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**Trust and electronic commerce in the agrifood sector.
A trust model and experimental experiences**

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TRUST AND ELECTRONIC COMMERCE IN THE AGRIFOOD SECTOR. A TRUST MODEL AND EXPERIMENTAL EXPERIENCES

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Abstract

Opportunities coming from electronic commerce provide interesting support options for the agrifood sector. However, due to the product specific information asymmetry in the agrifood sector, the anonymity of the medium creates a lack of trust increasing transaction costs to engage in e-commerce. This paper develops a trust model for electronic commerce in the agrifood industry allowing for the analysis of trust determinants in traditional agrifood transaction relationships and their transfer to appropriate trust determinants in the e-commerce environment. First experimental results validating the suitability of the model to derive appropriate electronic trust generating elements for a given agrifood transaction environment are presented.

Keywords: Transaction costs (D23), asymmetric and private information (D82), laboratory experiment (C91), electronic commerce, trust

1 Introduction

The enlargement of the European Union opens new markets at the supply and vendor side to the European agrifood sector. Opportunities coming from electronic commerce such as more transparent markets with easier access to information about possible transaction partners and their products provide interesting support options for establishing business relationships with other EU countries. However, the agrifood sector deals with products where a large amount of information asymmetry exists between transaction partners. Many characteristics of food products may only be analyzed after use (experience characteristics), others even cannot be examined at all (credence characteristics). This makes quality management, quality control, contracts and trust between transaction partners to crucial elements in agrifood transactions (see Schiefer, Rickert, 2004, Wilson, Kennedy, 1999). Electronic commerce where physical product inspection and direct contact between transaction partners is not possible has often been criticized as too anonymous for agrifood transactions. This risk and uncertainty creating a new and additional information asymmetry created a lack of trust in electronic commerce in the agrifood sector and transaction costs were perceived as too high for agrifood companies to engage in electronic commerce. The benefits from electronic commerce were considered less important than the obstacles.

We argue that electronic commerce environments in the agrifood industry require an appropriate, trust generating configuration to lower these initial transaction costs coming from the medium's anonymity and information asymmetry. This paper deals with the problem how trust may be generated in an electronic commerce environment in the agrifood industry to lower the initial transaction costs impeding agrifood companies to engage in e-commerce transactions. As trust is generated in individuals ex post over time after positive experiences, alternative ways to anticipate trust generation in e-commerce suitable to the transaction situation in agrifood industries are necessary.



The objective of this paper is the development of a trust model for electronic commerce in the agrifood industry, the analysis of trust determinants in traditional agrifood transaction relationships and their transfer to appropriate trust determinants in the electronic commerce environment. The paper first outlines theoretical concepts dealing with the role of trust in business relationships. The following section derives and operationalizes a trust model for electronic commerce in the agrifood industry. The paper concludes with the presentation of first experimental results validating the suitability of the model to derive appropriate electronic trust generating elements for a given agrifood transaction environment.

2 Theoretical background: Role of trust in business relationships

The exchange of goods between businesses builds on a certain level of trust between the business partners (Fynes et al. 2001). Literature provides many definitions of trust in business relationships, but their essence is that trust is one party's belief that the other party will not exploit its vulnerabilities (see Barney, Hansen 1995). The relationship between buyers and sellers is subject to research areas such as transaction cost economics, information economics and socio-economics (for an overview see Hausen 2005). Transaction cost economics claims that every transaction between buyers and sellers creates transaction costs due to costs for coordination, information search, monitoring, and controlling that the transaction goes on as predefined (Williamson 1985). Transaction costs not only include quantifiable costs, but also "costs as disadvantages" (see Picot, Dietl, 1990). Trust in relationships between buyers and sellers lowers transaction costs by reducing the efforts for contracting and the costs for control and monitoring. As a consequence, the existence of trust in a buyer-seller relationship complements incomplete contracts. This is why trust in buyer-seller relationships is often considered as an economic asset creating value (Dyer, Chu, 2000; Wilson, Kennedy, 1999).

Information economics (Nelson, 1970, Akerlof, 1970) analyses the impact of an asymmetric information level of buyers and sellers and its effects on market performance. Information asymmetry is typical for goods where experience and credence characteristics are predominant such as in agrifood products. To overcome information asymmetry, information screening and signaling together with the creation of long-term business relationships is necessary. Long-term business relationships build on experience as alternative to information search (Weiber, Adler, 1995). Past experiences and interaction create trust between business partners (Anderson, Weitz, 1989).

Socio-economics (Granovetter, 1985, Etzioni 1988) analyzes the influence of social networks, the social environment and cultural rules on the behavior of market participants. Trust and "social embeddedness" in a society's values and moral ideas are considered as determinants to business decisions. It is argued that direct personal experiences and social ties play a more important role than indirect reputation. Different cultural backgrounds and habits influence the interaction between businesses (see Hofstede et al., 2002).

Exchange relationships between businesses may be transformed to electronic exchange relationships by introducing electronic marketplaces or electronic trade platforms (Malone et al., 1987, Bakos, 1991). Electronic marketplaces are intermediaries between buyers and sellers aiming at making transaction processes more efficient as opposed to traditional transaction processes. They intend to reduce transaction costs by supporting information and communication processes between businesses. However, despite those advantages electronic marketplaces – including those in the agrifood sector – faced difficulties to enter in buyer-seller relationships (Fritz et al., 2004). One problem may have been the lack of adapting and embedding the marketplaces' services to the demands of existing buyer-seller relationships (see Hausen 2005 for "embedded electronic commerce"). Another problem may have been the trust problem related with the anonymity of the electronic commerce environments and the

lack of experience how to deal with them (Franke Kleist 2004). This problem is of particular significance in the agrifood sector with the specific characteristics of food products.

3 Trust model for electronic commerce in the agrifood industry

The generation of trust in electronic commerce environments to overcome information asymmetry related with its anonymity is often related to elements like reputation systems where buyers and sellers can rate one another based on their experiences (Keser, 2003, Bolton et al., 2004). Trust signs such as VerSign signaling a positive third-party ranking are also frequent means to create trust in e-commerce. Others specify the technical infrastructure of an e-commerce presence with, e.g., SSL-encryption as important trust generating element (Franke Kleist 2004; Ratnasingham 2004). However, existing work on trust in electronic commerce does not consider the particular transaction situation in the agrifood. There is no consistent model allowing for the analysis and transfer of a traditional trust structure in agrifood business relationships to an electronic transaction environment.

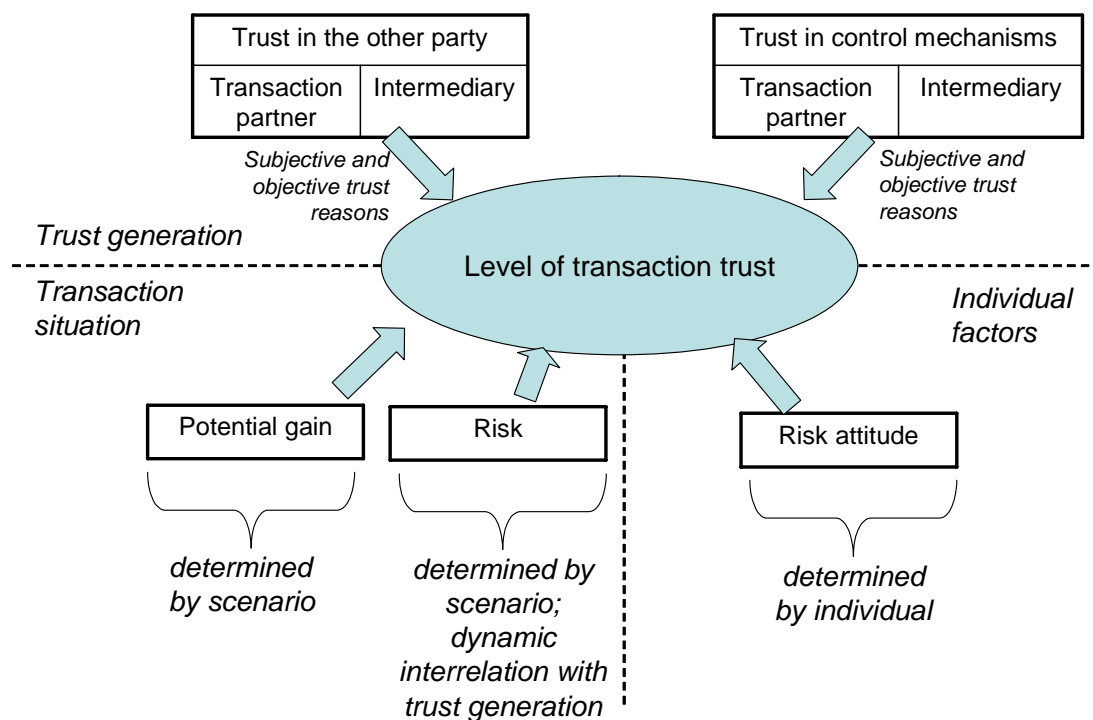


Figure 1: Trust model for electronic commerce in the agrifood sector (based on Tan, Thoen 2001)

The model for trust in electronic commerce in the agrifood sector presented in this paper builds on a basic model for designing trustworthy electronic commerce environments (Tan, Thoen, 2001). This basic model presumes that an individual's level of trust in a transaction is determined by his trust in the transaction party and the control mechanisms, potential gains from the transaction, the risk involved and the individual's risk attitude. Individuals would only engage in a transaction if the level of trust exceeds their personal threshold of trust. However, the basic model does not specify the dynamic interrelation between the risks and benefits in a transaction situation and the trust generation for the design of a trustworthy e-commerce environment. In addition, the basic model does not provide



a “toolbox” of trust elements appropriate for e-commerce. This paper expands and adapts the trust model to the situation of electronic commerce in the agrifood industry, includes the dynamic interrelation between a transaction situation and trust generation and its influence on the level of trust in a transaction (see figure 1), and provides trust generating elements for an e-commerce environment in the agrifood sector. The trust model allows for analyzing the trust determinants and trust reasons creating a certain level of trust in a given “traditional” transaction situation with a certain risk. The design of an appropriate electronic transaction environment for this given scenario requires the creation of appropriate trust generating reasons to reach at least the same trust level (see also Franke Kleist 2004). In addition, the interrelation between trust generation and potential benefits and risks related with the altered, electronically supported transaction scenario must be taken into account.

3.1 Analysis of the trust determinants in agrifood e-commerce

In the center of the figure is the level of trust in a transaction, which is determined by five blocks addressing the other parties and control mechanisms involved in the transaction, the transaction situation’s gains and risks, and the individual. Changes in the five blocks dynamically alter the level of trust in a transaction.

The upper half of figure 1 shows the trust generating determinants, the trust in the transaction party and the trust in the control mechanisms provided to monitor the performance of a transaction. In transactions, trust and control complement each other. The underlying control mechanisms must be trusted as well. When it comes to electronic commerce in the agrifood industry, trust in two transaction parties may be required, the actual transaction partner and an intermediary, e.g. an electronic trade platform. Accordingly, trust is required for the control mechanisms of the transaction partner himself and the intermediary. For both determinants, there exist subjective and objective reasons creating trust in the other party and the control mechanism. The trust generating determinants together with appropriate, hierarchically derived trust reasons can be used to design trustworthy transaction environments for electronic commerce in the agrifood industry.

The lower left quarter of the figure shows the factors in a transaction situation particular to a specific transaction scenario determining the transaction trust level: the potential gain and benefit to be expected from a transaction and the risk involved. Electronically supported transactions have an efficiency potential offering a potential benefit as opposed to traditional transactions (see Hausen 2005). In addition, electronic commerce can open access to new markets. However, the perceived risk may lower the trust level too much to make companies engage in e-commerce. Risk in electronic commerce transactions in the agrifood industry is complex and arises from a number of sources. In general, every transaction with agrifood products contains risk as an information asymmetry exists between buyer and seller regarding the food product quality consisting of search, experience, and credence characteristics (see Fearne et al., 2001). In addition, the degree of risk in a transaction depends on the possible degree of damage and the negative consequences following a failed transaction. International transactions with partners from other countries – e.g. fruits and vegetables from Mediterranean EU countries to northern EU countries – always bear an additional risk. When it comes to e-commerce transactions with agrifood products, risk not only comes from an information asymmetry between buyer and seller regarding product quality, but also regarding the overall transaction settling including payment and shipping (see also Franke Kleist 2004).

In essence, it may be said that an e-commerce transaction situation in the agrifood industry on the one hand has a potential gain through efficiency potentials, but on the other hand adds an additional risk to agrifood transactions. As the trust model shows, high risk may rise the trust level needed for an individual to engage in a transaction. A high level of risk in a transaction situation may be compensated by an intense trust generation.



The lower right part of the figure shows the individual’s risk attitude determining his personal trust threshold.

3.2 Elements for trust generation

To design a trustworthy e-commerce environment for transactions in the agrifood industry achieving a sufficient level of trust, appropriate reasons to generate trust in the other party and the control mechanisms must be derived. Reasons to trust a transaction party or a control mechanism overlooking a transaction may be grouped into objective and subjective trust reasons (Tan, Thoen 2001, see table 1). An objective reason to trust someone or something can be a commonly known and widely accepted social indicator such as a uniform or a certified procedure. Subjective reasons to trust are previous, positive personal experiences, the understanding of someone’s objectives and capabilities or how something works, and communality. Communality refers to opinions of trusted community members and may be considered equivalent to the concept of reputation in socio-economics (Granovetter 1985).

Table 1: Trust reasons and trust sources
(based on Tan, Thoen 2001)

Trust reasons		Trust sources	Party trust	Control trust
Objective trust reasons			Uniforms	Control procedure certified by trusted organization
	Social indicators			
Subjective trust reasons	Personal experience		Previous, positive interactions (“normal” experience and transaction experience)	Previous positive interactions with control procedure
	Under-standing		Understanding of others’ goals, plans, capabilities	Understanding how control procedure works
	Communality		Opinions and trust of trusted community members regarding party	Opinions and trust of trusted community members regarding control procedure

It is important to differentiate that trust arising from positive experiences comes ex post and develops over time. In contrast, understanding, communality and social indicators generate trust ex ante before a personal experience has been made. Electronic commerce is a rather new transaction situation where individuals have only little – or even negative – experiences. As a consequence, personal experience is not the appropriate trust reason to generate a trustworthy e-commerce environment supposed to attract businesses to start engaging in e-commerce. To increase the initial level of trust in e-commerce transactions, ex ante trust reasons must be focused. Personal experience with electronic commerce transactions – if positive – as an ex post trust reason comes into play over time. This shows that there is a dynamic shift in the relevance and appropriateness of trust reasons creating a trustworthy e-commerce environment. Figure 2 shows the shift in the relevance of ex post

and ex ante trust reasons over time. The changing relevance of trust reasons also interferes with the particular transaction scenario and the risks and potential gain involved.

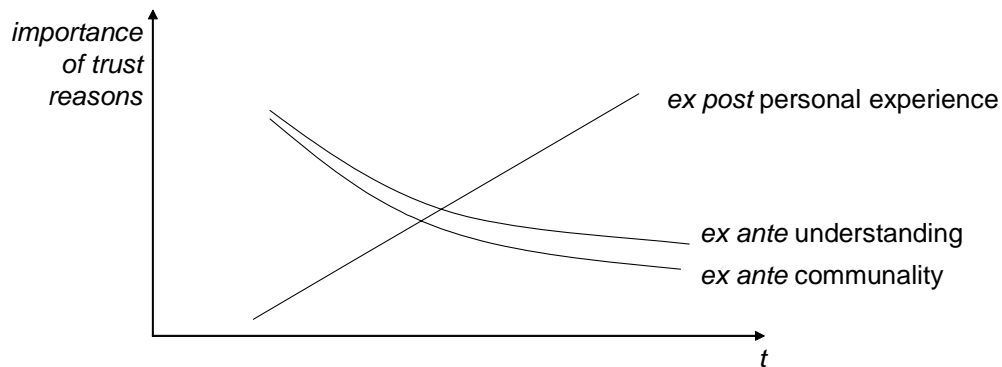


Figure 2: Change in importance of ex post and ex ante trust reasons over time

The ex ante trust reason understanding requires from an individual time to analyze or study information about the transaction partner or the control mechanisms. According to the “costs as disadvantages” view of transaction costs, understanding as trust reason increasing the trust level of a transaction involves transaction costs. As a consequence, to enable businesses to engage in electronic commerce transactions, the cost-benefit-ratio between transaction costs related to understanding the party or the control procedure and the potential gain coming from electronic commerce transactions such as access to new markets or supply sources must be less or equal one $C/B \leq 1$.

Table 2 analyses reasons to trust the transaction parties and control mechanisms in traditional agrifood transactions. In addition, it analyses whether the trust reasons can be transferred to an electronic transaction environment. The analysis takes into account the shift in the relevance of ex post and ex ante trust reasons (see above).



Table 2: Trust reasons in traditional and electronic agrifood transactions

Trust reasons		Trust sources		Trust sources	
		Party trust	Control trust	Transaction partner	Intermediary*
Objective trust reasons	Social indicators	Recommendation from industry association	Recommendation from industry association*	Quality of production processes (e.g. quality systems, ISO 9000ff.)	Quality of intermediation processes (e.g. VeriSign)*
	Personal experience	Impression of company's representatives; Preliminary product sample; Past transaction experience; Past personal experience	Usability *; Preliminary product sample*; Past transaction experience*; Past personal experience*		
Subjective trust reasons	Understanding	Product warranty Product description Common culture Company information Transaction contracts Logistics warranty Transaction partner's reputation at other companies;	Strong technical infrastructure*; Tailored transaction processes*; Transaction support (e.g. finance, logistics, trade regulations)* Transaction partner's reputation at other companies*;		Limited access to intermediary*
	Communality	Products' reputation at other companies	Products' reputation at other companies*		

*only in electronic transactions

In traditional agrifood transactions, main reasons creating trust between two parties are past, personal experiences with a transaction party, the understanding of his actions, and the social indicators of a control procedure such as ISO 9000ff. together with an understanding of control procedures.

In contrast, in electronic transactions, personal experience with business partners is less intense than in traditional transactions. Trust generated by personal experience is – in particular in the beginning – only very small. As a consequence, trust reasons from other areas must be implemented to



generate trust for electronic commerce transactions in the agrifood. Appropriate compensation must be provided by intensifying other trust reasons. In particular, trust reasons grouped under understanding must be focused and transferred to an electronic transaction environment. Additional trust generation may come from social indicators and communality. Personal long-term experience may to some extent be converted into the first impression of the transaction partner and the intermediary (see table 2). In addition, potential efficiency gains in electronic commerce transactions positively influence the trust level.

To analyze the relative importance of trust generating factors in a specific transaction scenario, the Analytical Hierarchy Process (AHP, Saaty, 1990) is an appropriate method. The AHP builds on a hierarchy of criteria and pairwise comparisons between the criteria at every level of the hierarchy. The trust generating factors shown in table 2 can be mapped in a hierarchy to allow for the pairwise comparisons and the analysis of the relative importance of the single trust generating factors in a specific transaction situation (see figure 3). The actual transaction situation influences the trust level by its potential gains and risks.

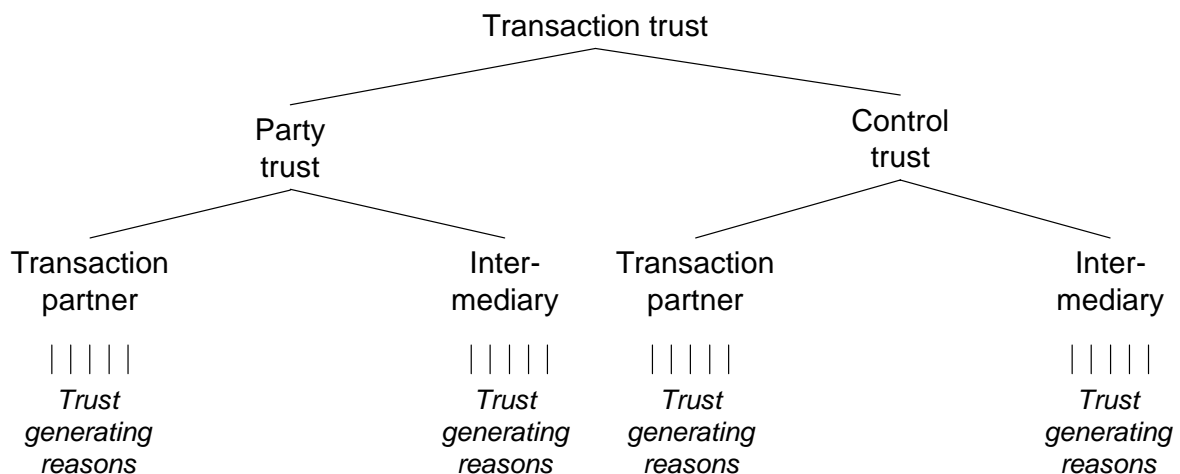


Figure 3: AHP-hierarchy

Table 3 derives appropriate electronic trust elements for the implementation of the trust reasons relevant in a specific agrifood transaction scenario to an electronic trade environment.



Table 3: Trust reasons and their electronic implementation

Trust reasons	Electronic implementation
Recommendation from industry association	Letter of recommendation
Impression of company's representatives	Videoconferencing, personal get-together at meeting
Preliminary product sample	Shipping of product sample
Past transaction experience	<i>Only ex post</i>
Past personal experience	<i>Only ex post</i>
Preliminary product sample	Shipping of product sample
Product warranty	Signaling
Product description	Multimedia product description
Common culture	Signaling with information and design, usability, communication processes
Company information	Multimedia company information
Transaction contracts	
Logistics warranty	Signaling
Transactions partner's reputation at other companies	Reputation system
Products' reputation at other companies	Reputation system
Usability	Usability engineering (see Haas 2004)
Strong technical infrastructure	see Franke Kleist (2004)
Tailored transaction processes	see Hausen (2005)
Transaction support (e.g. finance, logistics, trade regulations)	Hausen (2005)
Quality of production processes	Signaling with sign
Quality of intermediation processes	Signaling with sign
Limited access to intermediary	Authentication, trusted partner criteria

4 Experimental study

The trust model for electronic commerce in the agrifood sector was evaluated in a first experimental study that tested whether electronic trust elements derived with the trust model for a specific scenario increased the level of trust sufficiently to make test persons engage in electronic transactions. The international trade of agricultural fresh fruits between southern and northern EU countries was taken as traditional agrifood transaction scenario to be transferred to an electronic transaction environment. In an expert interview, the determinants of the trust level particular to this transaction scenario were identified. Fresh fruits are highly perishable goods with a very large amount of different quality levels. As a consequence, risk in this international transaction scenario is considered as very high. Past personal contact and experience between transaction partners as well as past transaction experiences are trust reasons of outstanding relative importance.



4.1 Experimental design

For the evaluation of the trust model for e-commerce in the agrifood sector, the traditional ex post trust reason “past personal experience” was electronically implemented by the ex ante trust reason “impression of company’s representative”. The impression of company’s representatives describes personal experiences from a personal contact between transaction partners, but excludes past transaction experience. As an ex ante trust reason, the impression of a company’s representative is suitable to generate trust before a transaction and may be transferred to an electronic transaction environment.

An experimental long-term study during eight weeks was accomplished to analyze if the trust reason “impression of company’s representative” increases the trust level in an electronic agrifood industry transaction scenario sufficiently to overcome the risk perceived in the electronic transaction environment and to realize transactions. The underlying hypothesis was: The existence of direct, electronically mediated, and indirect (reputation) personal relationships between transaction partners raises the trust level in e-commerce transactions in the agrifood industry sufficiently for transaction partners to engage in electronic transactions. Metric was the relative frequency of transactions between transaction partners of the four relationship levels as opposed to the expected value. The transaction scenario were transactions between the first two levels of the fresh fruit supply chain (fruit growers – fruit traders) with an electronic trade platform with request for quote (RFQ) as tailored transaction process (see Hausen 2005).

Participants in the experiment were agricultural and food science students from the University of Bonn, Germany and the University of Natural Resources and Applied Life Sciences, Vienna, Austria to map the different intensity of relationships between potential transaction partners and the international differences. Their task was to accomplish supply or sales transactions that could be executed independently from time and location. Participants from Bonn and Vienna were evenly distributed to companies at both levels of the supply chain. Half of the participants were logged into the electronic trade system with their name to signal a reputation, the other half anonymously. Participants from Bonn and Vienna known by name were introduced to each other via videoconference.

Table 4 shows the possible transaction constellations in the experimental study.

Table 4: Possible transaction constellations in the experimental study

						Offers			
		SuBk	SuBa	SuVk	SuVa	SaBk	SaBa	SaVk	SaVa
Closed deals	SuBk	-	-	-	-	P	A	V	A
	SuBa	-	-	-	-	P	A	R	A
	SuVk	-	-	-	-	V	A	P	A
	SuVa	-	-	-	-	R	A	P	A
	SaBk	P	A	V	A	-	-	-	-
	SaBa	P	A	R	A	-	-	-	-
	SaVk	V	A	P	A	-	-	-	-
	SaVa	R	A	P	A	-	-	-	-
SuBk:	Supplier Bonn, known				P:	Personal relationship			
SuBa:	Supplier Bonn, anonymous				V:	Contact via videoconference			
SuVk:	Supplier Vienna, known				R:	Reputation			
SuVa:	Supplier Vienna, anonymous				A:	Anonymous			
SaBk:	Sales Bonn, known								
SaBa:	Sales Bonn, anonymous								
SaVk:	Sales Vienna, known								
SaVa:	Sales Vienna, anonymous								



Table 5 shows the expected values of each transaction constellation serving as reference values. In addition, four transaction directions between participants were possible: Bonn to Bonn ($B \rightarrow B$), Bonn to Vienna ($B \rightarrow V$), Vienna to Vienna ($V \rightarrow V$), and Vienna to Bonn ($V \rightarrow B$). The transaction direction shows which partner has taken the initiative to start the transaction.

Table 5: Expected values of transaction constellations

Transaction constellation	P	V	R	A
Expected value	1/4	1/8	1/8	1/2

4.2 Results

During the eight weeks of the experimental long-term study, 88 requests for quotes were published with 220 offers. 65 request for quote deals were closed. Tables 6 and 7 show the relationships between the transaction partners and the transaction directions for the request for quote transaction mechanism in detail.

Table 6: Transaction relationships in request for quote transactions

Perspective	Transaction phase	Number of actions	Transaction relationship			
			P	V	R	A
Sales	Offers	220 (100%)	94 (43%)	28 (13%)	32 (14%)	66 (30%)
Deviation from expected value			+ 18%	+ 0,5%	+1,5%	-20%
Supply	Realizations	65 (100%)	18 (28%)	9 (14%)	10 (15%)	28 (43%)
Deviation from expected value			+ 3%	+ 1,5%	+ 2,5%	- 7%

Table 7: Transaction direction in request for quote transactions

Perspective	Transaction phase	Number of actions			Transaction direction			
		total	B	V	$B \rightarrow B$	$B \rightarrow V$	$V \rightarrow V$	$V \rightarrow B$
Sales	Offers	220 (100%)	87 (40%)	133 (60%)	12 (5%)	75 (34%)	109 (50%)	24 (11%)
Deviation from expected value			-5%	+5%	-17,5%	+6,5%	+22,5%	-11,5%
Supply	Realizations	65 (100%)	12 (18%)	53 (82%)	1 (1%)	11 (18%)	36 (55%)	17 (26%)
Deviation from expected value			- 27%	+ 27%	-21,5%	-9,5%	+27,5%	+3,5%

4.3 Discussion

The results of the experimental study regarding the transaction mechanism request for quote show – in particular at the offers – a clear movement to transaction relationships between personally known



partners. Transactions between partners known via videoconference and reputation were more frequent than expected, but the deviation from the expected value was less obvious. Transaction directions show an interesting picture: the largest part of the realized transactions has taken place within the Vienna group. The relationships among the participants from Vienna were closer than among those from Bonn. This result suggests that the trust level in e-commerce transactions is to a large degree influenced by the existence of a previous personal, not transaction related contact between future transaction partners. The result corresponds with conclusions from socio-economics showing that the indirect contact reputation is less trust generating in business relationships than personal contact.

The results from the experimental study show that the developed trust model for electronic commerce in the agrifood sector is suitable to derive electronic trust elements for a specific agrifood transaction scenario increasing the level of trust sufficiently to make test persons engage in electronic transactions.

5 Conclusions

Electronic commerce is an interesting support option for companies in the agrifood sector to establish new business relationships. However, the agrifood sector deals with products where a large amount of information asymmetry exists between transaction partners. Many characteristics of food products may only be analyzed after use and others even cannot be examined at all. Electronic commerce where has often been criticized as too anonymous for agrifood transactions. The risk and uncertainty created a lack of trust in electronic commerce in the agrifood sector. Due to trust problems, the benefits from electronic commerce where considered less important than the obstacles.

This paper has developed a trust model for electronic commerce in the agrifood industry supporting the analysis of trust determinants in traditional agrifood transaction relationships and their transfer to appropriate trust determinants in the electronic commerce environment. The model was evaluated in a first experimental study. The results show that the trust model for electronic commerce in the agrifood sector is suitable to support the implementation of electronic trust elements for a specific agrifood transaction scenario increasing the level of trust sufficiently to make test persons engage in electronic transactions.

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