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Modeling and Simulation of Selling, Buying, Deceit, and Trust Behavior in the Trust and Tracing Game¹

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People from all cultures behave differently when confronted with trade dilemmas due to differing attitudes towards uncertainty avoidance, individualism, mutual caretaking and other traits [1]. In global supply chains and networks these differences are studied to improve governance structures. The Trust and Tracing game [2] is a research tool designed to study human behaviour with respect to trust and deception in commodity supply chains and networks in different institutional and cultural settings.

The focus of the full papers is on behavior of traders in negotiations. Firstly there are sellers with the opportunity for deceit that their information advantage offers them. Secondly, buyers face a trade-off to trust a seller or trace his product.

The papers study trust in a business partner when acquiring or selling commodities with invisible quality. In the game there are five roles: traders (producers, middlemen and retailers), consumers and a tracing agency. Typically there are 3 to 4 producers, middlemen and retailers and 6 to 8 consumers, to reflect the multiple steps and oligopoly character of most supply networks. The real quality of a commodity is known by producers only. Sellers may deceive buyers with respect to quality, to gain profits. Buyers have either to rely on information provided by sellers (Trust) or to request a formal quality assessment at the Tracing Agency (Trace). This costs a tracing fee for the buyer if the product is what the seller stated (honest). The agency will punish untruthful sellers with a fine. Results of tracing are reported to the requestor only or by public disgrace depending on the game configuration. A strategy to be a truthful seller is to ask for a trace before selling the product. Sellers use the tracing report as a quality certificate. Middleman and Retailers have an added value for the network by their ability to trace a product cheaper than a consumer can.

A buyer's decision to trace the product or trust the seller is based on his past experience of interaction with the seller and uses the individual-level trust model presented in [3]. According to this model trust is a real number from interval [0;1]. This definition of trust enables the interpretation of the trust as a probabilistic measure.

A multi-attribute negotiation model from [4] was adopted by expressing agent's bid utility function as a weighted sum of evaluations of two factors: the money the agent can

¹ The full papers:

- "Modeling and Simulation of Selling and Deceit for the Trust and Tracing Game" is to appear in the *Proceeding of the "Trust and Agent Societies" workshop (Trust 2005)*, Fourth International Joint Conference on Autonomous Agents and Multiagent Systems.
- "Multi-Agent Model of Trust in a Human Game", is to appear in the *Proceeding of "Artificial Economics 2005: A Symposium in Agent-based Computational Methods, Game Theory and their Applications"*.

make and the he takes in case of acceptance of the bid by both parties. Here risk evaluation is based on the agent's trust in his partner.

The decision to deceive is not merely a rational one with respect to financial advantages and risks. In real world business social-cultural influences change the decision. To model this on an aggregated level we introduced a random factor influencing the cheating decision. Each agent has an honesty parameter that represents the agent's threshold for cheating. Honesty is modeled to degrade on each successful deceit and to be reinforced by fines for revealed deceit.

These models were implemented as a multi-agent system and computer simulations were performed with populations of 15 agents: 3 producers, middlemen and retailers, 6 consumers. Game sessions are performed in continuous real-time and depend only on the performance of the computer. Agents can be involved in only one transaction a time. This design allows (future) the combination of artificial and human agents in one game session. Values of free parameters were selected uniformly from their definition intervals to confirm the models capability to reproduce desired input-output relationships and explore their sensitivities.

A preliminary verification of the simulation output against hypothesis build by the experts based on conventional economic theory and observations of the human trust and tracing game session on the system-level was performed. Confirmation of most of the hypotheses confirms system-level usefulness of the individual-level models we designed. The next step in the research will be to validate of the simulation result against traces of the game sessions with human players that have been played so far. After that we will vary parameters of the agents' behavior models and perform then numerous simulations to select the most interesting settings for future game sessions with human players.

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