

Traceability systems in the German food industry – towards a typology

Birgit Gampl,

University of Kiel, Department of Agricultural Economics, Innovation & Information
Olshausenstr. 40, 24098 Kiel, Germany
E-mail: bgampl@agric-econ.uni-kiel.de

Abstract

The great variety of traceability systems in the German food industry makes it difficult to describe them coherently and to distinguish them clearly one from another. Therefore a classification system or typology is needed to facilitate their description and analysis. This study suggests an approach to extract distinguishing aspects from a detailed description of traceability systems for pork. The aspects form the basis for creating a typology of traceability systems.

Keywords: Traceability, pork, typology

1 Introduction

Traceability is a concept that has recently attracted much attention. Food companies advertise products by communicating to consumers that their products and ingredients are “fully traceable”. However, there is no uniform, commonly shared understanding of what traceability actually is, as different industry sectors adjust traceability as appropriate to their own needs (van Dorp, 2002). I adopt the definition of ISO 8402:1994: “Traceability is the ability to trace the history, application or location of an entity by means of recorded information”, because it is one of the broadest definitions of traceability. It is suitable both for products and ingredients and it has been applied in the food as well as in the non-food sector. Until recently, consumers were not much concerned about the traceability of food products and they did not pay much attention to the whence of their bread and beef. This attitude has, however, changed dramatically in the wake of the BSE-outbreak in 2000. At the end of that year - German cattle was infected for the first time - a survey showed that two thirds of Germans felt threatened by BSE (Allensbacher Berichte, 2001) and beef consumption dropped sharply. The crisis triggered a range of public and private quality assurance initiatives. One policy response to the BSE threat was Regulation (EC) No. 178/2002 of the European Parliament. It stipulated various rules concerning food safety, and it made traceability mandatory (article 18). In the private sector, the meat industry developed a multitude of quality programs, information campaigns, and also traceability systems to counter the crises and the loss of sales.

There is a considerable design variation of traceability systems because food product suppliers may have several reasons, in addition to legal requirements, for establishing a traceability system. The variety of traceability systems is a challenge for traceability research which must be able to describe traceability systems concisely and distinguish different systems unambiguously. In this paper I first suggest an approach to describe traceability systems in terms of their purpose, component parts and the environment in which they operate. In the second part of the paper the usefulness of these dimensions for describing traceability systems is discussed and a typology of traceability systems is suggested. A telephone survey in September 2002 of 17 associations of German food industry about traceability projects in their sector showed that the meat sector leads in terms of established traceability programs (Drusch, Gampl and Bruhn 2002, unpublished). Traceability of beef is

already well established due to regulations enacted to fight BSE. Single animal identification is obligatory and beef traceability systems are not likely to vary that much. I therefore decided to examine traceability systems for pork which are voluntary and subject to fewer regulations allowing a greater variation in their designs.

2 Development of a conceptual framework for describing traceability systems

To be able to classify traceability systems they need to be described distinctively. A distinctive description should give a true picture of the real system and should highlight its main characteristics. Describing always means renouncing parts of an accurate reproduction in favor of pointing out the main features of what is being described (Sen, 1983).

Providing a useful description of a traceability system requires simplification by focusing on the essential features of its design. For the identification of the essential features of traceability systems I draw on Simon's (1985) theory of artificial systems, i.e. systems that are made by man for a purpose.

Artificial systems can be described by the following three dimensions (Simon, 1985):

- The purpose of the artificial system
- The character or inner environment of the artifact
- The outer environment in which the artifact operates.

The purpose represents the goal that should be attained with the help of the system. A purpose of a traceability system may be to establish a crisis management system to prevent or to minimize the costs of a crisis. Another purpose may be to establish a consumer confidence management system that communicates traceability information to consumers.

The character or inner environment stands for the substance and organization of the artifact itself. The inner environment of a traceability system can be described, for example, by the information management system employed or by the traceable unit of the product.

The outer environment describes the surroundings in which the system is applied. The outer environment of a traceability system can be described, for example, in terms of the structure of the supply chain in which it operates or by legal requirements.

3 Case study on traceability systems for pork

To test the usefulness of describing traceability systems in terms of these three dimensions a case study on traceability systems for pork was conducted by applying this frame. A detailed list of meat quality programs in Germany (Ottowitz, 1997) was used to identify 59 pork quality programs that might comprise a traceability component. The programs were examined to find out which of them also had established a traceability system. In addition, I conducted a web search for traceability programs and researched the websites of the top 30 German retailers (<http://english.lz-net.de/retailers/rankings/>, 29th January, 2003) for traceability programs. This resulted in 18 systems in Germany that appeared to keep traceability information of pork. With the help of telephone interviews conducted in February 2003 I found out that five of them, however, did not have a traceability system and another four were uncooperative. The people in charge of the remaining nine systems have been interviewed with the results shown in table 1.

Table 1: Results of the survey

		Traceability (TA) programs for pork								
		Eichenhof Schweinefleischprogramm	Schwäbisch-Hällisches Landschwein	HoFra Qualitätsfleisch (Hohenlohe Franken)	Frankenfarm	Gutfleisch	Burgentaler	BESTSCHWEIN	Orgainvent (System only starts at slaughterhouse level)	Qualität und Sicherheit (QS)
Dimensions	Observed system attributes									
Purpose	Original purpose when founded	Enhance confidence	Improvement of breeding	Enhance confidence	Enhance confidence	Enhance confidence	Sales co-operation	Crisis management tool	Crisis management tool	Crisis management tool
	Communicated information	Adress of producer	Adress of producer	Adress of producer	Adress of producer, breeding and feeding information	Adress of producer	Adress of producer	No TA relevant information	Nothing	No TA relevant information
	Foundation of system	1982	1992	1994	1996	1999	1999	2001	2001	2002
Inner Environment	Traceable unit	Single animal	Single animal	Single animal	Single animal	Day batches	Day batches	Day batches	Day batches	Day batches
	Data collection, storage and exchange	On paper and digital	On paper and digital	On paper and digital	Digital	On paper and digital	On paper and digital	On paper and digital	On paper and digital	On paper and digital
	Location of data storage	centralized	centralized	centralized	centralized	centralized	centralized	centralized	de-centralized	centralized
	Certified and regularly monitored control system	yes	yes	yes	yes	yes	yes	yes	yes	yes
Outer Environment	Number of participants (without POS, only: farmers, slaughterhouses, cutting halls)	600	150	31	11	188	2	1000	2	> 22.000
	Participant is bound by contracts to system	yes	yes	yes	yes	yes	yes	yes	yes	yes
	System manager is involved in handling the physical product	yes	yes	yes	yes	yes	yes	yes	no	no
	Possibility to achieve mark-ups	partly	yes	yes	yes	yes	yes	partly	no	no

Source: Survey, February 2003

Table 1 shows the survey results. The names of the interviewed systems are in column heading and the rows represent the dimensions.

Purpose

Three systems are employed to prevent crises and do not deliver traceability relevant information to consumer. The other systems all deliver such information, at least the address of the producer, to consumers. Two of these systems were initially designed for purposes other than managing consumer confidence. The original purpose of one system was to improve breeding by improving the flow of information. The other system was designed as an

instrument for establishing vertical sales cooperation. An interesting aspect is that all systems serving as crisis management tools have been established after 2000 maybe as a direct response to the lack of confidence in meat products triggered by the BSE outbreak. Systems that attempt to enhance consumer confidence or at least pass on information to consumers, in contrast, have all been established before the year 2000.

Inner environment

The four oldest systems are able to trace their products back to individual animals. The other five systems trace back to daily cohorts of animals. Only one system stores and passes on all information digitally (“Frankenfarm”). Eight systems use both computer and paper for information processing. Fax, telephone, or written messages are most often found at the production stage. At the processing stage digital information transfer dominates. In all systems but one (“Orgainvent”) data are stored in a centralized database.

All nine systems in the survey have a control system in place that ensures that participants comply with system regulations. Systems have been certified by an accrediting organization and are regularly monitored by an external organization.

Outer environment

To describe the organization of the supply chains, first the number of participants was examined (in this survey without Points of Sale (POS), only number of farmers, slaughterhouses and cutting halls, because not all interviewees were able to provide information about their number of POS). The number of participants of the different systems varies from two (“Burgentaler” and “Orgainvent”) to more than 22.000 (“Qualität und Sicherheit”). “Orgainvent” offers a system that only starts at slaughterhouse, information about the origin of the meat is obtained from the marking stamps on the meat. The number of participants does not seem to clearly determine the design of the system. Also the degree to which the systems trace back and which information they pass on to consumers do not seem to depend upon the number of participants. Examining vertical cooperation between participants showed that there is vertical cooperation in form of contracts enforcing the system. In seven cases the system manager is part of the physical supply chain in the sense that the manager’s company also handles the physical product. The other two systems outsourced information management (“Orgainvent” and “Qualität und Sicherheit”). Both are systems for crisis management and do not pass on traceability information to consumers. In this context it is interesting to note that the representatives of the seven systems stated that they could realize or partly realize a higher price for their product and that they divide these gains amongst the partners of the supply chain. The two systems that outsourced information management, in contrast, answered that they cannot price differentiate their products. The legal and regulatory environment has not been examined in detail because all systems comply with national laws and regulations and even exceed them in some aspects.

4 Elaboration of the framework for description

The conducted test of the framework for description showed that describing traceability systems in terms of purpose, inner and outer environment is a useful approach. As a next step I want to extend this description of traceability systems to make it possible to apply it also on other products of other food sectors. Therefore it is necessary to elaborate the concept in detail. In the following part I will further specify the three dimensions described above by assigning describing aspects for each dimension. From these observable system attributes are developed offering a more detailed framework for examining traceability systems. Table 2 shows on the left side the three dimensions. The second column displays aspects describing

every dimension, the third column lists observable system attributes derived from the aspects. So observable system attributes are measurable features of each aspect.

Table 2: Characteristics of dimensions and observable system attributes

Dimension	Aspect	Observable system attribute
Purpose	Crisis management	System allows fast product recalls
		Information flow is established downstream and upstream between first production stage and POS
	Consumer confidence management	Information flow is established downstream from first production stage to consumer
		Information about TA is given to consumer Information about product history is given to consumer
Inner Environment	Product	Existence of natural product units
		Traceable unit
		Information is attached directly on product or on package
	Ingredients and degree of processing	Amount of information
		Mechanism of adding new information at each stage of production process
	Packaging	Size of packing units
		Information given on package
	Applied information technology	Medium of data collection
		Medium of data storage Location of data storage
	Control system	TA system is certified by an accrediting organisation
Regular monitoring to control system performance		
Outer Environment	Organization of supply chain	Number of participants of the TA system
		Vertical cooperation between participants
		System manager's involvement in handling the physical product
	Legal and regulatory environment	TA system complies with national laws
TA system complies with international standards		

The purpose of the system

The purpose of a traceability system can be described by two aspects. One purpose is to create a crisis management system. Such systems do not need to provide traceability information to consumers. They serve as quality management tools to prevent or minimize costs of a crisis by establishing transparency and fast information flow - downstream and upstream between the first production stage and the Point of Sale (POS) - to allow for example fast product recalls (Bund für Lebensmittelrecht und Lebensmittelkunde e.V., 2000). Crisis management systems are internal system without an information interface to consumers.

Traceability systems may also be employed in order to improve consumer information about the product and to enhance consumer confidence. In this case, the objectives of traceability systems are similar to those of meat quality programs (Ottowitz, 1997). Evidence of this may be an information interface to consumers and the establishment of continuous information flow downstream from the first production stage to consumers.

The inner environment

The first aspect of this dimension is the product itself. The product, its type, size, etc. determines if there is a natural product unit that can be traced. For example, the individual animal is a natural unit. If a product does not constitute such a natural traceable unit, for

example fluids or ground meat, traceable units have to be defined. Another observable attribute of the aspect “product” is the possibility of attaching information directly or on package as an information carrier. Fresh meat or fruit usually do not offer this possibility. The number of ingredients and the degree of processing of a product is another aspect of the inner environment of a traceability system. This aspect can be measured, for example by the amount of information occurring. Mechanisms have to be established to add this information at each production stage to a data base. Traceability of raw products is therefore much easier to establish than for heavily processed products which may contain many different ingredients.

Another important aspect is packaging. Packaging allows labeling, and labels can be used as a medium for carrying traceability information. Unpacked products, such as fresh meat at the POS, are often not suitable for labeling. The aspect packaging can be described by the size of packaging units and by the information given on package.

The information technology employed is another aspect of the inner environment. In particular, the organization of data transfer - as digital data transfer is faster and less prone to error compared to printed or oral communication -, the degree of standardization of content and media, or whether information systems are networked or not. Important issues in measuring are if data is collected, transferred and stored digitally or if printed forms are used and also where the data is stored. Previous studies have shown that the utilization of digital data transfer is much higher on the food processing level than on the agricultural level (Branscheid, 2002).

The inner environment can also be described by the control system established. Traceability systems usually set up a control system to ensure compliance with their regulations (Amelung et al., 2002). Observable attributes of this aspect are if the control system is certified by an accrediting organization and if regular monitoring ensures system performance.

Outer environment

The organization of the supply chain is one of the two aspects describing this dimension. In this context the number of participating parties is important, because it is easier to organize traceability for a chain with only few participants than for a huge supply net. The degree of vertical cooperation is important because a stronger cooperation is believed to facilitate achieving higher quality objectives (Forschungsgemeinschaft Controlling in der Landwirtschaft e.V. (FCL), Bonn 2000) and traceability forms part of quality management. Within a system of strong vertical cooperation may already exist an intensive information flow and supply chain partners may have built up sufficient trust to pass on confidential information like traceability information. If partners do not fear passing on this information, data storage can be organized within the chain. So the manager of the system could also be involved in handling the physical product without gaining advantage by storing the information in comparison to other elements of the chain.

Another aspect of this dimension is the legal and regulatory environment of the system. Observable attributes of this aspect are, if the traceability system complies with national laws and if it complies with international standards.

5 Applying the descriptive framework for classifying traceability systems

For a typology or classification it is necessary to determine those factors that influence a system and at the same time help to distinguish one system from other systems. The results of the case study suggest that not all of the examined aspects are useful to create a typology for traceability systems. It found, that the existence of vertical cooperation or the establishment of a certified and regularly monitored control system are not factors to distinguish systems from

each other, because these aspects do not vary between systems. The aspect data collection, storage and exchange also shows only minimal variation. The purpose of the system at the time it was founded cannot be used, because the answers are too variable. Other aspects, however, seem to be useful to distinguish the systems from another. These aspects are: Communication of traceability information to consumer, the traceable unit and the location of the information management system. These aspects are displayed in the following cross-classified table and systems are allocated to the appropriate combination of the three aspects. Four groups of traceability systems can be detected this way.

Table 3: Dividing traceability systems by the fact of passing on information to consumer

	System communicating TA information to consumers		System not communicating TA information to consumers	
	Daily batch	Individual animal	Daily batch	Individual animal
Information management system within the supply chain	<ul style="list-style-type: none"> •Gutfleisch •Burgentaler 	<ul style="list-style-type: none"> •Eichenhof •Schwäbisch Hällisches Landschwein •HoFra •Frankenfarm 	<ul style="list-style-type: none"> •Bestschwein 	
Information management system has been outsourced			<ul style="list-style-type: none"> •Orgainvent •QS 	

Table 3 shows, that the information management system (IMS) of those systems that pass on information to consumers is always located within the supply chain of the physical product. Four of them trace back to individual animals and the other two keep records of daily batches. Systems that do not pass on traceability information to consumers, in contrast, do not trace back to individual animals and only once the IMS is located within the supply chain of the physical product. Twice the manager of the traceability system is not part of the physical supply chain.

It is not possible to gather conclusions from this data about possible correlations between traceable unit, location of system manager i.e. of the IMS, or on passed information. But the data indicates, that communication to consumers, the traceable unit and the involvement of system managers in handling the physical product are distinguishing aspects of the examined systems.

6 Conclusion

The great variety of traceability systems in Germany makes it difficult to distinguish them from each other. The intention of this study was to approach a typology for traceability systems. To achieve that, systems for pork had been surveyed to create a detailed description for traceability systems in terms of dimensions and aspects on basis of the survey results. Examining traceability systems on the basis of this description should point out distinguishing aspects and allow a classification of systems. The results of the survey conducted indicated that the examined systems can be distinguished by the aspects communication to consumers, traceable unit of product, and involvement of system manager in handling the physical product. Subsequent to this survey it is necessary to extend the research by examining systems for other food products to approach this way a broad and universal typology for traceability systems.

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Examined systems for traceability of pork:

Traceability Program	System manager	Website
BESTSCHWEIN	Westfleisch eG	www.westfleisch.de
Burgentaler	Agrarunternehmen Barnstädt e.G. und Fleischerei Karl-Heinz Post GmbH	www.aub-online.de www.burgentaler.de
Eichenhof Schweinefleischprogramm	Erzeugergemeinschaft Osnabrück (EGO)	www.eichenhof.net
Frankenfarm	Frankenfarm Direktvermarktungs GmbH	www.frankenfarm.de
Gutfleisch	EDEKA Nord	www.edeka.de/gutfleisch
HoFra Qualitätsfleisch (Hohenlohe Franken)	UEG: Unabhängige Erzeugergemeinschaft für Qualitätsferkel Hohenlohe-Franken	www.hofra-fleisch.de
ORGAINVENT	ORGAINVENT- Entwicklungs- und Koordinationsgesellschaft mbH	www.orgainvent.de
QS	Qualität und Sicherheit GmbH	www.q-s.info
Schwäbisch-Hällisches Landschwein	Bäuerliche Erzeugergemeinschaft Schwäbisch Hall	www.besh.de