System Dynamics in Quality Certifications: Development of an Audit Quality Controlling System

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1. Introduction

Over the past few years, certification schemes in the agribusiness sector have gained great importance as an instrument of quality assurance in the supply chain (Jahn et al. 2005; Fulponi 2006; European Communities 2006a). Especially in the EU several standards have been established, which partially diverge extremely according to their focus, target groups and goals. While most of these systems have a rather low diffusion in the food sector (e. g. Label Rouge or Geprüfte Qualität Bayern), certification schemes such as QS, BRC, IFS or EurepGap already cover substantial parts and are widely known within the business (European Communities 2006a). However, the reputation and status which these systems have built up during the past few years, greatly depend on the confidence in meeting the promises of assuring quality and food issues. If the standard is unable to come up to the expectations of consumers and business partners, the value of such a scheme is easy to doubt and trust is going to fade (Fulponi 2006: 8). In consequence, the withdrawal of considerable parts of the supply chain could bring down the entire system. Aside from this effect, a certification scheme is always exposed to the interests of censorious stakeholders (e. g. consumer associations and NGOs) who generally have good connections to media and politics. In this case, even the rumour or accusation of flaws and scandals poses enormous problems for the reputation of the standard.

Due to the complex structure of certification schemes the risk of apparent flaws and scandals is generally high, but is also increased by several developments during the last few years. The rapid expansion, for instance, has extremely enhanced the number of participants within the systems (e. g. more than 110,000 in the German QS-system). Most systems are expanding their performances (more production levels in the food chain, different products, etc.); some systems, like the QS-system, even aim to control the entire supply chain – from the animal feed industry to retailing. Furthermore, the interest of external stakeholders in food issues has increased and has been extremely amplified by the mass media.

With regard to the potential effects of these developments, the question is posed of whether the respected certification approaches are actually able to detect deficiencies within the systems and thus prevent scandals and crises which may lead to the breakdown of standards. Most of the certification schemes nowadays arrive at the point where they have to stay abreast of these changes and build mechanisms to prevent harm to their systems. Thus, the importance of this development should enforce the implementation of a controlling tool which monitors the audit quality, which in this contribution is defined as the quality or ability of a standard to meet its requirements in order to ensure a high quality and safety of food products manufactured under the respective scheme. By analysing possible negative influences on the system, opportunistic behaviour can be detected. Hence, the audit quality controlling tool should always be state-of-the-art, highly risk-orientated and flexible.

A controlling tool is presented below. In theoretical aspects the development of this instrument refers to the audit risk approach, whereas the practical appliance is based on the central data banks of the respective quality assurance systems. These inherit the potential to be the basis of an effective external quality control, revealing weaknesses, changes and irregularities along the system elements.

2. Quality Certification in the Agribusiness Sector

During the 1990s, the European agribusiness sector was afflicted by several crises and scandals (Tuncer 2001). The consumer's confidence in the ability and capacity of traditional governmental regulators to deal with the safety and quality issues of food products and processes declined. However, the consumer today has developed a high demand for information about food production and the guarantee of food safety and quality (Hatanaka et al. 2005: 3; Fulponi 2006: 2). As a consequence, many European countries and especially the private sector have launched specific initiatives to implement standards with requirements – partially – higher than the respective state regulations. In consequence, a multiplicity of various quality assurance schemes has been established in the agribusiness sector (Jahn et al. 2005; European Communities 2006a; Sodano 2006). These can be classified according to different criteria (Jahn et al 2005; European Communities 2006a):

- focus: product characteristics (e. g. Protected Designation of Origin (PDO), Protected Geographical Indication); process characteristics (e. g. environment-friendly, welfare standards);
- target group: consumer-oriented schemes (e. g. organic farming, fair trade); business-to-business (e. g. International Food Standard, EurepGap, BRC Global Standard);
- goal: guarantee of legal minimum requirements in a mass market (e. g. IKB in the Netherlands, QS in Germany); product differentiation (e. g. organic farming schemes);
- contents: product quality (for instance PDO schemes); process quality (e. g. organic farming standards); safety (e. g. IKB);
- standard owner: state-run systems (like organic farming in Denmark), international standardization organizations (e. g. ISO 9000, 9001 and 22000), stakeholder approaches (e. g. Fairtrade), producer schemes (e. g. farmers` associations in the case of the British Assured Farm Standard), private inspection bodies (e. g. Vitacert by the German Technical Monitoring Institution/TÜV); retailer driven schemes (e. g. BRC Global Standard and International Food Standard);
- areas of application: local (e. g. Geprüfte Qualität Bayern in Germany); national (e. g. Danske Slagterier in Denmark); international (e. g. ISO 22000);
- number of stages involved along the food supply chain: single-stage (e. g. EurepGap is applied in farming); multistage (e. g. the QS-system covers the whole supply chain).

Especially the approaches which aim to guarantee legal minimum requirements in a mass market attained a high share in the respective business (European Communities 2006a). The QS-system, for instance, looks retrospectively at more than 110,000 audits which were conducted during the past five years. QS is mainly prevalent in the meat industry, including about 80 % of all German pigs for slaughter. The animal feed industry and all important German slaughterhouses are also covered. Additionally, almost 15,000 retail stores are integrated in the QS-system. In 2004 QS expanded their product categories to fruits and vegetables including the levels of production, wholesale and retailing. Besides QS, EurepGap has a strong international angle: about 51,000 certificates have been issued in the fruit and vegetable sector in more than 60 countries, covering an area of more than 830,000 hectares (EurepGap 2005). The product range

is nowadays extremely broad and in addition to green coffee, it also includes flowers and ornaments as well as meat and fish. EurepGap is only applied on the production level. By contrast, the International Food Standard (IFS) covers the companies at the top of the supply chain. The IFS certificate is used in the business relation between processor and retailer. Currently, more than 4,935 food producers all over the world are certified according to the IFS (IFS 2006). Since 2006 the IFS has offered a logistic standard which closes the gap between production level and the trading companies in the food chain (LZ 2006).

While certification schemes differentiate on the basis of different variables, the institutional structure is comparable for almost all privately organised standards. Various institutions participate in the certification process, as shown in Figure 1. Basic structure of certification (Source: Jahn et al., 2005).

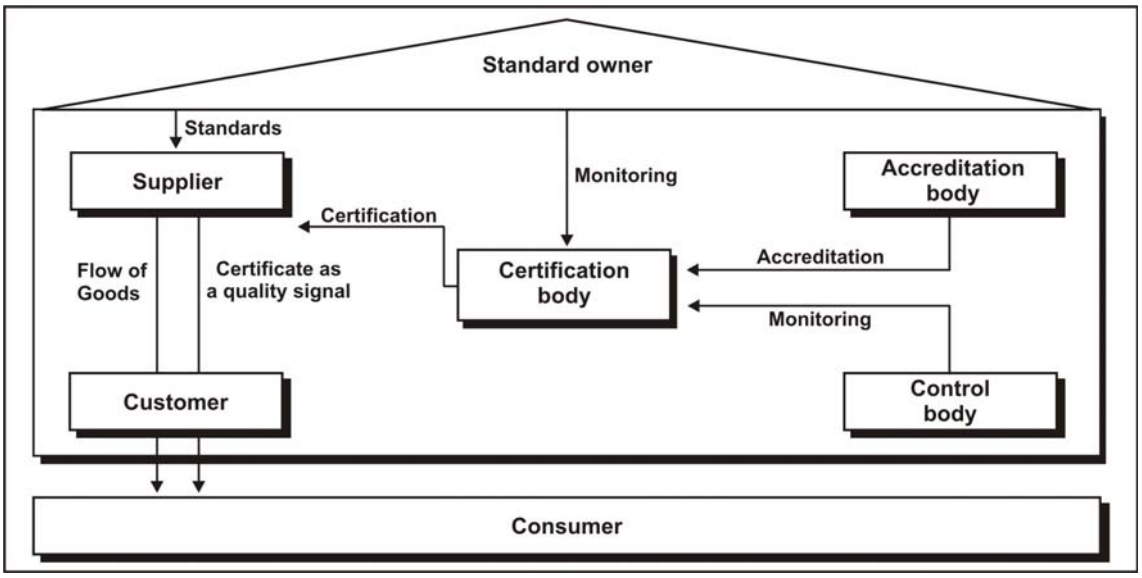

Figure 1. Basic structure of certification (Source: Jahn et al., 2005)

The starting point is the link between the producer and the customer (consumer or institutional buyer). The supplier provides a certificate serving as a quality signal for the customer or within the supply chain, which is issued by a neutral certifier (third party audit) (Luning et al. 2002). The audit is based on requirements laid down by the respective standard initiator. Certifiers, in turn, have to prove their ability to carry out inspections according to these rules through an accreditation. This accreditation is usually given by the ISO 65/EN 45011, standard which includes general requirements for assessment and accreditation of certification bodies (Jahn et al. 2005).

3. System Dynamics in Quality Certifications

Due to the special characteristics described above, the approach is very sensitive towards flaws and opportunistic behaviour which highly endanger the performance of the system. To fulfil the promises of a valid and reliable control, the standard therefore decidedly relies on the functioning and the genuine behaviour of the participating institutions in the certification scheme. It only works when the system elements interdigitate among each other. For this purpose, the relationships and the interactions within the system exert significant influence and restrict the way in which auditing processes are carried out in quality assurance systems.

3.1 Application of System Dynamics on Certification Schemes

With the growing complexity of the respective standards (more production steps, different products, credence attributes, external stakeholders) a system oriented view ("Systems thinking"[1]) on certification schemes becomes essential (according to Sterman 1994; Ossimitz 1995). This concept enables a fundamental comprehension of the dynamics within a quality assurance standard. By analysing the interactions and their effects on changes risk factors can be exposed which negatively influence the certification system.

The theory of System Dynamics provides an appropriate foundation for an analysis of certification schemes. This approach is especially applied in socio-economic studies and provides a central concept for an improved perception (Kapmeier 1999) and an advanced understanding of how objects in a complex system interact (Sterman 2001). Thereby, systems are generally defined by the structure, characteristics and interplay among their elements (sub-systems). These are connected and form a unified whole by interrelationship. A change in one variable reinforces (positive) or balances (negative) other variables, and influences the whole system over time (Ossimitz 1997). The starting point of System Dynamics, however, is always an investigation of adverse system behaviour (Forrester 1994: 245). Thus, negative development can only be managed if the causer/catalyst for this situation is ascertained (Forrester 1991: 5). The comprehension of the structure in considered social or physical systems is the key to achieving the objective of systems improvement (Forrester 1994: 245). Moreover, System Dynamics applies a simulation model to gain a better understanding of the system behaviour.

However, the System Dynamics approach in this contribution is applied metaphorically. Emphasis is not laid on the development of a detailed simulation model, but on the application of the idea of Systems Thinking on certification schemes in the agribusiness sector. Systems Thinking generally belongs in the conceptualizing phase of System Dynamics, in which the basic system is described (Forrester 1994).

Well-intentioned attempts to solve problems or improve situations frequently create unanticipated side effects (Sterman 2001: 8). Seen from our considerations, quality assurance schemes are generally endangered by two reactions which cause adverse system behaviour: Slow, creeping processes were inducted somewhere in the certification scheme by a single event and affect the systems by degrees. Single events, for instance, can be a change in the requirements of auditors' qualification or an increasing competition among the certification bodies (see Figure 2: Examples of positive and negative feedback effects). As harmless as this single decision might be seen to be at the beginning, due to interactions and feedback loops they can lead to distorted and unexpected consequences, but also redound to positive reinforcement.

1. Richmond (1994: 139) defines systems thinking as "the art and science of making reliable inferences about behaviour by developing an increasingly deep understanding of underlying structure".

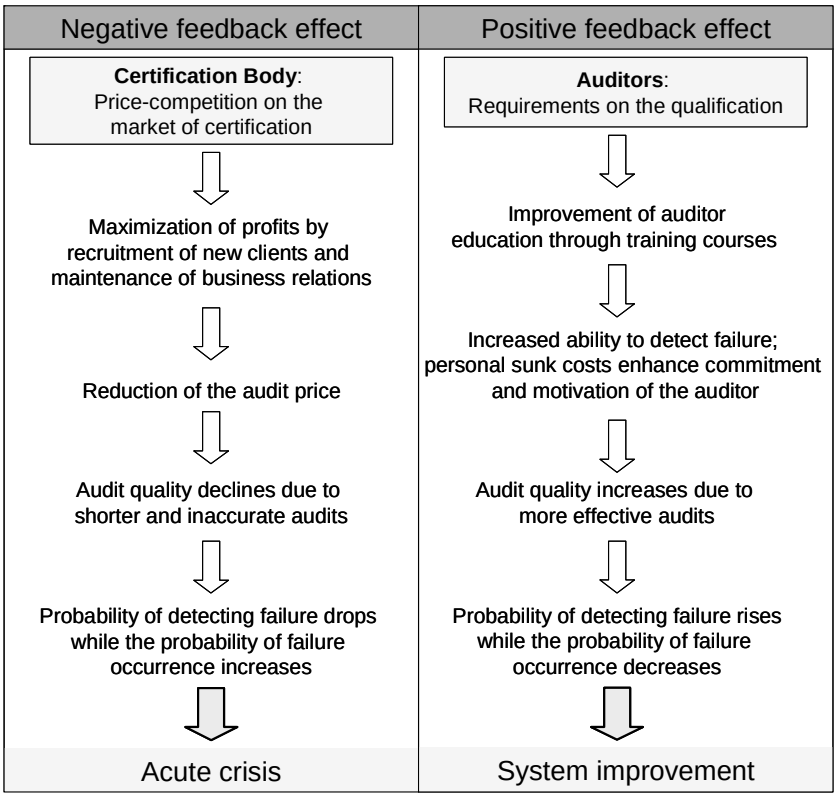

Figure 2. Examples of positive and negative feedback effects

While the development of these creeping effects is characterised by a time delay between taking a decision and its effects on the state of the systems, exponential effects underlie a rapid and spontaneous behaviour. They occur selectively and are based on down trading processes (in general negative creeping effects) which, accumulated, catalyse the development of exponential overshoot effects. The latter is especially burdened by the unstable constitution of certification schemes – strong dependency on gatekeepers within the food supply chain and high exposure to critical stakeholders.

3.2 The importance of System Dynamics in Certification Schemes

Based on System Dynamics, this study is going to institute a new perspective on certification schemes by pointing out interactions and feedbacks which will cause an acute crisis and in consequence, a loss of reputation and credibility. These factors have hardly been researched yet, although they should – especially against the background of the rapid systems growth – be perceived as a matter of great importance for the standard owners since these greatly influence the performance of certification schemes.

An analysis of the factors influencing the certification systems performance thus represents the initial point for the application of System Dynamics. From experience, we know that quality assurance systems are generally susceptible to opportunistic behaviour. In 2000 about 10 % of organic corn sold in Germany came from “conventional” agriculture despite the existing control scheme (Jahn et al. 2005). Other examples of imperfect monitoring standards can be found in Anania and Nisticó (2003), GfRS (2003), and McCluskey (2000).

While the auditor checks that the companies have conformed to the standard requirements, the certifier himself has to comply with the requirements of proper certification (Bush et al. 2005: 33). Studies of the IFS and QS-system exposed discrepancies in the audit result of different certification bodies and auditors (Schulze et al. 2006). The identified differences and irregularities

generally document varying assessment standards between different certification bodies and auditors. However, several interpretations of these flaws are possible. On the one hand, differences in the know-how of the auditors and varying auditing intensities could be the reason for variations. On the other hand, economic dependencies might cause an auditor to issue "courtesy certificates".

Precise investigation to uncover the reasons for deficient audit results generally draws on knowledge in the structural framework of certification. This information provides a basis for an effective intervention in the improvement process of audit quality. Only if the auditing company is unbiased and succeeds in detecting opportunistic behaviour, i. e. rule breaking along the value chain, will certification schemes be credible. While the relationships between single system elements were identified in the context of the certification process (see Figure 1. Basic structure of certification (Source: Jahn et al., 2005)), the interactions and feedbacks among the sub-systems are reproduced in Figure 3: Quality assurance systems as a System Dynamics model . Based on the System Dynamics approach (Forrester 1961, 1991, 1994), Figure 3: Quality assurance systems as a System Dynamics model is a first attempt to clarify the interrelations within the system. However, these interrelations at the same time represent crucial factors in the audit quality. Further analyses of respective quality assurance systems reveal that there are many more interactions with the potential of a negative influence on the total system (Schulze et al. 2006). These observations describe in an exemplary way interactions among the system elements.

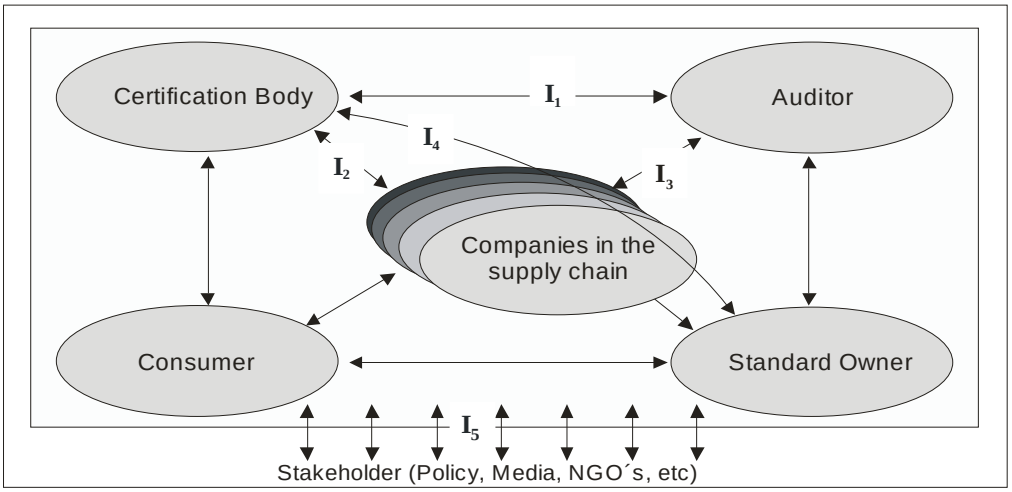

Figure 3. Quality assurance systems as a System Dynamics model

Interaction 1 (I_1): a certification body exerts influence on the certification process by the dependence of their auditors. Thus, price and costs as well as possible strategic concepts concerning auditing can be realised. Moreover, the certification body also achieves an essential importance by the selection of auditors for the certification process (Schulze et al. 2006).

Interaction 2 (I_2): in general, a company is free to choose between several certification bodies. The pronounced stress of competition and the low prices that certifiers report in personal conversations can lead some auditors to deliberately audit inattentively in order to minimise their costs and, at the same time, increase the chances for re-contracting and recommendation (DeAngelo 1981). This situation can arise because of the interest of the audited companies in being sure of passing the audit and, thereby, reaching the customers. They will avoid very strict audi-

tors and exert pressure on the certification body. Especially if individual clients have powerful positions, this dependence can achieve great importance. This situation generally increases the risk for side contracts between the audited company and the certification body (auditor).

Interaction 3 (I_3): by the same token, the certifiers may provide a "mere rubber stamp to existing practices" in order to win or keep clients (Bush et al. 2005: 33). Beyond the occurrence of financial or personal dependencies, the auditor's expertise and qualification, as well as subjective influences such as the motivation and the attitude towards codes of honor, endanger the validity of an audit (Schulze et al. 2006). However, since the certifier directly influences the quality of the audit, one single fraudulent auditor can damage in the entire certification process (Bush et al. 2005: 33) and eventually cause the collapse of the overall system.

Interaction 4 (I_4): comparable to the auditor, the certification body needs to be accredited by the standard owner. By requirements and monitoring processes the standard owner could control the certification bodies and their performance. However, deficiencies of the structural design can increase the competitive situation beyond the certification bodies. In the case of the QS-system, the so-called "Buendler" (slaughterhouse companies or co-operative marketing associations), for instance, can choose the auditor for connected companies – in many cases several hundred farmers. The certification body thus becomes dependent on the "Buendler". Similar structures and problems can also be found in other certification standards such as IFS or EurepGap.

Interaction 5 (I_5): modern agriculture is lacking public trust and confidence (Meier 2003: 1; Kafka 1999: 56). These problems are especially due to the meat sector, where several scandals have occurred during the last few years. Nowadays, consumer awareness is extremely sensitised towards possible product failure (European Communities 2006b). This development is increased and utilised by strategic issue campaigns of NGO´s like Greenpeace, which have a great impact on public opinion.
From personal experience we know, that standard owners are generally not aware of these risk factors on the audit quality. In the case of a scandal within the system, it cannot be assumed that a dynamic response to flaws is possible. Literature dealing with public relations - particularly with regard to crisis communication - indicates that in cases of a critical incident it is almost impossible for the affected company to comment on the matter via the media (Barth/Donsbach 1992; Schmitt/Hauser 1994; Ruhrmann 2005: 521ff.). These observations generally pose the question of whether the owner of a quality assurance scheme is de facto able to steer the system or whether the initiator is just reacting to the system's behaviour.

4. Risk Assessment and Controlling in Certification Schemes

While the audit quality of certification systems in the agricultural and food industry have hardly been scrutinised so far (Schulze et al. 2006, Jahn et al. 2005), the auditing process in financial auditing has already undergone an intensive analysis. In theoretical aspects the following contribution therefore adopts the risk-oriented approach from financial auditing to analyse the interactions of factors influencing the dynamic certification system. This concept concentrated on a dynamic constitution of the auditing process – effectivity and efficiency effects are achieved by focusing on risk priorities. The inspection delved into areas where problems are great and major negative effects evolve. Thus, the content of certification approaches can generally differ among different companies. An intensive analysis of the company and its environment is necessary to collect essential information about possible risks.
Since the 1970s and increasingly after the recent scandals such as Enron or Parmalat, which

evoked a deep loss of confidence in the quality of financial auditing (Nussbaum 2002; Thomas 2002; Vinten 2003), auditing theory has developed approaches that are geared to the risk potential of the audited company (AICPA 1984; Adams 1989; Alderman/Tabor 1989; Cushing/Loebbecke 1983; Graham 1985; Konrath 1989).
The purpose of the risk concept is the alignment of audits with the risk situation and risk potential of the individual client (Alderman/Tabor 1989; Konrath 1989). The central focus is on the so-called audit risk. This risk constitutes a false estimation of the annual accounts; in this case the audit certificate is unwittingly not restricted or rejected, even though the accounts contain significant flaws (Leffson/Bönkhoff 1981; Quick 1996; v. Wysocki 1992). The risk is composed of several subcomponents. Firstly, the risk of error occurring specifies the probability that errors fundamentally occur in the sample. Secondly, the detection risk concretises the risk that the flaws occurring in the company are not detected by the auditor (Graham 1985). This risk originates in the choice of improper procedures and in personal deficiencies of the auditor (Brumfield et al. 1983). If this approach is applied to the certification systems in the agribusiness sector, differences and peculiarities of the quality assurance systems have to be accommodated in a modified model (Schulze et al. 2006).
Thereby, the risk-oriented concept cannot only be assigned to the single audit, but also to the whole multistage certification control system – the companies` self-check, the auditing process by neutral auditors and even the standard owner can conduct an auditors` and certification` bodies check. Hence, accountability for the functioning and optimizing of the whole system is possible. In the following such a control tool is presented.

5. Development of an Audit Quality Controlling System

The basis of the “Audit Quality Controlling System“ consists of the risk-oriented audit approach. In comparison to financial auditing and even to governmental food safety control, discussion about a risk-oriented audit in privately run certification schemes seems to have been astonishingly neglected. However, especially the characteristic of a consistent, private standard ownership basically creates the possibility of an audit quality controlling system. A suitable foundation for such a system is the audit data base which is already established in the respective certification schemes such as QS or IFS. These data bases contain important facts about the certified companies (name and register office, location etc.), the audit results (judgement and status) and, furthermore, extensive data of single audits. On the basis of this information, detailed statistic analyses of single control issues are possible. These are presented in Figure 4: The Audit Quality Controlling System , which is based on the elements shown in Figure 3: Quality assurance systems as a System Dynamics model .

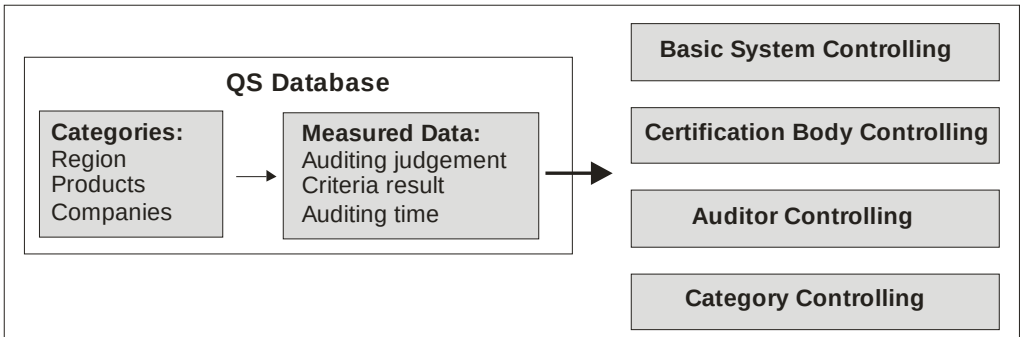

Figure 4. The Audit Quality Controlling System

General information is incorporated in the Basic System Controlling, which gives an overview on main data like the amount of audits. However, to establish the certification body and auditor controlling systems, more facts about these institutions need to be integrated in the existing data bases. So far, the lack of consistent monitoring of certification bodies and auditors results in a lack of data. The more specifications are given about each control sector, the more categories can be measured. Based on these data a valid risk analysis can be conducted. A well-defined central data base is, thus, the starting point for the Audit Quality Controlling System.

Compared to accounting, quantification and an objective ascertainment of sub-risks defined by the risk-oriented approach become possible. However, by virtue of the great influence of the auditor, a universal objectivity can never be stated for the audit result (Buchner 1997: 163f.). Analytical models, which enable the auditor to deduce probabilities by available information, are totally absent in financial auditing (Nagel 1997: 156). The data bases of certification schemes in the agribusiness sector represent “Data Warehouses” exhibiting this potential. Necessary information for the single control branches of the “Audit Quality Controlling Systems” can be adduced. The aim of this information system is to receive automated information on the status quo of the total certification system as well as on the certification bodies and auditors. Based on this knowledge, a dynamic improvement of the system’s quality (reliability and validity) is possible. Weaknesses and irregularities can be detected by special operating figures which have to be determined by the standard owner.
The advantage of such a system is the connection between statistical methods and a detailed profile of the analysed institution. Thus, mavericks can be displayed and reasons for deviations individually researched for each system element. Support for the causal research is an automated online portal which is linked with detailed information of the certification bodies, auditor (audit amount, scope etc.,) and company. The results of single control branches, for instance, could be visualised by automated figures and tables and recalled online from the standard owner. Hence, this automated online system report could provide information about the situation within the certification system (e. g. amount of passed and failed audits, applied audits per product categories or level) as well as crucial variations in the audit quality of special certification bodies and auditors. However, it is finally the job of the standard owner to analyse individual cases and to verify whether reasons for variations can be given, or whether sanctions have to be applied. Each systems partner profits from such a control tool. Companies, for instance can obtain comparable data for a benchmark of their quality management; furthermore, certification bodies can monitor their auditors by this tool.
The application of the Audit Quality Controlling System in practice offers the possibility to achieve detailed and actual information about the quality assurance system. Thus, the validity and reliability of audit control can be optimised continuously. Based on these results, measures like adaptation of control intervals and depths, application of unannounced sampling audits and the differentiated priorities of inspection contents, can be taken. Since so far none of the current quality assurance systems disposes of a systematic, data-based control system, the critical factor for future development seems to be the implementation of an audit controlling tool. For practical application, an automated instrument is necessary to verify the interactions and to enable a system-oriented perspective on the certification scheme.

6. Conclusion

Within the framework of this contribution the relevance for a systemic perspective on certification schemes was highlighted. Especially against the background of an advanced expansion, the interactions among the system elements need to be mapped and crucial factors have to be revealed in order to achieve an optimized control procedure. Only then can systems flaws be detected and remedied and the systems performance improved. On the basis of the audit risk approach this is – in the first instance – particularly related to the enhancement of the audit quality of certification systems in the agribusiness sector. Efficiency and effectiveness of the certification process can be clearly improved by the application of this model. However, the advantages of this concept can also be transferred to the companies' level (risk-orientated self check) and the "control of the control" (risk-oriented standard owner). Hence, a total system's improvement is possible by monitoring each element of the system which is directly involved in the certification process. Furthermore, the consumers' confidence and the acceptance of other stakeholders in the guaranteed quality and safety of food will also be strengthened in the long run.
The Audit Quality Controlling System was presented to the German QS-system and the IFS, who generally demonstrate their willingness to improve the scheme. The system owners are interested in enhancing the audit quality and preventing possible structural deficits. The first objective, which has been developed after a presentation of this concept to the QS GmbH, is an improved systematic data warehouse which will be implemented to allow automatically conducted quality control routines.
The Audit Quality Controlling System, which monitors the performance of the whole system, is nevertheless neither implemented in the QS-system nor in the IFS. So far, the standard owners concentrate on a single control by the auditor and certification bodies. Thus, the perception, or rather, Systems Thinking is not established in the minds of the standard owners. The main arguments against such new controlling tools are the higher costs related to the respective certification system. This may lead to internal trade-offs and barriers to implementation. However, the principal objective of such an approach is to minimise the costs of a well-defined audit quality in certification systems and to ensure the survival of the entire certification scheme. Further research has to evaluate the impact on the whole system of single interactions between the system elements.

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