had a SS lower than the theoretical minimum. This, and the finding from the producers, indicates that consumers could buy from all upstream agents. The MinimumSelectiveness(PMR) is the theoretical minimum SS for producers, middlemen and retailers available in the session of the particular consumer. The ranks table shows 16 positive ranks that stem from consumers who did not buy at all. (ActualSelectiveness = 0) The test statistics show a .000 significance for ActualSelectiveness being smaller than the theoretical minimum. This rejects the proposition that there will be no preference for trade partners.

Figure 6: Wilcoxon Signed Ranks Test for SS(Consumers)

		N	Mean Rank	Sum of Ranks
MinimumSelectiveness (R) - ActualSelectiveness	Negative Ranks	127	98.53	12513.00
	Positive Ranks	62	87.77	5442.00
	Ties	5		
	Total	194		
MinimumSelectiveness (PMR) - ActualSelectiveness	Negative Ranks	178	104.60	18619.00
	Positive Ranks	16	18.50	296.00
	Ties	0		
	Total	194		

Test Statistics(c)

	MinimumSelectiveness (R) - ActualSelectiveness	MinimumSelectiveness (PMR) - ActualSelectiveness
Z	-4.696(b)	-11.701(b)
Asymp. Sig. (2-tailed)	.000	.000

b Based on positive ranks.
c Wilcoxon Signed Ranks Test

Test 1B1: The amount of points earned by consumers depends on economic and relational variables (assuming network mechanism).
A regression of the number of points earned by consumers with economic and relational variables yields the model in figure 7. (R-square = .486)

Coefficients(a,b)

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta	B	Std. Error
(Constant)	45,074	35,802		1,259	,212
Money spent	,111	,087	,116	1,280	,204
# Participants in session	3,515	1,432	,216	2,455	,016
Average knowledge of others	-16,586	5,604	-,259	-2,960	,004
Difference in knowledge of others	-,239	5,126	-,004	-,047	,963
Trust in others	-12,156	6,159	-,171	-1,974	,052
Did you cooperate	-3,458	3,422	-,084	-1,011	,315
How many envelopes did you buy	4,831	,710	,786	6,808	,000
How often have you been cheated upon	-2,034	1,672	-,117	-1,217	,227
How many suppliers	-7,238	3,812	-,196	-1,899	,061

a Dependent Variable: Points
b IsConsumer = 1,00
Figure 7: Coefficients of the number of points earned by consumers, sample 2, 3 and 4

The relation between ‘how many envelopes did you buy’ and the number of points earned seems obvious at first, but considering the differences in points that each envelope is worth, it could have been the case that people buying only the 12-point-type had more points than people buying many of the less-worth envelopes. The amount of points earned can further be explained from relational variables ‘average knowledge of others’ and ‘trust in others’, though negatively. The number of participants in a session is significant too. The number of suppliers was negatively influencing the amount of points earned. It appears from this analysis than the less you know the others and the more anonymous one is in a larger group, the more points you earn. Forming a good trade relationship with only a few suppliers indicates the use of the network mechanism. The amount of money spent is insignificant. This is in line with observations that prices differed enormous between transactions.

Test 1B2: The amount of money earned by traders depends on economic and relational variables (assuming network mechanism).
A regression of the amount of money earned by traders (Money) with economic and relational variables yields the model in figure 8. (R-square = .244)

For traders the number of envelopes sold is not significant for the amount of money earned. The number of buyers, the number of participants in a session and if they cooperated with somebody else were determining the success of a trader. The insignificance of average

knowledge and trust of other participants seems to contradict the model in figure 8, the differences of knowledge of others is significant. The cooperate-factor upon closer inspection is influenced by producers cooperating and forming a kongsi. These kongsies were very successful in asking high prices. The significance of the number of people in a session suggests that the same more anonymous situation in which consumers earn more points works for traders too.

Coefficients(a,b)

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta	B	Std. Error
(Constant)	-165,401	55,263		-2,993	,003
# Participants in session	6,005	2,431	,201	2,470	,015
Average knowledge of others	1,892	11,099	,013	,170	,865
Difference in knowledge of others	13,507	7,835	,130	1,724	,087
Trust in others	11,212	11,203	,079	1,001	,319
Did you cooperate	12,818	7,242	,138	1,770	,079
How many envelopes did you sell	,892	,834	,118	1,069	,287
How many buyers	18,676	6,140	,329	3,042	,003
How often did you cheat	-3,750	2,409	-,139	-1,557	,122

a Dependent Variable: Money

Figure 8: Coefficients of the amount of money earned by traders, sample 2, 3 and 4

Test 1C: Various correlations

Figure 9 shows four correlations found in a correlation matrix of social variables 'Trust in others', 'Average knowledge of others' and 'Did you cooperate' with variables that described cheating, buying and selling behaviour. The matrix used data from sample 2, 3 and 4, separated in subgroup 'traders' and 'consumers'.

Variable		% Cheated Of Sell
Trust in others	Corr	.170
	Sign.	.029
	N	165

Variable		%Low Quality Of Total Buy
Average knowledge of others	Corr	.150
	Sign.	.046
	N	178

Variable		How Often Did You Cheat	How Many Envelopes Did You Sell
Did you cooperate	Corr	-.200	-.221
	Sign.	.009	.004
	N	169	169

Figure 9: Various correlations for traders, sample 2, 3 and 4.

5.2: High trust between traders in a network reduces transaction costs.

Test 2A: Test for correlation between trust and measurable transaction costs (Checking costs in the T&T game)

Outcome of this test is calculated using sample 2, 3 and 4. No correlation could be found between the stated trust level and the number of traces, as is shown in table 3. When tested for each of the roles that were able to trace, there still is no correlation found.

Table 3: Correlation between stated trust and number of traces for different roles

	M+R+C	Middlemen	Retailers	Consumers
Correlation	-.085	-.068	-.167	-.107
Significance	.169	.617	.211	.194

Test 2B: Test for correlation between trust and stated existence of a preferred business partner.
Outcome of this test is calculated using sample 2, 3 and 4. No correlation could be found between the stated trust level and the stated existence of a preferred business partner, as is shown in table 4. When tested for each of the roles that were able to trace, there still is no correlation found.

Table 4: Correlation between stated trust and stated existence of a preferred business partner.

	M+R+C	Middlemen	Retailers	Consumers
Correlation	-.062	-.027	.262	-.201
Significance	.505	.891	.206	.105

Test 2C: Test whether tracing was the only way to reveal cheats.
It is invisible from the outside whether the product is of high or low quality. If the sub-propositions are confirmed, there have to be mechanisms at work between traders that make cheats detectable.

Test 2CA: The more a participant is cheated upon, the more he will trace.
Test for correlation between the number of traces and the number of cheated envelopes of a particular actor. Outcome: significant for retailers and consumers with sample 2, 3 and 4. Table 5 shows that the proposition cannot be generally accepted on a 5% confidence level. (Sign. = 0.085). The population consists of all cheatable participants, being middleman, retailers and consumers. When the population is dived in middlemen, retailers and consumers the proposition can be accepted for retailers and consumers.

Table 5: Correlation between number of traces and the number of cheated envelopes of a particular actor

	M+R+C	Middlemen	Retailers	Consumers
Correlation	.100	-.085	.263	.187
Significance	.085	.510	.034	.015

Test 2CB: Tracers will reveal more cheats than random tracing would.
If cheating cannot be detected from other methods than checking an envelope, the chances of revealed a cheat with tracing are equal to the ratio cheated / not cheated envelopes the participant bought. The test shows significance for consumers using sample 2, 3 and 4 for all actors who traced for differencing means of the percentage cheated envelopes found in a trace and the percentage envelopes of all bought envelopes of each individual actor. The test is done both with a Wilcoxon Signed Ranks test and a paired sample T-Test to see whether the conclusion holds true both for the assumption of normally distributed variables (T-Test) and just similar distribution (Wilcoxon). Both are significant for consumers on the 10% confidence interval (Table 6 and 7). For the other roles the number of tracers was to low to have a usable N.

Table 6A: Wilcoxon Signed Ranks test for cheating detection (Ranks)

role			N	Mean Rank	Sum of Ranks
Consumer	PercentageCheatedOfTrace - PercentageCheatedOfBuy	Negative Ranks	19(a)	14.29	271.50
		Positive Ranks	20(b)	25.43	508.50
		Ties	8(c)		
		Total	47		

a PercentageCheatedOfTrace < PercentageCheatedOfBuy
b PercentageCheatedOfTrace > PercentageCheatedOfBuy
c PercentageCheatedOfTrace = PercentageCheatedOfBuy

Table 6B: Wilcoxon Signed Ranks test for cheating detection (Test Statistics)

role		PercentageCheatedOfTrace - PercentageCheatedOfBuy
Consumer	Z	-1.654(a)
	Asymp. Sig. (2-tailed)	.098

a Based on negative ranks.

Table 7: Paired samples test for cheating detection

role		Paired Differences			t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean			
Consumer	PercentageCheatedOfBuy - PercentageCheatedOfTrace	-.08810	.33045	.04820	-1.828	46	.074

6. Discussion

Test 1A confirms that there was a preference for some trade partners above others in the Trust and Tracing game. This proves that the sessions were not a perfect market, because a perfect market would have forced prices of all suppliers towards the equilibrium price and clients wouldn't have had preferences when the price was the same.
Test 1B investigates what factors determine outcomes of the performance indicators money and points for the various roles. Included in the analysis are financial, relational and behavioural factors. Sub-tests show a difference between trader roles and consumer roles. Consumers gathered more points in sessions with more participants, when they knew and trusted the other participants less, when they had fewer suppliers and when buying with a bulk strategy. Neither the amount of money spent, nor being cheated upon, nor cooperating, nor knowing some people better than others were significant. The scores of the factors explaining the results of consumers lead to the view that consumers who were successful used the network mechanism to set up a working trade relation for repeated transactions in high volumes. Consumers who knew the others better and trusted them more were less successful in terms of points earned. Pre-existing relations thus hindered a fast exchange of goods in the setting of the Trust and Tracing game.
For traders the situation was different. Successful traders were again in sessions with many participants, but they cooperated. The average knowledge and trust of others was not significant, but knowing some people better than others was. The more buyers they had, the better. Neither the number of cheats nor the number of envelopes sold significantly influenced the amount of money earned. From session transcripts and from the questionnaires it becomes clear that the preferred partner to cooperate with was somebody in the same role (especially producers among each other). The dominant mode of organization used by successful traders seems to be market. Successful traders formed a monopoly on the products and traded with as many clients as possible. The importance of knowing some people better than others could indicate that the ones you knew better were easier to bind for a sell.

The outcomes of test 1B and the preferences for trade partners from test 1A lead to the conclusion that pre-existing social relations did influence the course of the action in the Trust and Tracing game. Consumers who earned many points were the ones that were less socially embedded, due to their lower knowledge and trust of the others. They were able to form efficient network modes of organization with few suppliers. Traders who earned a lot of

money used the market mechanism by forming monopolies and trading with as many clients as possible. Being socially embedded and letting your social network influence your trade behaviour was not positive for the score on the performance indicators in the situation of the Trust and Tracing game.
Test 1C further illustrates this with correlations found. Traders who trusted others more cheated more upon their buyers: a clear case of opportunistic behaviour. The better the average knowledge of the other participants the higher the percentage of low quality of their total buy, which is a way to avoid being cheated upon. Traders who cooperated more according to their questionnaire cheated less and sold fewer envelopes. Combined with the trader model from test 1B this indicates that cooperating traders were able to ask better prices for their goods, eliminating the temptation to cheat to earn more. Sticking to the market mechanism they just sold goods at a high price, without exploiting trust by being opportunistic.

The positive effect of the number of participants on the outcomes of both consumers and traders can be explained by the qualitative observations that in smaller groups the participants were watching each others' moves. People would listen to the negotiations of other people in the room. Fast exchange of goods was rare, especially in the beginning of the session. The larger the group, the more the noise levels went up, and hearing a conversation without being physically close was impossible. Participants who were a bit late in starting to trade quickly stood up and approached a possible trade partner. There were fewer passive participants in larger settings. A sound pressure level-measurement would have been an interesting variable in retrospect.

It has been impossible to find correlations between (ex ante) trust and the number of traces (Test 2A) or between trust and the existence of a preferred business partner (Test 2B). The trust stated in the pre-questionnaire did not show in trade relationships. The next question is whether the tracing mechanism was the only source of finding out who was honest or not. Although technically it is impossible to know the real quality of an envelope until opening it, it might be that other mechanisms help in detecting cheats as well. Test 2C proves via two paths that a traced envelope was not a randomly selected product. There is a positive relation between how often one has been cheated upon and the number of traces (for consumers and retailers). This means that people who were cheated upon did suspect this and performed traces accordingly. A possible explanation is that the load A-sessions (Sample 2 and 3) were allowed to check their envelopes between rounds in the 3-round sessions. If they found out they were cheated upon they could start tracing more. To investigate this explanation the second test in test 2C was carried out. It showed that the percentage of cheats found when doing a trace was higher than could be expected if a trace was a random choice. Because being cheated upon in the next round is independent of the round before, the second test proves that participants were better in detecting cheats than could be expected. There must be social mechanisms at work that detect if one is being cheated upon.

The initial assumption was that existing social relationships would be beneficial for building trade relationships, incorporating the social network in a newly formed trade network. In the setting of the Trust and Tracing game the opposite is true when considering the performance indicators money and points only. What has not been measured is the quality of the trade relations formed. A first possible explanation for the gap between the social relations and trade relations comes from the institutional environment the T&T game provides. It might be that the people who were not successful in terms of the performance indicators money and points were more successful in building a good relationship that might pay off in the future.

The duration of a game session is relatively short. In almost any session the people who were less successful on the performance indicators explained afterwards that they were busy making negotiations, exploring the wishes of their possible clients or waiting politely for busy producers to have some time negotiating. Repeating the game with the same group of people would be very interesting to see if cheats from the past and the trade relations built would lead to new long-term relations with trusted partners. A change in the incentive structure, like for instance taking into account both money and the amount of points for consumers and price per point earned by traders, would possibly change the nature of the negotiations. Sessions with a different incentive structure would be interesting for future research.
A second explanation for the gap between social and trade relations might come from the culture of the participants in the sessions. In the sample 1 sessions the multi-cultural sessions yielded interesting qualitative observations. In the sample 2, 3 and 4 sessions together 73% of the participants had the Dutch nationality. On the cultural dimensions of Hofstede (Hofstede and Hofstede, 2005) the Dutch are particularly individualistic, extremely feminine, and have a lower than average uncertainty avoidance index. This combination of dimensions leads to a cultural profile in which the risk of being cheated upon is not very important to them, nor is it to be a member of a permanent group. The dominance of the Dutch in the number of participants might explain the course of the sessions. The numbers of participants from other cultures are too low and they are spread over too many nationalities to distinguish quantitatively between nationalities in the analysis. A series of sessions with people from one or two nationalities could build a group to compare with the Dutch sessions. This way culture could be incorporated directly as an independent variable in the analysis.
A third possible explanation could be what Omta and Van Rossum (1999) called the ‘dark side of cooperation’. In ten leading R&D firms they noted the negative effects of being embedded due to social liability, e.g. reducing the possibilities for relating to companies outside the network. Uzzi (1997) mentions the vulnerability of firms that are ‘over-embedded’ too, because they do not have access to new partners giving them a unique collaboration within the trade network. In the situation of the Trust and Tracing game the incentive structure of the gaming simulation is strictly economic, as you either earn money or points. The social embeddedness could shape the transaction costs such that switching between trade partners is not likely. The possibility of a better price might not be attractive when you lose a friend and possibly future business partner. Buying something might not be only for the purpose of points or money but could be a gesture to a friend too. While the Trust and Tracing game allowed for making transaction costs a little more measurable via the checking costs, it cannot measure the other types of transaction costs in its current form. Williamsons (2000) and Menards (2005) remark of transaction costs being notoriously hard to measure still is true.

Methodology
The use of gaming simulation as data gathering tool for testing quantitative hypotheses in chains and network is new. In the current a methodology has been used that is part of a larger (Ph.D-)project in which more research in the domain of chains and networks is addressed using the method. The T&T game was the first case to start in the project.
The methodology can be divided in two cycles (design and empirical), as is depicted in Figure 10. The design cycle is a basic iterative design cycle used in many design approaches (Duke and Geurts, 2004; Fullerton and Hofmann, 2004, among others). Iterative improvements are checked against and steered by a list of requirements (#4) and (game) design theory (#5) in test sessions.
The important aspect for empirical research is that the design cycle results in both the tool and induced hypotheses. Testing and developing a gaming simulation gives better insights in the complexity of the problem through the test sessions that can help in the start-up of the

empirical cycle. Duke and Geurts' approach of formulating the problem with participants in the game sessions is a far worked out application of the same principle.
In the case of the T&T game the design cycle resulted in a gaming simulation with a learning purpose and was almost completed before the start of the PhD project. In the project the empirical cycle was added and the last rounds of the design cycle were completed. Meijer *et al* (2006) give a full description of the gaming simulation prototype (#6), test session setup (#7), test sessions (#8) and unstructured session transcripts (#9). The empirical cycle took the finalized gaming simulation prototype (i.e. The T&T game) as a given gaming simulation tool (#13). The sessions described in Meijer *et al* (2006) (sample 1-sessions) resulted in induced hypotheses (#10). Hypotheses from theory (#11) were added too. In the current paper hypothesis 1 is an induced hypothesis while hypothesis 2 stems from theory.

An experimental session setup (#12) (section 4.2) has been constructed having a list of variables and hypotheses to be collected and tested. An important third element for the experimental session setup is the case description (#3). For the T&T game the case description has been kept simple as it models a generic supply networks of good with a hidden quality attribute. The absence of a real-life chain as case to provide constraints for the experimental session setup cleared the path to use student groups as participants. The experimental session setup defines the data collection methods, load and situation of the data sessions.

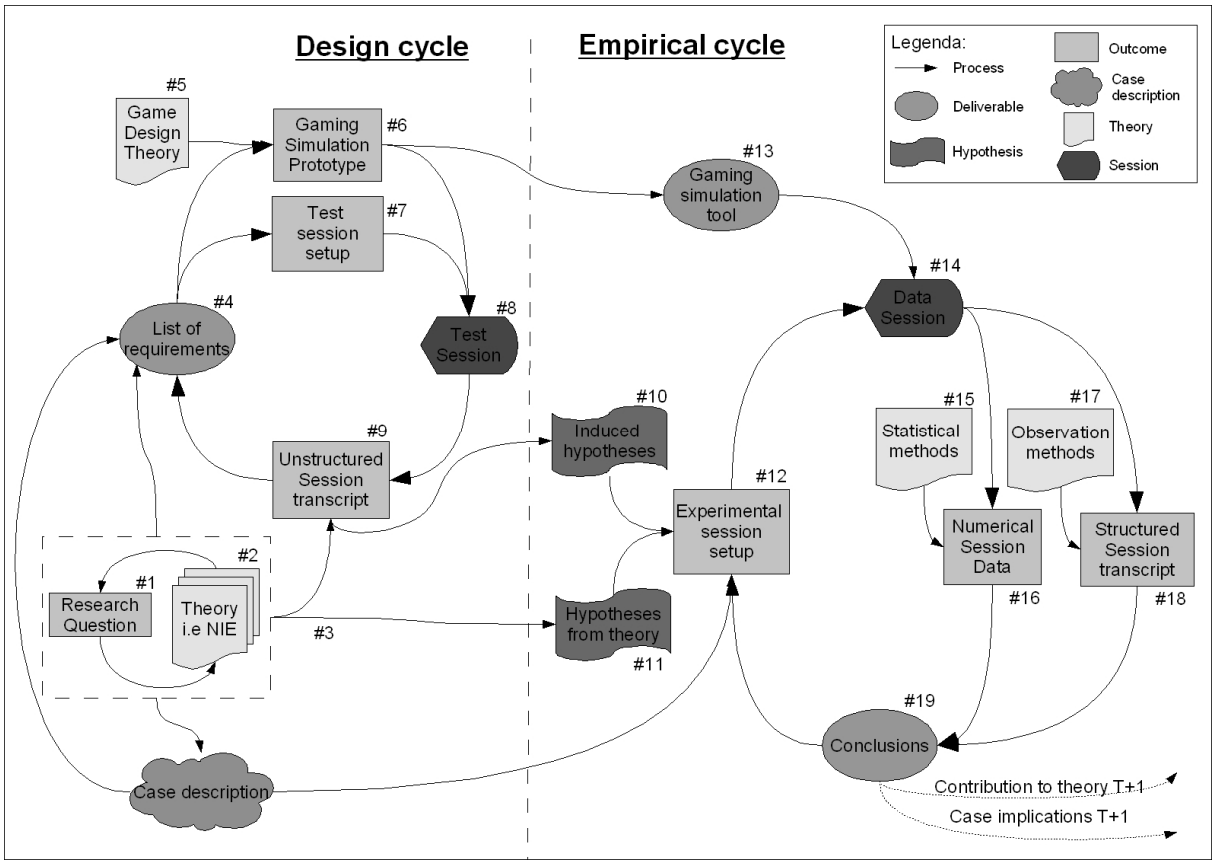

Figure 10: Methodology scheme T&T game research.

The experimental session setup defined the constraints for organizing data sessions (#14). The sessions resulted in two types of data (#16 and #18) that were analyzed using statistical methods (#15, as described in this paper) and observation methods (#17, used as clarification only in this paper). Intermediate conclusions (#19) derived from the data lead to adaptations

in the experimental session setup (i.e. the need to adjust the load and questionnaire as described in section 4.2)

Preparing the data gathered for analysis has been a complicated task. The design of the T&T game did not incorporate a time stamp to each transaction. In the data collection it has not been feasible to add a time-stamp to each transaction without altering the way the T&T game is played. This made it impossible to see the effects of a cheat or trace on later transactions or lack of it. Furthermore the materials used (labels, envelopes, game money) made the digitization of the data very labour intensive. Standard tools like SPSS and Excel could not convert the individual transactions to data per participant, so that it was necessary to build a custom data converter tool. Looking back, the broad scope of the research and the explorative nature of it, combined with a pre-existing gaming simulation not designed for quantitative data analysis resulted in a complicated and time-consuming analysis phase. In a second case within the project two of the authors have been involved in the design and application of a gaming simulation for a specific research question with pre-determined analytical requirements. This project (Zuniga *et al*, 2007) started later and ended sooner, benefiting from the focus on specific data to be gathered. The number of sessions required to gather this data was lower due to a better design of the gaming simulation. Special attention has been paid to the operationalization of the concepts to be measured. A one-to-one translation of a concept to a variable in the gaming simulation helped dramatically in the analysis. Important concepts should not be derived from a constellation of variables but be measured directly. Kriz and Hense (2006) come to the same conclusion for improvement of gaming simulations for learning and propagate 'theory-based evalution'-methods.

7. Conclusions

The first hypothesis (*The dominant mode of organization used in the T&T game is Network, not Market*) could be confirmed for consumers and rejected for traders. Further analysis showed the influence of pre-existing social relations on the course of the action in the sessions. Being socially embedded was not positive for financial results in a session. Reasons have been discussed why this could be the case. The second hypothesis (*High trust between traders in a network reduces transaction costs*) has been rejected. Neither measurable transaction costs from tracing nor the appearance of a preferred business partner with high trust could be found. Further analysis revealed that participants are able to suspect cheats based on other factors than tracing.

The previous conclusions prove that it has been possible to test hypotheses quantitatively using data gathered in sessions with the gaming simulation. The method worked. It has yielded a data set that could be analyzed using quantitative techniques. The way it has been done is a contribution to the gaming simulation methodology, both in type of data gathering and application domain. The field of chains and networks now has a new tested research method to complement the methods already in use.

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Appendix 1: List of sessions with the Trust and Tracing game.

Number	Year, place and number	Sample	#Producers	#Middlemen	#Retailers	#Consumers	#Participants	#Envelopes Sold By P	#Envelopes Bought By M	#Envelopes Bought By R	#Envelopes Bought By C
1	2005 WUR SCM course, session 1	1									
2	2005 WUR SCM course, session 2	1									
3	2005 WUR SCM course, session 3	1									
4	2005 WUR SCM course, session 4	1									
5	2005 WUR SCM course, session 5	1									
6	2005 RU, SCM course	1									
7	2005 WUR Food Safety Economics course	1									
8	2006 WUR Food Safety Economics course	2	4	4	4	9	21	148	33	32	150
9	2006 KSV knowledge session	3	4	4	4	8	20	120	46	31	130
10	2006 Larensteijn SCM week	3	2	1	2	4	9	82	6	21	116
11	2005 INHOLLAND SCM course, session 1	2	3	3	3	14	23	134	46	47	170
12	2005 INHOLLAND SCM course, session 2	2	3	3	3	9	18	105	79	69	58
13	2005 INHOLLAND SCM course, session 3	3	2	1	2	3	8	2	2	5	70
14	2005 INHOLLAND SCM course, session 4	2	3	2	2	6	13	0	0	0	0
15	2005 INHOLLAND SCM course, session 5	2	3	3	3	9	17	134	85	61	146
16	2005 INHOLLAND SCM course, session 6	2	2	2	2	5	11	79	9	37	70
17	2005 INHOLLAND SCM course, session 7	2	2	2	2	5	11	48	48	38	57
18	2005 INHOLLAND SCM course, session 8	2	2	2	2	5	11	85	32	59	83
19	2005 INHOLLAND SCM course, session 9	2	3	2	3	6	14	91	4	21	93
20	2006 Imagineering teachers	2	3	2	2	6	13	127	11	23	138
21	2006 RU, SCM course	1+2	3	3	3	7	16	143	36	12	118
22	2006 WUR SCM course, session 1	2	2	2	2	4	10	40	43	36	24
23	2006 WUR SCM course, session 2	2	3	2	2	5	12	138	43	18	124
24	2006 WUR SCM course, session 4	2	4	4	4	8	20	113	98	77	108
25	2006 INHOLLAND SCM course, session 1	2	2	1	2	4	9	38	17	21	43
26	2006 WSM, Purdue university MBA Group	2	2	2	1	3	8	23	19	9	25
27	2005 KUB SCM course	2	3	3	3	8	17	102	47	37	93
28	2005 TOMATO session Venlo venue 1 Sebas	1+3	3	3	3	6	15	141	62	46	134
29	2005 TOMATO session Venlo venue 2 Gert Jan	1									
30	2005 Agrotechnology welcome session 7pp	3	2	1	2	3	8	69	0	69	56
31	2005 WSM, Purdue university MBA Group	1+3	3	3	3	12	21	115	23	24	112
32	2003 WSM, Purdue university MBA Group	1									
33	2005 Scholierenconferentie session 1	1									
34	2005 Scholierenconferentie session 2	1									
35	2006 INHOLLAND SCM course, session 2	2	3	3	3	6	15	145	137	123	127
36	2006 INHOLLAND SCM course, session 3	4	3	3	3	8	17	118	31	17	117
37	2006 INHOLLAND SCM course, session 4	4	3	2	2	6	13	122	16	20	118
38	2006 INHOLLAND SCM course, session 5	4	3	2	2	5	12	111	29	13	110
39	2006 Larensteijn SCM course	4	3	3	3	8	17	86	29	22	89
40	2006 INHOLLAND SCM course, session 6	4	2	2	2	5	11	74	12	0	62
41	2006 INHOLLAND SCM course, session 7	4	3	3	3	11	20	100	21	16	120
42	2005 Kids session with primary school children	1									
43	2003 Ministry of Agriculture knowledge center	1									

Appendix 2: Questions asked in the questionnaires

Pre questionnaire:
Your name:
Your gender: Female Male
Your year of birth: 19
Your country of birth:
Your home country (if different):
Your study:

How well do you know the other participants?

On average I know them:	very well	1 … 2 … 3 … 4 … 5	not at all
I know some of them much better than others.		1 … 2 … 3 … 4 … 5	I know them equally well

How much do you trust the other participants?

Most of them can be trusted	1 … 2 … 3 … 4 … 5	I trust none of them

Post questionnaire:

Have you been cheating?	never	1 … 2 … 3 … 4 … 5	all the time
Did you get away with cheating?	never	1 … 2 … 3 … 4 … 5	all the time
Did you cooperate with somebody else?	never	1 … 2 … 3 … 4 … 5	all the time

If so, with whom?.....
If so, why?.....