Management and food safety systems in the agri-food industry- a cost-benefit analysis

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1 Introduction

Enterprises in the agri-food sector are increasingly confronted with the need to adjust their production processes and operations to the requirements of quality systems and to integrate these requirements into their own individual integrated process management system. Integration efforts are further aggravated by correlations of quality system requirements with other process related requirements. An integrated approach is necessary for a cost effective implementation of systems. The main target of this project is the development of a description model for quality standards, which includes a benchmark of requirements of quality and environmental management and of occupational health systems.

Output of this project will be an advisory model (database model with computerized support), which presents a support tool for the implementation of quality, environmental and occupational health systems into the individual integrated (process) management system of enterprises. In addition, the database can be a basis for a cost benefit analysis in decision situations concerning the implementation of systems. Selected scenario studies will present first specific results of costs and benefits for different stages and sectors. Another part of the project will identify business environments and related best practice relationship of different enterprises in the chain. Combining these two parts of the study will result in a number of practical and workable recommendations for effective quality management.

2 Quality management and food safety standards in the agri-food chain and their structure

Before the model for the measuring of cost and benefits of quality systems will be presented an explanation about, the structure of quality systems is necessary.

In general, quality standards composition is a handbook with standard requirements and interpretations, a self-control checklist and an audit checklist. Other standards have only guidelines. The requirements are in most cases in different hierarchical dimensions. In some cases, the classification of requirements is in high and low priority (IKM), in critical, not critical and recommendations (EurepGAP), in basic and high level (IFS), in level 1, 2, and 3 (SQF 1000 and SQF 2000) and with the possibility of non-applicable demands and KO-Criteria or without any schedule line.

This means that to get a certification not all requirements have to be fulfilled in some systems by the processor because of non-applicable requirements and the level of implementation. The differs from quality system to quality system. In some cases, like the International Food Standard, the implementer has to fulfil 75% of the requirements, but has to include all KO-Criteria to get a basic level certification, the Danish Quality Guarantee standard asks for 100% fulfilled requirements. The SQF 1000 and 2000 codes are divided into three certification levels. Level 1 indicates the food safety fundamentals, content of level 2 are requirements of an accredited HACCP Food Safety Plan and quality management requirements exists in level 3. The certification in level 2 or level 3 indicates the requirements of level 1 or level 1 and 2 respectively. Other systems like the Q+S standard from Germany groups the results of the audit in three categories according to the number of fulfilled checklist points.

The audit checklist is the basis for the valuation of the implemented quality system and the basis for the following model to measure cost and benefits of quality systems.

To estimate the costs of a quality improvement scheme, three alternative approaches were presented by Antle (1999), namely the engineering analysis approach, the accounting approach and the econometric estimation approach. In contrast to quantitative cost estimations, at the firm level the benefits of compliance with quality norms and standards have often been assessed in a qualitative way (Romano et al. 2005). In addition, two further approaches are typically used to estimate the benefits of a quality system or improvements in food safety: the willingness-to-pay-approach and the cost-of-illness method.

3 Description of the advisory model

The following theoretical framework discusses the costs and benefits, which arise due to the implementation of a quality management system with an accounting approach. Firstly, a way to find the requirements, which arise due to the new system, is presented.

The aim of the advisory model is the development of an integrated description model to simplify the management of different quality, environmental and occupational health systems in the agri-food industry. The model utilizes a data base, which automatically generates operational system descriptions. The model is an advisory model for the minimization of costs in different quality management, environmental and occupation health scenarios and supports the presentation of a best practice solution in the implementation of different management systems. There exist a lot of benefits for an integrated management system in enterprises, which are for example: use of synergies, reduction of time and costs and an easier integration of new management systems (Petridris and Schlüter, 2001).
The advisory model is an internet based data base and users with special codes can use the function of the data base. Two languages are at the moment standards of the data base: English and German and parts of the data base are available in French. It contains the requirements for a certification and the first step was and is the benchmark of these different requirements. The result of the data base procedure is the presentation of the audit checklist points and an automatic generalisation of same and additional certification requirements. Next to these basic results a connection to cost and benefit categories, to departments and to the ISO 9000 chapters can be a result. The connection to departments and to the ISO 9000 should be support parts of the data base concerning the implementation of a new system. The cost and benefit categories are basis for the following cost and benefit analysis.

4 Measuring of costs and benefits of management and food safety systems

A questionnaire and expert interviews are the basis for the categorisation of requirements in cost and benefit categories and during the analyse about the importance of different cost and benefit categories.
The questionnaire was done in the year 2003 and the 300 biggest enterprises of the German food industry were contacted; 85 questionnaires were evaluated. Next to the results of this survey, literature and management/food safety standards were analysed to find the important cost and benefit categories for this cost and benefit analysis.
The results of this analysis were the following :

Cost categories are (with sub categories):

- process costs: transport, storage, traceability, animal welfare etc.
- administration costs: documentation, management of the system, training, certification
- infrastructure/equipment: technical equipment, buildings

- product quality/food safety assurance: hygienic measures, laboratory tests

Benefit categories are (with possible effects):

- market entry: international sales
- image: higher sales; lesser supplier audits
- product liability: documented evidence of conformity in crisis situation
- process quality: improvements in the internal process and transactions between chain stages
- product quality/food safety: reduction of microbiological, chemical and biological hazards
- occupational health: lower working accidents
- environmental protection: fulfilment of legal requirements or emission demand
- traceability: improvements in the products recall and crisis management
- Cross Compliance: fulfilment of requirements to get subsidy payments (only for farmer)

In addition, the weighting of these categories was done in expert interviews with support of the Analytical Hierarchic Process (AHP) method. With this method, a pairwise comparison of criteria is possible. Another aspect for using AHP was that AHP is one of a few methods where hard (e.g. costs) and soft (e.g. trust) facts can be combined.
Saaty (1995) has developed the Analytical Hierarchic Process to structure and solve complex decision situations.
Basic of the AHP is that specific foundations and axioms will be accepted:

Axiom 1: The decision maker can compromise two different elements, which will be done in a pair wise comparison.

Axiom 2: It is not possible that a decision maker has no concrete comparison between two criteria.

Axiom 3: A decision problem can be formulated in a hierarchical order.

Axiom 4: All criteria and alternatives, which are relevant for the decision problem, are integrated into the hierarchy. These hierarchic elements will be evaluated by priorities (Meixner and Haas, 2002).

Figure 1 presents first results of an expert interview. The support of this interview was the AHP and especially the Expert Choice software.
The following part presents results of one interview, which was done with a quality manager in a baking ingredient enterprise. This expert lays more importance on the benefits than on the costs (3:1) concerning the implementation of a quality system. The next question was, which category is the highest cost factor, if changes arise due to the implementation of a new system. Changes in the part of infrastructure/equipment would result in the most costs. After that this expert expects that many costs concern changes in process organisation. The next category is the part of administration costs and the last block is product quality/food safety requirements. The order concerning the importance of benefits for the implementation of management systems is the following: better process quality, traceability, market entry, product liability, image/trust, environmental protection, fulfilment of legal requirements and occupational health.

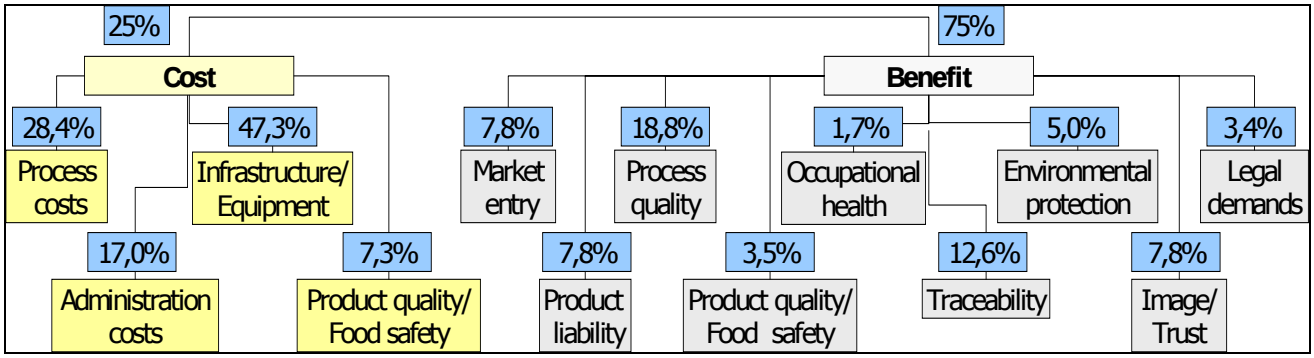

Figure 1: Weighting of cost and benefit of quality systems (Baking ingredient producer, 2006)

5 Ongoing work

The next step of the project will be the implementation of the results of the environmental management and occupational health standard benchmark into the database. To have the possibility of a graphical presentation of the overlapping requirements of different standards, a program will be developed. The connection of the data base with the results of the expert interviews concerning costs and benefits will also be an additional part of the ongoing work.
After that, the connection to the best practice project has to be discussed and has to be transformed. Computer supported results will be created. Moreover, combing these two project parts will result in a number of practical and workable recommendations for effective and efficient quality management within the firm and with partners of the firm.

6 References

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