

INTEGRATED MODEL OF SAFETY, QUALITY, WORK STANDARDS AND COMMUNICATION MANAGEMENT (SQPI) IN THE FOOD PRODUCTION CHAIN

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Available management systems should increase satisfaction of customers of the organization in terms of the quality and safety of food produced and supplied on the market. The ISO management systems accessible for food business organizations as an ISO 22000:2005, 15161:2001, 9001:2000 clearly specify requirements however, they do not identify tools which need to be used to reach the ultimate goal.

The integrated SQPI model of safety (S), quality (Q), work standards of personnel (P) and communication – information flow (I) management in the food production chain is an individual project of a universal model.

The practical application of the SQPI model in a production plant consist of three areas of management: raw material and material supply processes, foodstuff production processes and distribution processes.

When organization is working on an integrated system of food safety and quality management the primary activity is to define processes, establish their interactions and identify among them the chains of actions adding value, referred to as key processes. In order to define processes in the SQPI model the SIPOC (Suppliers, Inputs, Process, Outputs, Costumers) method was applied.

The SQPI model defines four organizational levels in the management system of the organization. The first three are executive levels S, Q and P, while the fourth is the decision level I. Level I plays the most significant role in the management system and serves as the decision centre for levels S, Q and P. Due to effective management of information from levels S and Q and information coming from the environment, the organization realizes tasks of improving and updating binding standards. The DMAIC (Define, Measure, Analyze, Improve, Control) method is the primary management tool in the SQPI model. It is used to introduce improvement programs of the management system both in terms of food safety and quality.

The integrated model of safety, quality, work standards of personnel and communication management – SQPI may be applied at all production and supply elements of the feed and food production and distribution chain.

INTRODUCTION

Among agrifood enterprises the opinion is becoming increasingly common that currently realized food safety and quality management systems do not meet expectations. First of all they do not prove useful in the realization of business objectives, they are not always effective, frequently they are inefficient and their management hinders everyday operation of the organization.

Available management systems should increase satisfaction on the part of customers of the organization in terms of the quality and safety of food produced and supplied on the market. Their key role in this respect needs to provide them with sufficient support of the top management and full acceptance of the personnel. However, the managing board frequently treats their implementation as a troublesome (burdensome) obligation. They do not treat these systems as strategic support tools for the management process of the entire company.

Standards clearly specify requirements concerning documentation, records and individual actions. However, they do not identify tools which need to be used to reach the ultimate

goal – customer satisfaction, improvement of all processes affecting both the quality and safety of food products, but also profitability of the enterprise and meeting all binding legal regulations.

Representatives of these organizations frequently show a lack of sufficient knowledge on effective management methods, tools and techniques, required in the processes of appropriate design, implementation and improvement of management systems and presenting this knowledge in the simple form, comprehensible for the personnel.

The aim of the paper was to present an original, integrated model of food safety, quality, work standards of personnel, information (channel of communications) management (SQPI). It is a solution which is simple to implement, effective in operation and comprehensible for the workers of the organization applying it, following the principle: Let people understand the system, then no much control is required [Latzko *et al.*, 1998]. It integrates proven management methods and tools in such a way that it is possible for the organization to focus solely on the crucial aspect, *i.e.* supplying customers with safe food, meeting at the same time also their other expectations concerning quality.

A new standard of requirements, ISO 22000:2005, was developed to ensure food safety over the entire production and supply chain. The way to achieve it is to meet its key requirements, *i.e.*: (1) active communication and cooperation inside and outside the company – with suppliers, contractors, customers and legislative and regulatory authorities; (2) management system based on elements and structure of the standard ISO 9001:2000 defining requirements for the quality management system; (3) prerequisite programs (PRP) such as GAP, GMP/GHP/GDP and GVP, as well as operational prerequisite programs (o-PRP) and legal regulations; and (4) 7 principles and 12 stages of HACCP based on *Codex Alimentarius* [2003].

Tools proposed in the further part of the paper are to facilitate their more comprehensive realization.

STANDARDS CONSTITUTING THE FOUNDATION FOR THE SQPI MODEL

Standard ISO 9000:2006 *Quality management systems. Principles and terminology* stipulates that managing an organization and operating in a way ensuring success requires for the organization to be managed and supervised in a systematic and transparent way and the success may depend on the implementation and maintenance of the management system, developed for the continuous improvement of its operation by taking into consideration the needs of all interested parties.

Eight basic management principles were defined for the sake of improved operation of organizations [Ibid]: (1) customer focus, (2) leadership, (3) involvement of people, (4) process approach, (5) system approach to management, (6) continuous improvement, (7) making decisions based on facts, and (8) mutually beneficial relationships with suppliers.

These principles constitute a system which may be called synergistic [Hamrol, 2005]. The key element is being customer oriented (1). To implement the system it is necessary to have the process (4) and systemic approach (5) to the operation of the organization, making decisions based on facts (7), especially in case of decisions leading to continuous improvement (6) of processes and products. Since meeting the requirements of customers is determined to a considerable extent by suppliers, it is necessary to maintain partner relationships with them (8). Fundamental principles concerning leadership (2), including management responsibility, and involvement (3) in terms of all established quality objectives, including safety need to be followed.

One of the determining factors in the market success of most enterprises, including those in the food sector, is skillful combination of eight management principles according to ISO 9000:2000, applicable also in ISO 22000:2005, in the model of the management system and its practical application in an organization, *i.e.* in relation to food safety management.

Such a solution is the original model of food safety and quality management, work standards and communication SQPI (Safety, Quality, People and Information standards).

KEY PROCESSES IN ORGANIZATIONS AND THEIR STAGES IN THE SQPI MODEL

When working on an integrated system of food safety and quality management the primary obligations of each organization is to define their processes, establish their interactions (usually in the form of a process map) and identify among them the chains of actions adding value, referred to as key processes. In each organization it is the key processes which determine the realization of goals assumed by the organization, connected with meeting the requirements of the system and customers of the organization.

In order to define processes in the SQPI model the SIPOC method is applied, which consists in the identification of all process **Suppliers**, **Input** supplied by them, the description of the chain of tasks realized in the **Process** and listing products (**Output**), as well as all internal and external **Customers** of the process. Thus, this method plays a key role in the appropriate mapping of diagram flows for technological processes and using them in the hazard analysis in the HACCP system.

When defining processes it needs to be remembered that most tasks introduce something to the chain of values, but only some of them play a key role, connected with the physical manufacture and distribution of products to customers. According to Michael Hammer [1999], value is brought about by results of all actions undertaken to meet the requirements of customers, thus the difference between an action and a process is such as the difference between a part and a whole.

A requirement of the SQPI model is to define a typical key process for most organizations, *i.e.* the realization of orders of customers of the company, and to present it on the axis of value flow between the organization and its suppliers and customers, and to divide this key process into 3 main stages (Figure 1), *i.e.*:

1. **supply of raw materials and materials**, common for the external suppliers of the process (Suppliers) and the analyzed organization,
2. **manufacture of products**, occurring within the organization, consisting in adding value by successive internal customers of the manufacture process (Producer / Processor),
3. **distribution of products to customers**, common for external customers of the process and our organization (in practice the process of distribution usually ends in the site and time defined by the external customer).

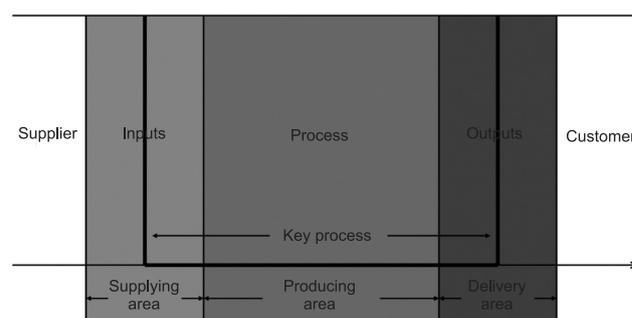


FIGURE 1. The SQPI model. Defining areas in the key process by the SQPI model.

It needs to be stressed that the key process of realizing orders of customers in the SQPI model is not limited solely to “external areas” of one’s organization, but reaches inside areas occupied by its suppliers and customers. For the organization it means greater commitment in the cooperation with suppliers and better understanding of expectations of its customers. Thus, the SQPI model makes the management system a system open to information from outside the organization.

ORGANIZATIONAL LEVELS OF THE MANAGEMENT SYSTEM IN THE SQPI MODEL

The SQPI model defines four organizational levels in the management system of the organization, out of which the first three are executive levels S, Q and P, while the fourth is the decision level I (Figure 2).

Executive organizational levels S, Q and P in the SQPI model

Level S (Safety Level) is the level, at which the organization realizes tasks, the aim of which is to ensure food safety for products manufactured during the 3 successive stages of the key process of realizing orders of customers.

Level Q (Quality Level) is the level, at which the organization realizes tasks, the aim of which is to meet quality requirements of products of the key process and to meet the expectations of internal and external customers of the organization.

Level P (People Standards Level) is the level, at which the organization defines workstation standards, indicates necessary skills and competences of the executive personnel of the organization. Thanks to workstation standards the executive personnel is focused solely on adding value to products of the key process, in tasks defined by the organization for levels S and Q. Additionally, precisely specified work standards limit errors made by the workers and losses generated at workstations to an acceptable level and reduce the risk of accidents at work. A considerable advantage of standardization of workstations is also connected with increased satisfaction of workers from the precise determination of their duties and responsibilities and from the optimized organization of their work.

Decision organizational level “I” in the SQPI model

Level I (Information & Decision Level) is the level, at which the organization focuses on planning, verifying and improving the management system. Level I plays the most



FIGURE 2. The SQPI model. Defining major levels in areas of the key process by the SQPI model.

significant role in the management system, it serves as the decision centre for levels S, Q and P.

At the decision level the organization uses respective competences of managerial personnel to conduct analyses of food safety hazards, analyses of customer needs and their assessment, which is critical to safety (CTS) and critical to quality (CTQ) at a given stage of the key process, using management techniques and tools such as HACCP, ISO 22000, MRA, QFD and FMEA analyses.

To ensure control over processes, which the organization realizes at levels S and Q – a system of parameters – indexes is established (*pLS*, *pLQ* – parameters of level of safety and quality) and work standards are defined (level P) for executive personnel at all stages of the key process (Figure 3). The organization uses for this purpose the KAIZEN methods and 5S programs. Standardization is based on the application of the SDCA cycle (S – Standardize, D – Do, C – Check, A – Act), which ensures a situation when workers respect obligatory standards and do their tasks with no deviations from the standard and the key process remains under control [Imai, 2006]. The status quo in the process is established by the organization on the basis of results of measured process parameters *pLs* and *pLq* at levels S and Q.

At the decision level the organization defines channels and principles of internal communication in the organization, for the prompt and correct exchange of information between levels S, Q, P and I, and external communication between the organization and its environment: suppliers and customers of the key process, institutions related to business and consumers.

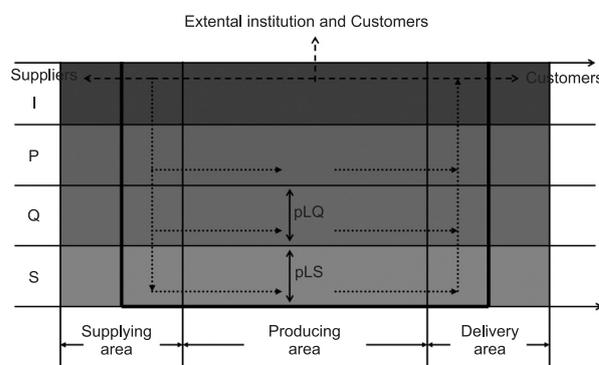


FIGURE 3. The SQPI model. Communication channels in the SQPI model.

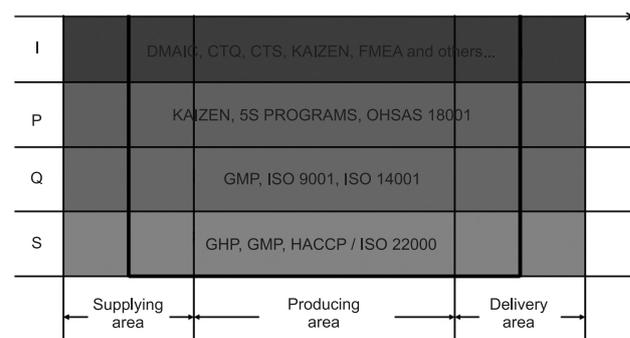


FIGURE 4. The SQPI model. Managements tools and methods in the SQPI model.

In result of effective management of information from levels S and Q and information coming from the environment, the organization realizes tasks of improving and updating binding standards (Figure 4):

- requirements of standard ISO 22000:2005, including GMP/GHP, HACCP [*Codex Alimentarius*.2003], traceability (ISO 22005:2007) as requirements specific for planning and ensuring food health safety for all organizations in the food chain,

- requirements of standard ISO 9001:2000 to plan conformity of the system with advanced principles of quality management in the organization,

- requirements of standard ISO 14001:2004 to plan conformity of the system with advanced principles of environment management in the organization,

- requirements of standard PN-N 18001 to plan the conformity of the system with advanced industrial safety principles in the organization,

- requirements of standard ISO 19011:2002 to plan the verification and auditing of the management system.

Improvement may be provided using the following tools:

- the DMAIC (Define, Measure, Analyze, Improve, Control) method in order to plan management system improvement programs [Pande, 2003],

- the FMEA analysis (Failure Mode and Effect Analysis) used to assess potential causes of effects and failures in the key process,

- the SWOT analysis (Strengths, Weaknesses, Opportunities and Threats) indicating weak and strong points of the management system, its opportunities and external threats,

- the Why – Why method (or 5W), making it possible to observe the so-called root causes, i.e. actual causes of potential non-conformity of the process,

- the QFD method (Quality Function Deployment) used to “transfer” the language of customer needs to the language of technological requirements of the company,

- the Ishikawa cause and effect diagram used to analyze causes of non-conformity,

- the 5M + E method: Man, Machine, Method, Management, Material, Environment,

- the KANO model of customer satisfaction classifies product or service attributes based on how they are perceived by customers and their effect on customer satisfaction.

The DMAIC method as the primary management tool in the SQPI model

The DMAIC method applied in the SQPI model is truly a more detailed transcription of the classical PDCA cycle according to Deming. It is used to introduce improvement programs in the organization in order to improve the management system both in terms of food safety and quality. Improvement programs are designed and realized by the organization according to the following stages of actions: (a) **Define** – define all features critical to safety (CTS) and critical to quality (CTQ) in the key process; (b) **Measure** – Use parameters pLS and pLQ to measure defined features and determine measurement results; (c) **Analyze** – analyze results and determine actual causes of non-conformity in the process. Use indicated analysis methods; (d) **Improve** – eliminate

causes of non-conformity, improve the process; and (e) **Control** – control the results of the improved process. Standardize the process and all actions of the organization in terms of reaching a permanent effect.

At the “Analyze” stage of the DMAIC method the organization uses *e.g.* the FMEA (Failure Mode and Effect Analysis) as a tool to define and assess potential problems, failures and non-conformity in processes and in products.

The FMEA analysis is applied primarily prior to the initiation of manufacture of new products and the introduction of changes in production processes. In the course of analysis the risk of non-conformities is assessed, their effects for customers are forecasted and the possibility to detect these failures by the organization is determined. The result of analysis consists in undertaking corrective actions, aiming at the minimization of the effect of potential non-conformity on customer satisfaction.

In the SQPI model the FMEA analysis is performed according to the following steps: (1) appointment of the FMEA team and determination of objectives of the analysis; (2) definition of the product or process; (3) identification of potential non-conformities of the product or process and their causes; (4) assessment of FMEA indexes for each potential non-conformity (the weight of non-conformity, frequency of occurrence, potential for non-conformity detection); (5) assessment of results, taking a decision on performance of corrective actions, indication of schedule of works and responsibilities; (6) performance of corrective actions; and (7) repeated assessment of FMEA indexes.

The application of corrective actions (they pinpoint the causes of non-conformities in order to eliminate them), being a consequence of the conducted FMEA analysis, makes it possible for the organization to focus on the limitation of the frequency of occurrence of potential non-conformity in the key process and in its products. The organization also increases its potential to detect possible non-conformity, which undoubtedly affects an enhancement of food safety and improvement of food quality, thus increasing customer trust and satisfaction.

POTENTIAL APPLICATION OF SQPI MODEL

An example for the practical application of the SQPI model is the project for the development and implementation of corporate standards (Corporate Governance) in terms of food safety and quality in one of the leading international feed and food industry corporations in Poland HaGe Polska Sp. Z o.o. The realization of the project includes seven production and distribution plants, located in north of Poland.

The SQPI model is referenced to:

1. defining the scope of the project for identified in the organizational structure of the corporation the following areas:
 - management of suppliers,
 - product development and manufacturing,
 - sale & distribution and customer service,
 - quality control – data assessment and analysis,
 - information management and decision taking,
2. meeting the requirements of standards ISO 9001:2000 and ISO 22000:2005
3. the application of proven techniques and tools, *i.e.*

TABLE 1. The tools utilized in SQPI model to meet requirements of ISO 9001:2000 and ISO 22000:2005 standards and quality (Q) and safety (S) goals.

No.	Name of area	Tools for quality and safety assurance	Examples of quality/safety goals
1.	Management of suppliers	GMP, GHP (PRP*, o-PRP*) suppliers qualification	Standardization of people work to realize proper quality & safe product (Level P)
2.	Designing of product to meet customer/consumer requirements	QFD, KANO model	Understanding and proper qualification of customers needs (Level I)
3.	Manufacturing of product	GMP, GHP (PRP*, o-PRP*), HACCP 5S method	Standardization of people work (Level P) to realize proper quality & safe product (Level Q,S)
4.	Quality data assessment and analysis	FMEA analysis, CTQ,CTS	Continuous improvement of supplying and production chain (Level I)
5.	Information management and decision taking	QFD method DMAIC method	Translation of customers needs to technical/functional capabilities of corporation (Level I)

DMAIC and FMEA for food and feed quality and safety assurance.

In Table 1 tools utilized for SQPI model to meet requirements of ISO 9001 and ISO 22000 standards and quality/safety goals have been presented.

The appointed within the corporation team managing the project, applied initially the DMAIC method to define and take measurements in all areas affecting the safety and quality of manufactured food and feed. At the stage of data analysis, the team utilized the FMEA technique to indicate potential non-conformities affecting food safety and quality in corporate areas. As a result of the analysis corrective actions were defined, aiming at the elimination of reasons and sources of potential non-conformities new corporate standards in terms of food safety and quality for levels S and Q of the organization were designed.

The primary expected aim of the realized project is ensuring the highest manufacturing and supplying standards of safe products of high and repeatable quality to customers, implementing the best operational practices, management improvement in relation to suppliers, contractors and sub-contractors of the corporation.

CONCLUDING REMARKS

The SQPI model presented in the paper is based on the system and process approach to management; therefore it may be applied at all stages of food and feed production according to the "from field to table" principle. It includes management tools, techniques and methods, which application guarantees success in the process of design, implementation and improvement of a professional management system.

In spite of a slightly different approach to the realization of business tasks and measurement of advantages, all the applied tools (like DMAIC method, FMEA analysis, SWOT analysis, 5W method, QFD method, 5M + E method) make it possible to meet requirements imposed by standards concerning safety and quality management [ISO 9001:2000, ISO 22000:2005]. They also partly make it possible to meet requirements of environment systems as well as safety and work environment management.

The presented approach meets the expectations of organizations in the agrifood sector concerning a simple and easily applicable tool in food safety and quality management.

REFERENCES

1. Codex Alimentarius. Food Hygiene Basic Texts, Code of Practice. General Principles of Food Hygiene. 2003, Annex. Hazard Analysis And Critical Control Point (HACCP) System and Guidelines for its Application, FAO/WHO.
2. Hammer M., *Reinżynieria i jej następstwa*. 1999, Wydawnictwo Naukowe PWN, Warszawa, pp. 19-23 (in Polish).
3. Hamrol A., *Zarządzanie jakością z przykładami*. 2005 Wydawnictwo Naukowe PWN Warszawa, pp. 88-89 (in Polish).
4. Imai M., *Gemba Kaizen: Zdroworozsądkowe, niskokosztowe podejście do zarządzania*, 2006, Wydawnictwo MT Biznes, Warszawa, pp. 91-96 (in Polish).
5. ISO 22000:2005. Food safety management systems – Requirements for any organization in the food chain.
6. ISO 9000:2005. Quality management systems – Fundamentals and vocabulary.
7. ISO 22005:2007. Traceability in the feed and food chain – General principles and basic requirements for system design and implementation.
8. ISO 15161:2001. Guidelines on the application of ISO 9001:2000 for the food and drink industry.
9. ISO 9001:2000. Quality management systems – Requirements.
10. ISO 19011:2002. Guidelines for quality and/or environmental management systems auditing
11. ISO 14001:2004. Environmental management systems – Requirements with guidance for use.
12. Latzko W. J., Saunders D., M., *Cztery dni z dr Demingiem*. Nowoczesna teoria zarządzania. 1998, Wydawnictwo Naukowe PWN, Warszawa, pp. 35-36 (in Polish)
13. Pande P. M., *Six Sigma, Sposób poprawy wyników nie tylko dla takich firm jak GE czy MOTOROLA*. 2003, Wydawnictwo KE Liber, Warszawa, pp. 222-225 (in Polish).
14. PN-N-18001:1999. Systemy zarządzania bezpieczeństwem i higieny pracy. Wymagania.

ZINTEGROWANY MODEL ZARZĄDZANIA BEZPIECZEŃSTWEM, JAKOŚCIĄ, STANDARDAMI PRACY I KOMUNIKACJĄ (SQPI) W ŁAŃCUCHU PRODUKCJI ŻYWNOSCI

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Dostępne systemy zarządzania powinny zwiększać satysfakcję klientów organizacji w zakresie jakości i bezpieczeństwa wyprodukowanej i dostarczonej na rynek żywności. Systemy zarządzania ISO zalecane organizacjom reprezentującym biznes żywnościowy, takie jak ISO 22000:2005, ISO15161:2001 czy ISO 9001:2000 jasno precyzują wymagania, jednakże nie identyfikują narzędzi, które należy zastosować aby osiągnąć ostateczny cel. Zintegrowany model SQPI zarządzający bezpieczeństwem (S), jakością (Q), standardami pracy personelu (P) oraz komunikacją tj. przepływem informacji (I) w łańcuchu produkcji żywności jest autorskim projektem uniwersalnego modelu.

Praktyczne zastosowanie modelu SQPI w zakładzie produkcyjnym dotyczy trzech obszarów zarządzania: procesem dostaw surowców i materiałów, procesem wytwarzania produktów spożywczych oraz procesem dystrybucji. W pracy nad zintegrowanym systemem zarządzania bezpieczeństwem i jakością żywności podstawowym działaniem każdej organizacji jest zdefiniowanie swoich procesów, ustalenie ich wzajemnych oddziaływań i wyodrębnienie wśród nich łańcuchów czynności dodających wartości, określonych mianem procesów kluczowych. W modelu SQPI w celu definiowania procesów stosuje się metodę SIPOC.

Model SQPI wyznacza cztery poziomy organizacyjne w systemie zarządzania organizacją, z których pierwsze trzy to poziomy wykonawcze S, Q i P a czwarty to poziom decyzyjny I. Poziom I odgrywa najistotniejszą rolę w systemie zarządzania, pełni rolę centrum decyzyjnego dla poziomów S, Q i P. Dzięki sprawnemu zarządzaniu informacją z poziomów S i Q oraz pochodzących z ich otoczenia, organizacja realizuje zadania doskonalenia i aktualizacji obowiązujących standardów.

Metoda DMAIC jest narzędziem systemowym o pierwszorzędym znaczeniu dla modelu SQPI. Służy do wprowadzania w organizacji programów poprawy, w celu doskonalenia systemu zarządzania zarówno bezpieczeństwem jak i jakością żywności.

Zintegrowany model zarządzania bezpieczeństwem, jakością standardami pracy i komunikacją w łańcuchu produkcji żywności SQPI może mieć zastosowanie we wszystkich ogniwach produkcji i dostaw łańcucha paszowo – żywnościowego.