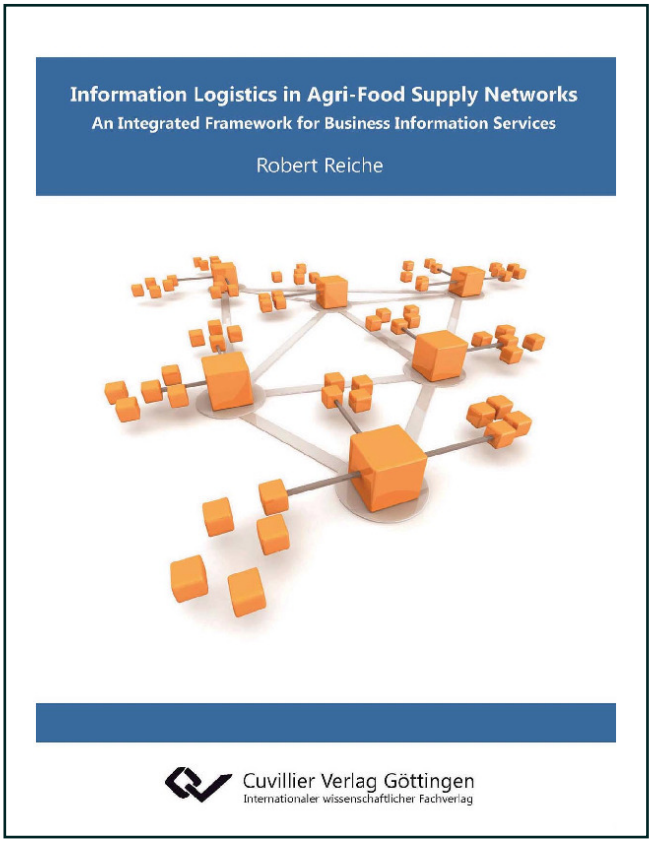
Robert Reiche (Autor)

Information Logistics in Agri-Food Supply Networks

- Integrated Framework for Business Information Services -



https://cuvillier.de/de/shop/publications/192

1 Introduction

Food products and their consumption are vital parts of our daily life. Consumers are interested in providing themselves with food that is safe, healthy and meets their quality expectations at affordable prices. Agri-food enterprises are globally connected in a multitude of business relationships to provide the food market with an unprecedented variety of products meeting the consumer demand and reaching from fresh and naturally grown products to complex processed food.

The past decade in the European food sector was and is still tremendously affected by different cross-national and national food crises (e.g. BSE in the early 2000s) as well as food-borne diseases (e.g. the recent outbreak of EHEC O104:H4 in Germany in 2011). These crises increased the awareness for the sensibility of the food production and food-borne diseases and resulted in joint efforts of all European member states to consolidate and adapt the European food law. Concurrently, a shift in consumer awareness (VERBEKE 2005) towards food additives, pesticides, genetically modified organisms for production of food (KUIPER ET AL. 2001), novel food products as well as the sustainability of global food production in general (FRITZ AND SCHIEFER 2008, LEHMANN 2011) challenges agri-food enterprises every day.

Food markets, consumer demand and politics are continuously adapting to recent issues and consequently new challenging requirements for agri-food enterprises emerge. Due to these developments, agri-food enterprises are forced to assure food safety by implementing quality and hygiene management concepts for their production and trade processes to comply with these requirements (HANNUS 2008). Additionally, certification of these activities, based on quality management standards, to control and assure compliance with legal and specific requirements from food retail and industry, is leading to a sophisticated mix of requirements that has to be addressed for market access.

The success of agri-food enterprises is closely linked to the ability to satisfy these requirements. Agri-food enterprises are challenged to provide products according to the required attributes, and to provide additional product information to proof their quality and safety (VERBEKE 2005, MEYER 2010, LEHMANN 2011). Today, the need for transparency related to food products and the status of interfirm business processes are not only a trend, but also a major

driver of increasing competitiveness by providing quality and safety guarantees on detailed and reliable data for process flexibility, coordination and optimisation (BEULENS ET AL. 2005, FRITZ AND SCHIEFER 2010). Other trends, such as ecological and social responsibility, are extending the required product quality attributes by new indicators (LEHMANN 2011). This requires the chain-wide collection of related information and its aggregation for measurement and evaluation of these indicators. Because the product life cycle includes all stages of the supply network, the re-organisation of processes for optimising the ecological and economic efficiency requires new approaches and an extension of the current information exchange practice.

The consumer demand on food products is as individual as the demand for information on these products and might not be completely met in future by providing general information. However, information provision to any stakeholder has to address their specific information needs, and requires a form that is directly understandable in order to be effective (VERBEKE 2005).

1.1 Problem statement

Answers to specific and individual information needs can often be found in information systems of agri-food enterprises along the food supply chain; enterprises already have systems in place to record, monitor, evaluate and communicate various types of relevant information throughout production- and trade-processes. However, these systems are mostly situated in the individual enterprise or encompass only a few members of the network (SCHIEFER 2004). The communication, especially of food quality and safety information, is poorly developed. In times of a food crisis this lack of communication and resulting long reaction times adds to greater uncertainty at every level. Required information and guarantees about the effectiveness of food safety mechanisms cannot be provided on time to agri-food enterprises along the chain and to the consumer to reduce these uncertainties.

The major reason for this deficit, besides technical issues, is the sensitivity of specific information for the competitiveness of agri-food enterprises. Furthermore, the willingness to share information is decreased by the uncertainty about the information processing and possible provision to actors other than the intended ones. Any information exchange system devel-

opment has to assure that information is only provided to specific recipients and the protection of data ownership (CUTELOOP 2008).

To overcome these issues, innovations in the fields of process organisation and the way information is exchanged between stakeholders are urgently required. Innovation in this context does not necessarily mean to invent new things, but also to re-organise existing practice to enable new solutions to existing problems (OMTA 2002). Developments and improvements of information and communication technologies (ICT) – more specific digital computing and the internet – offer tremendous chances for the food sector in general and agri-food supply chains in particular to increase market transparency and therefore reduce transaction costs and improving inter-enterprise coordination (BUNTE ET AL. 2009). The adoption of ICT strongly depends on available enterprise resources, which are very heterogeneous in the food sector due to the high degree of small and medium sized enterprises (SME) (SCHIEFER 2004). Innovations in the field of network solutions for the sector require arrangements to include SME's into the innovation process (OMTA 2002, GELLYNCK AND KÜHNE 2008).

1.2 Research objectives

Research needs in the field of information logistics generally focus on the individualisation and task-orientation of information supply to meet specific information needs. New technologies such as radio frequency identification (RFID) or developments of web-based technologies (e.g. web services) offer great possibilities, when combined with each other, to overcome present deficiencies by "Information as a Service" concepts. However, the current landscape of ICT in agri-food enterprises has been developing in the course of 10-15 years and aligned to a multitude of internal requirements leading to a monolithic system landscape with individual character (GABHARDT AND BHATTACHARYA 2008). Electronic data interchange (EDI) has developed to a valuable tool for the exchange of static transaction-related data, but it lacks the ability to communicate product- and dynamically changing process-related data.

Improving transparency by extension of the current information exchange practice for dealing with the previously stated challenges of the food chain, calls for initiatives addressed in this thesis. This thesis concentrates on the elaboration of a framework for flexible communication services that build on interactions between suppliers and customers, so called feedback loops, which serve the communication needs. The framework considers the integration

of new technologies to improve the information exchange and thereby improve product- and process-related transparency between agri-food enterprises.

The integration of existing "applications" from different agri-food enterprises along the chain could provide the necessary information through appropriate information collection and processing schemes to serve stakeholders' needs. This integration could mean new developments or, alternatively, the adaption of existing applications to chain and network based communication services. As information needs might change over time, the framework has to provide flexibility in exchange of relevant applications.

Aligned to the increasing need for transparency and the lack of solutions to solve present issues in information exchange, the research objective of this thesis is to develop a general applicable framework for business information services independent from product types or business domains as well as the integration of these information services into business processes by considering supportive technologies.

1.3 Research design

To reach these research objectives, this thesis is based on a design-oriented approach. Design-oriented research originates from engineering science and provides a problem focussed approach for developing solutions alternatives (SIMON 1988, VAN AKEN 2004). The elaboration of a design-oriented concept for solving a problem by the construction of new artefacts (VAN AKEN 2004, SIMON 1988) involves different consecutive stages (DENZIN AND LINCOLN 1994, BARAB AND SQUIRE 2004, HEVNER ET AL. 2004):

1) **Problem identification and description,** encompassing organisational and technological needs, based on different perspectives as well as examining constraints leading to the described deficiencies,
2) **Development of theories or artefacts**, supported by the "knowledge base", which includes foundations (e.g. frameworks, theories, models) and methodologies (a.o. formal descriptions, modelling techniques),
3) **Evaluation** of the developed concept, using analytical methods such as experimental case or field studies, prototyping or simulation,
4) **Drawing conclusions and inferring** from the research to the identified problem and the feasibility of the developed theories or artefacts.

Especially research, involving the development of IT-based concepts, has to address the design tasks faced by practitioners, which requires a proper conceptualisation and representation provided by the application of appropriate techniques e.g. modelling or simulation (MARCH AND SMITH 1995). Additionally, guidelines for the implementation or optional implementation examples are required for testing and evaluation (MARCH AND SMITH 1995). The transfer of this approach into a thesis outline is depicted in Fig. 1.

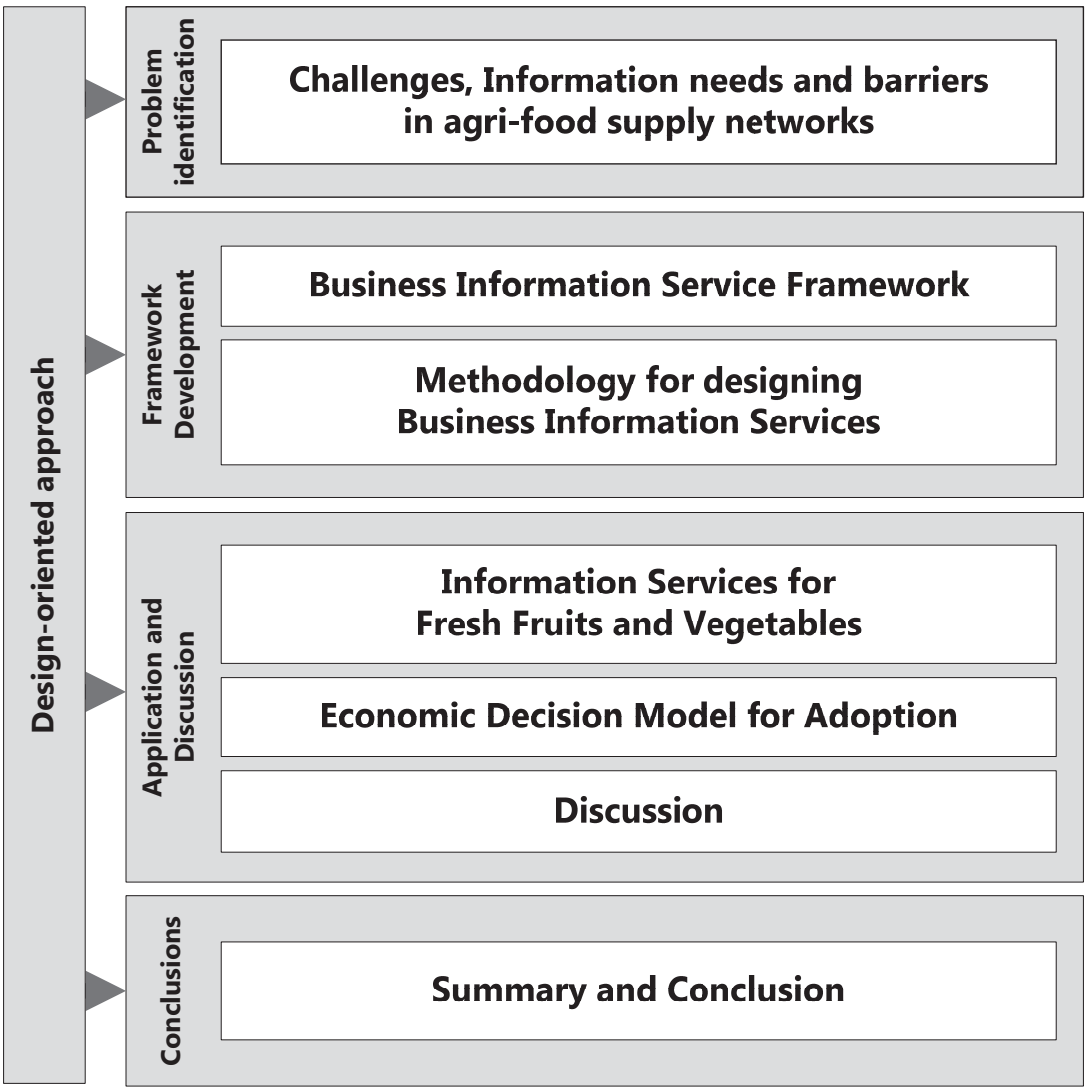


Fig. 1: Outline of this thesis

The outline of this thesis follows the steps of the presented design-oriented approach and is separated it into four parts.

The problem identification and description is presented in chapter 2 based on literature research and preliminary informal expert interviews with representatives from retail organisa-

tions (quality management and regional organisation), trade organisations (agricultural co-operative societies and one distribution centre) as well as service providers (logistic and box service providers). This results in different implications for the research objective.

The development of a generic framework for business information services to tackle the research objectives (chapter 3) initialises the second part of this thesis. This includes the definition of generic elements and integrated technical components as well as a methodology for modelling and development of information services (chapter 4).

In the third part of this thesis, the previous developed framework is applied to an application scenario in the fresh fruit and vegetables sector, and three principle reference services are developed focussing on specific information needs identified from expert interviews (chapter 5). This is followed by an economic decision model for adoption (chapter 6) of new technology in conjunction with the elaborated services and the service framework. The third part closes with a discussion (chapter 7) of the findings based on an expert workshop and experience from the application scenario.

The thesis finishes with a summary and conclusion (chapter 8) reflecting on all three parts and outlines implications for the transfer of results to the food sector.