Inter-Organizational Information Systems in Meat Supply Chains

Jan Bahlmann1 and Achim Spiller2

1 Department of Agricultural Economics and Rural Development, University of Goettingen, Germany, j.bahlmann@agr.uni-goettingen.de
2 Department of Agricultural Economics and Rural Development, University of Goettingen, Germany, a.spiller@agr.uni-goettingen.de

Abstract

The German meat sector is faced with increasing cost pressures and a high demand for quality and safety. Both issues require powerful and holistic IT solutions in order to achieve knowledge transfer, process alignment and transparent information flow across the supply chain. In recent years, some Inter-Organizational Information Systems (IOS) with a broad range of functions were developed for the German red meat supply chain. However, there is hardly any research on these systems. The current findings offer comprehensive insight into the literature on IOS, the status quo of data flows in the pork sector and the most relevant existing web applications. The present analysis is affiliated to an interdisciplinary research project on IT supported traceability, quality assurance and supplier evaluation in the German meat industry (IT FoodTrace).1

Keywords: Inter-Organizational Information Systems, Meat Industry, Information Technology, Information Management, Data Flow, Food Chain Information, Web Applications

Introduction

The globalization of meat trades, intensive cost competition at the food retail level and continuous meat scandals require a more efficient utilization of and a reliable exposure to meat chain information. In Germany, approximately 25 meat scandals have happened since 2005 (Dittberner, 2008). This induced an urgent need for action to control the flow of goods, its associated data and the quality of suppliers across the meat supply chain.

In recent years, various Inter-Organizational Information Systems (IOS) were introduced into the market. Still, there is little knowledge on the application area of these systems and the scope which ranges from unidirectional transfer of slaughter and meat-inspection results to seamless tracking and tracing. So far, holistic Information Systems which are capable of managing data and information across the supply chain as a whole apparently failed to materialize beyond vertically aligned systems. However, the spot market in which 90% of the total pork is traded in Germany is the most relevant channel in terms of the total effects on food quality and safety. It remains unclear which IT solutions already exist for non-integrated chains which are characterized by unstable relationships and frequent switching behavior. The

---

1This paper discusses partial results of a research project on IT-supported agrifood chains for improved traceability of meat products (IT FoodTrace) financed by the German Federal Ministry of Education and Research (code: 0330761).
research gap complicates the identification of further development potentials and bears the risk
to reinvent already existing technologies.

**Objectives and methodological framework**

This paper discusses first results of the interdisciplinary research project IT FoodTrace which is
focused on IT supported traceability and quality assurance in meat supply chains. In this project,
agricultural economists, animal production scientists, veterinarians and information scientists
work together with companies of the IT and meat sector (e.g. IBM Germany). The vision of IT
FoodTrace is an IT solution for decentralized, holistic data management across the meat supply
One concrete objective is to develop a conceptual framework for IT supported supplier
evaluation systems which shall be realized as part of an Internet-Based Information System
(IBIS).

The present findings of our long-term project first provide insight into the general and
sector specific literature on IOS and the status quo of inter-stage data transmission. The results
are mainly based on 11 expert interviews with CEOs and department managers of the meat (7)
and IT (4) sector. Furthermore an extensive literature review on IOS with particular
consideration of the agribusiness sector was carried out. The findings were completed and
discussed in one of the project’s internal seminars and a workshop with scientists and
practitioners of the meat industry.

In a second step, the most important IOS for the pork sector were analyzed and classified
into three main clusters. The underlying information was collected by means of personal
interviews with the providers, system-documentations, company websites and software-testing
if the opportunity was given.

**Inter-Organizational Information Systems**

**Definition and delineation**

In recent years, Information Systems have intensively been discussed in information economics
and computer science. The high interest can be traced back to the growing relevance of
information as an important competitive factor (Blake, *et al.*, 1984) in increasingly complex
and globalized markets. The term “Information System” was coined by Langefors “Theoretical
Analysis on Information Systems” in the middle of 1960s in which he defines an Information
System as a medium to collect, store, process and distribute information sets (Langefors, 1966:
143). IOS are a sub category of Information Systems and underline the management of
information from a multi-organizational perspective. In this study IOS are treated as
“automated information systems shared by two or more companies” (Cash, *et al.*, 1985: 134)
that “extend beyond traditional enterprise boundaries” (Hong, 2002) and provide operative and
strategic information about relevant resources.

The various opportunities of information and data transfer in IOS require a further
differentiation into classic and computer-based communication channels which will become
relevant for the demonstration of the status quo of data and information flows in Chapter 4.
Classic communication channels, for example, include the use of face to face and telephone
conversation, mail and fax. In contrast, computer-based communication methods comprise the
digital transfer of data through company’s internal intranets or the WWW using stationary (e.g.
desktop computer) or mobile devices (e.g. mobile phone, PDA). Furthermore, the literature on
Information Systems distinguishes between non-internet-based IOS, such as classic EDI on the
one hand and Internet-Based Inter-Organizational Information Systems (IBIS) on the other hand (Soliman, et al., 2004: 698).

Research on Internet-Based Information Systems in the agribusiness

The general attention towards e-business in agricultural economics and information science has increased in recent years. There is a broad range of literature which is focused on the adoption of information and communication technologies. Among these studies, some are directed towards the acceptance and diffusion of IT in the agricultural input industry (Akridge, 2003), others refer to the acceptance at farm level (Fick, et al., 2007) or small and medium sized enterprises of the agribusiness (Doluschitz, et al., 2005; Vlachos, et al., 2007). However, the research which targets the inter-organizational dimension of Information Systems, especially IBIS in the agrifood chain is very limited (Storer, 2006).

Recent studies, for example, discuss the general requirements for IT enabled quality assurance, such as “full traceability”, “lifecycle information”, “extensibility and interoperability”, “cost efficiency” and “completeness” (Salampasis, et al., 2007). Theuvsen et al. (2007) analyzed the exchange of mandatory, certification related data across-the-stages. It was found that electronic information transfer in the German meat sector is “still in its infancy and is mainly restricted to providing online access to or email transmission of slaughter documents” (ibid.: 568).

In the application-oriented research, Poignée et al. (2003) have discussed the development of an inter-organizational, web-based quality communication system for a regional grain-flour processor, who established a vertically aligned partnership with his suppliers (ibid.: 582). The conceptual framework consists of the sub-systems “track & trace”, “quality assurance”, “quality coordination” and “quality improvement” which are tied to a centralized database. In a parallel study the authors provide a simplified semantic model for the implementation of the web-based system (Hannus, et al., 2003). However, the study describes an application prototype, which was developed under controlled conditions for a specific vertically aligned chain. It is therefore limited in terms of generalization and application to a spot market situation.

Very few studies broach the topic of web-based supply chain management in the red meat sector. Schulze Althoff et al. (2004) developed a food chain information system for animal health management and risk based meat-inspection in the pork industry. The study proposes a centralized data management system which integrates the first stages of the supply chain from pig production (breeding) to slaughter.

Against this, there was a scientific report on SiTRA, which is considered as a first attempt to provide internet based, spot market compatible Information Systems. The web application was designed to establish traceability for regional brands in 8 large Italian food chains (Giannerini, 2007). SiTRA achieves compatibility to the existing IT Systems at stakeholder level by means of special web services which are capable to produce supply chain specific XML data schemes. Noteworthy is the web GUI which provides methods to design and extend traceability data-flows for and the relation between various supply chains.

All in all, there is still no study which concretely analyzed a conceptual framework for the implementation of IBIS in spot markets. The following chapter provides a general overview on the supply chain framework, communication channels as well as the sources, possible destinations and the flow of important meat chain data.
Supply Chain Characteristics, Communication Channels and Data Flows

In general, the German red meat sector is characterized by a high degree of division of labor, predominant spot market organization and non-transparent marketing channels. The count of actors in the supply chain ranges from 214 slaughterhouses\(^2\) to 52,700 pig fatteners (Destatis, 2007). Some organizations require a more detailed explanation since they are characteristic for the German market (c.f. Fig.2).

- Livestock marketing agencies, such as private livestock dealers or farmer associations build an intermediate stage between farmers and slaughterhouses on which approximately 90\% (Traupe, 2002) of the slaughter pigs in (north-western) Germany are purchased (pooled), partly traded among each other, and resold to slaughterhouses.
- The Qualität und Sicherheit GmbH (QS) provides the most important certification system in the German meat sector which covers almost the entire supply chain. QS coordinates salmonella monitoring sample-plans and results across laboratories, farmers and slaughterhouses.
- The veterinary office is responsible for the mandatory\(^3\) carcass meat-inspection before slaughter.
- HI-Tier is a nation-wide internet database, provided by the Bavarian State Ministry of Agriculture and Forestry, to control livestock movements from breeding to slaughter.

The same applies to certain pool of data and information which is to some extent specific to the German meat sector.

- The term “special certificates” describes information on further certificates beyond QS. In Germany, there are approximately 30 different certification systems (Theuvsen, et al., 2007) which require the transfer of additional process data across the supply chain, at least the basic information on the certification status.
- The “standard supply note” is the farmers’ confirmation of or comment on mentionable limitations about the sanitary harmlessness of a certain batch of slaughter pigs which are prepared for delivery. The note has to be transferred not later than 24 hours before delivery to the corresponding slaughterhouse which forward it to the official veterinarians.\(^4\)
- The “carcass grading results” are a collection of meat quality data which are measured at the beginning of the slaughter process. The data furthermore serve as critical target values for the fattening process and build the basis for the final payoff beyond the live- and dead-weight, respectively.

Fig.2 contains a summary of the empirical and literature-based findings. The left side of the illustration shows the almost classic supply chain structure whereas the right side includes all those stages which are affiliated but not directly involved in the production process. The sources and possible destinations of relevant data in the German pork sector were described for each of the supply chain members. The right columns\(^5\) on each block include information which is provided from that level to the corresponding trading partners and there, in turn, are

---

\(^2\) Counted from a minimum of 20 employees.

\(^3\) Based on the German meat hygiene regulation (Fleischhygienegesetz) from 11.12.1986.


\(^5\) Described as “provide”.
The analysis reveals that the total range of meat chain data which has to be collected, entered and transferred down the supply chain declines from farmer to food retail level. This...

---

6 Described as “retrieve”.
7 I=Feed industry; F=Farmers; L=Livestock marketing agencies; S=Slaughterhouses; P=Meat processors; R=Food retail.
8 The map does not include the classic, transaction related information, such as orders or invoices which generally appear on every stage of the supply chain.
coincides with the count of contacts which is up to two times higher at primary producer level in comparison to the food retail. Farmers generally communicate with several other institutions apart from their suppliers and customers. On the one hand, animal inflow/outflow and fattening process data (standard supply note) has to be transferred to the government (HI-Tier database and official veterinarians). On the other hand, livestock farmers receive prescription documents from farm veterinarians, analyses from their consultants as well as audit reports and salmonella monitoring results from certification companies (e.g. QS). Against this, the food retail exchanges information with processors, QS and – to a limited extent – consumers.9

Thus, the majority of meat chain data has to be entered at the first stages of the supply chain. For this reason the acceptance of an IBIS at the primary producer level determines the final success in terms of seamless traceability. Currently, new information and communication technologies are still not sufficiently accepted at the farm level (cf. agriMA, 2005; Stricker, et al., 2003; Fick, et al., 2007). In general, farmers still prefer the use of classic communication channels for the exchange of information and data with slaughterhouses, marketing agencies, QS and all other business partners (c.f. dashed and continuous lines in Fig.2).

Presently, one of the major obstacles to establish appropriate IBIS for the spot market is the missing statutory basis. The European law regulates that every facility only has to prove the next direct supplier of resources one step up and the disposition of the finished goods one step down the supply chain.10 In general, there is hardly any willingness to exchange data or to accept the expenses of additional data providing. As a result, there are limited possibilities to track and trace products and product related data across the entire supply chain. Fig.2 shows, that the traceability of meat from food retail to primary production is hardly realizable. The farmers’ data, indeed, is exchanged with the feed industry and livestock marketing agencies, but is not transferred to slaughterhouses11, secondary processors, the food retail and, eventually, the consumer. Manual requests along the supply chain lead to considerable delays in time and relatively high expenses. Finally, this regulation not only pertains to the basic transaction related information (e.g. quantities, invoices, orders) which is crucial in terms of traceability but also to advanced food chain information, such as livestock health related information (e.g. mortality, drug application, finishing time, carcass meat-inspection history, salmonella monitoring history) which would be essential for, e.g., the recently introduced approach of risk based meat-inspection12 or general certification related processes.

Existing Internet-Based Information Systems in the German meat sector

In the past decade some slaughterhouses, public agencies and private companies already developed different types of IBIS to improve the efficiency of data communication across the supply chain. To the best of our knowledge, there is no research which systematically analyses these systems. Therefore, a general classification was carried out by means of the criteria

---

9 However, this argumentation does not apply to the total amount of data received from various processors which, by nature, is more complex at the retail and industry level.
10 Based on Regulation (EC) 178/2002.
11 This is due to the relatively high importance of intermediate livestock marketing agencies in Germany.
12 The risk based meat-inspection bases on the Regulation (EC) 854/2004 with further specification in the Regulation (EC) 1244/2007 and is currently at the very beginning stage of implementation. Under certain circumstances (e.g. controlled animal husbandry conditions, 24-h pre-transmission of animal health related data, regularly microbiological internal controls) the European law enables the inspection on carcasses on a visual-base (without palpation and incision).
“System type/ development”, “system owner”, “main addressees”, “channel characteristics” and “main functions” (cf. Tab.1).

**Tab.1. Classification of important IBIS in the German meat sector (Source: Authors’ analysis)**

<table>
<thead>
<tr>
<th>System name</th>
<th>System type/ development</th>
<th>System owner (availability)</th>
<th>Main addresses</th>
<th>Channel characteristics</th>
<th>Main functions (no claim to be complete)</th>
</tr>
</thead>
<tbody>
<tr>
<td>01 Qualiproof</td>
<td>Web application (database) / In-house design</td>
<td>Certification system (free for QS members)</td>
<td>Farmers, slaughterhouses, laboratories</td>
<td>Multidirectional, transfer and receipt of data</td>
<td>Coordination of salmonella monitoring results and sample plans across-the-stages</td>
</tr>
<tr>
<td>02 HI-Tier</td>
<td>Web application (database) / In-house design</td>
<td>Bavarian State Ministry of Agriculture and Forestry (free)</td>
<td>Farmers, slaughterhouses, marketing organizations</td>
<td>Multidirectional, receipt of data</td>
<td>Documentation of livestock history data (inflow/outflow) and master data</td>
</tr>
<tr>
<td>03 Westfleisch Extranet</td>
<td>Web application / In-house design</td>
<td>Slaughterhouse (exclusive for suppliers)</td>
<td>Farmers</td>
<td>Unidirectional, upstream</td>
<td>Carcass grading/meat-inspection result transfer + analysis, salmonella monitoring, inter-farm comparison</td>
</tr>
<tr>
<td>04 Farmingnet</td>
<td>Web application / In-house design</td>
<td>Slaughterhouse (exclusive for suppliers)</td>
<td>Farmers</td>
<td>Unidirectional, upstream</td>
<td>Carcass grading/meat-inspection result transfer + analysis</td>
</tr>
<tr>
<td>05 Schlachtdaten-Online</td>
<td>Web application / Standard design</td>
<td>Agricultural associations (commercial)</td>
<td>Farmers, slaughterhouses</td>
<td>Unidirectional, upstream</td>
<td>Carcass grading/meat-inspection result transfer + analysis</td>
</tr>
<tr>
<td>06 Qualifood</td>
<td>Web application / Standard design</td>
<td>Incorporated society (commercial)</td>
<td>Farmers, slaughterhouses</td>
<td>Multidirectional, up- and downstream</td>
<td>Carcass grading/meat-inspection result transfer + analysis, standard supply note transfer, salmonella monitoring</td>
</tr>
<tr>
<td>07 Farmer's Friend Online / Farmer's Friend Multi</td>
<td>Web and local application / Standard design</td>
<td>IT company/consultancy (commercial)</td>
<td>Feed mills, farmers, marketing organizations, slaughterhouses</td>
<td>Multidirectional, up- and downstream</td>
<td>Carcass grading/meat-inspection result transfer + analysis, profitability calculations, salmonella monitoring, standard supply note transfer, knowledge management across-the-stages</td>
</tr>
<tr>
<td>08 Mais Infosystem Fleisch</td>
<td>Web application / Customizable designs</td>
<td>IT company (commercial)</td>
<td>Farmers, marketing organizations, slaughterhouses, retail</td>
<td>Multidirectional, up- and downstream</td>
<td>Carcass grading/meat-inspection result transfer + analysis, inter-farm comparisons, benchmarks, salmonella monitoring, standard supply note transfer</td>
</tr>
<tr>
<td>09 Gutfleisch Transparenz</td>
<td>Web application / In-house design</td>
<td>Food Retail (exclusive for system members/ consumers)</td>
<td>Members of the vertically aligned system</td>
<td>Multidirectional, up- and downstream</td>
<td>Quality management support across-the-stages, t&amp;t, consumer information</td>
</tr>
<tr>
<td>10 GTNet</td>
<td>Web application / Customizable designs</td>
<td>IT company (commercial)</td>
<td>Chain coordinator (^{14})</td>
<td>Multidirectional, up- and downstream</td>
<td>Company-internal and inter-organizational t&amp;t</td>
</tr>
<tr>
<td>11 Chainfood meat Industry solution</td>
<td>Web application / Customizable designs</td>
<td>IT company (commercial)</td>
<td>Chain coordinator (^{15})</td>
<td>Multidirectional, up- and downstream</td>
<td>Integration of quality data, t&amp;t, risk management, animal health management</td>
</tr>
</tbody>
</table>

In the following, the IT-solutions were further classified into three main categories.

---

\(^{13}\) Conducted in June 2008.


\(^{15}\) Such as livestock-marketing organizations, slaughterhouses, processors or the food retail.
**Web-databases (systems 1-2)**
The first cluster comprises two nationwide known and (quasi-) mandatory web databases with a clearly defined scope of functions. “Qualiproof” is a central internet database which provides data to QS certified stakeholders in the pork supply chain. Its main features are to coordinate salmonella monitoring results and sample plans between slaughterhouses, laboratories, and farmers. The database is accessible by means of both, common website login and SOAP/XML interfaces to external systems. “HI-tier” is another web database provided by the public authorities to electronically record the inflow and outflow of livestock from the pig and cattle breeders stage to slaughterhouses. Additionally, livestock husbandry capacities on farming level have to be transmitted annually subject to a certain deadline. Those facilities which are obliged to report animal movements can access the database by means of a web frontend or locally installed batch processing software.\(^{16}\)

**Unidirectional data transfer between farm and slaughterhouse (systems 3-5)**
In the second cluster there are 3 IT solutions whose common denominator is the transfer of carcass grading and meat-inspection results from slaughterhouse to farm. Pig farmers can use these tools to control their slaughter results, compare themselves with farmer colleagues or check their livestock health by means of salmonella monitoring and meat-inspection analysis. Beyond some minor variation in the functional range, the main difference was identified in terms of availability. While the developments of Westfleisch (“Extranet”) and Vion (“Farmingnet”) are exclusively provided to their associated suppliers, “Schlachtdaten-Online” is an independent framework.

**Multidirectional data transfer across-the-stages (systems 6-11)**
The third and final cluster consists of 6 IT solutions which stand out from the above mentioned systems since their general focus is on more than 2 stages. Furthermore, these systems are capable to transfer meat chain data in both directions, up and down the supply chain. The scope of services and the structure within this group is quite different. “Farmer’s Friend Online/Multi”, “Mais Infosystem Fleisch” and “Qualifood” are generally related to the first cluster, since they dispose of a very similar scope of functions. However, “Mais Infosystem Fleisch” and “Farmers Friend Online/Multi” are partly more comprehensive in terms of profitability calculations, result representation, generation of information and additional marketing support for farmers. Furthermore, the Farmers Friend components provide a knowledge management tool for piglet producers, pig fatteners, feed mills, veterinarians and marketing agencies in order to enable collective troubleshooting. Against the dual system structure of “Farmers Friend”, including the “Multi”\(^ {17}\) and “Online”\(^ {18}\) version, “Mais Infosystem Fleisch” is structured modular. Dependent on customer requirements, the system is capable to integrate the complete supply chain.

Unique in the German red meat market is the holistic IBIS “Gutfleisch Transparenz” which has been specifically developed for the food retailer Edeka-Nord. “Gutfleisch” is an exclusive brand program by Edeka-Nord, in which “Gutfleisch Transparenz” is primarily used to control the flow of goods and its related information across the vertically aligned supply chain. The system furthermore includes a consumer web portal on which it is possible to trace additional data.

\(^{16}\) Further possibilities to report beyond the internet are mail and telephone.
\(^{17}\) Basic, locally installed application for breeders, consultants, feed mills, slaughterhouses and livestock marketing agencies.
\(^{18}\) Web application for farmers and consultants.
meat and meat products by means of the product code or the buying date back to a narrow pool of farms. At this aggregation level, certain information on the meat history, such as animal genetics, feed and feed supplier, animal husbandry and animal health is available.

The “Chainfood meat industry solution” (abbr. “Chainfood”) and “GTnet” are closely related to each other, since both systems base on a generic technology. Similar to the “Mais Infosystem Fleisch”, “Chainfood” and “GTnet” are customizable to various supply chain requirements and furthermore capable to link all stages of a supply chain. The main application areas of “Chainfood” are risk management (e.g. epizootics), health/quality data integration and monitoring (e.g. risk based carcass grading), cooperative animal health management as well as tracking and tracing. “GTnet” is specialized in intra- and inter-company tracking and tracing of products and product related information and bases on a decentralized data by reference technology. Due to the generic structure, traceability models and data sets are customizable and therefore meet various requirements on traceability.

In general, heterogeneous system structures, different marketing strategies and a very dynamic development complicate an accurate differentiation between the systems of the third cluster.

**Conclusion and further research**

The existence of a relatively large number of IBIS which are described in Chapter 5 may lead to the conclusion that the market is saturated and hence no need for further action in research. However, a closer view reveals that the majority of these systems focus on special application areas, such as slaughter and meat-inspection transfer and analysis (cluster 1), salmonella monitoring (“Qualiproof”) or archiving of animal movements (“HI-Tier”). In consequence, the German pork sector is generally compounded with different systems which focus on single parts of the supply chain. Transaction costs in terms of switching between and the adoption of these tools may even be greater than the advantages of computer-based communication. Especially for farmers, the use of classic communication channels such as telephone calls or faxes seems to be more efficient than using the internet.

However, there are also some more comprehensive approaches which integrate more than two or even all stages of the supply chain. For instance, Farmers Friend provides clearly defined applications for data exchange and inter-stage collaboration between various actors of the agribusiness. Still, the application is not designed for traceability and does not go further than from the feed industry to slaughterhouses. “Chainfood”20, “Tracetracker”21 as well as “Mais”22 provide customizable applications which generally require the initiation and coordination of a powerful supply chain leader (c.f. Grant, et al., 2006). According to Bowersox *et al.* (1996), this may be a company which initiated the inter-firm relationship, disposes of a sufficient size or the economic power to coordinate and harmonize the IT environment. However, a focal company, such as Danish Crown which controls the vast majority of the Danish pork production is not existent in Germany. There are a few partly aligned companies but hardly any completely integrated systems. Intense division of labor and non-contractual trades dominate approximately 90% of the market as a whole. Consequently, “Chainfood”, “GTnet”, “Mais Infosystem Fleisch”, “Gutfleisch Transparenz”, “Westfleisch

---

19 The system uses centralized data management/ data by value technology.
20 Provider of the Chainfood meat solution.
21 Provider of GTnet.
22 Provider of mais Infosystem Fleisch and custum development of Gutfleisch Transparenz for Edeka Nord.
Extranet” and “Farmingnet” are provided to a minor part of the market. Furthermore these systems are isolated from each other. This, to a large extent, precludes the utilization of netchain effects which enable horizontal, vertical and inter-chain collaboration (c.f. Lazzarini, et al., 2001).

As assumed in the introduction there is still no holistic IT supported IOS which is capable of establishing the seamless flow of meat chain information on the most complex and hardly coordinated spot market. On the one hand, further research which contributes to the heterogeneous supply chain structures, IT standards and the individual demands in terms of traceability and inter-stage collaboration has to be conducted.

On the other hand, the technical feasibility is only one side of the coin. It is more than questionable if completely integrated data transfer will ever take place in non-contractual systems if incentives are missing. To date, it is rather unlikely that these will come from any commercial actor of the supply chain since the coordination efforts would mean a competitive disadvantage on the hard-fought spot market. Equally, the case “Gutfleisch Transparenz” shows that the food retail calls for systems that distinguish them from their competitors.

Last but not least, the political and competitive opposition against the introduction of a new IBIS for the spot market should not be underestimated. Sometimes, new technologies to establish market transparency are intensively defeated by certain gatekeepers who are afraid of disintermediation (e.g. livestock marketing agencies) or benefit from non-transparent business relationships.

References

Giannerini, G. (2007) ETINET Web platform for traceability in the food chains: a large scale implementation for quality insurance and food safety control on an Italian region. In


