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Critical factors, food quality management and organizational performance

Dimitrios P. Kafetzopoulos [a,*], Katerina D. Gotzamani [b,1]

[a] Department of Business Administration of Food and Agricultural Enterprises, University of Patras, 2 George Seferis Str., GR-301 00 Agrinio, Greece
[b] Department of Business Administration, University of Macedonia, P.O. Box 1591, 54006 Thessaloniki, Greece

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ABSTRACT

This paper proposes a model for measuring the effectiveness of quality (ISO 9001) and food safety (HACCP) systems, based on their stated objectives, when these systems are jointly implemented in a food company. In addition, it investigates the critical factors for effective implementation (CFEI) of the ISO 9001 and HACCP systems; and examines the degree to which the combined implementation of ISO 9001 and HACCP influences the overall performance of the certified firms. To achieve these objectives, primary field data was collected through an empirical survey that was conducted among 347 food companies in Greece, which were certified to ISO 9001, HACCP and/or ISO 22000 systems. Initially, Exploratory Factor Analysis (EFA) and then Confirmatory Factor Analysis (CFA) were applied. The connections among the non observed model factors were verified through Structural Equation Modeling (SEM) inspection. The findings suggest that “employee attributes”, “organizations’ attributes” and “internal business motives” make a significant contribution to the effective implementation of the ISO 9001 and HACCP systems. In addition, the effective implementation of the ISO 9001 and HACCP systems contribute to the business performance of companies in the Greek food industry. The evidence provided in this study helps managers to realize the importance of CFEI and the effective combined implementation of these systems in order to provide the necessary resources and support and develop the necessary policies, practices and procedures.

1. Introduction

An increasing number of food companies all over the world have been implementing quality and Food Safety Systems (FSS) in order to improve the quality and safety of their products and to witness the related benefits. Nowadays, the main Quality Management Systems (QMS) that are implemented by food companies are those in the International Organization for Standardization (ISO) 9000 series, such as ISO 9001: 2008. The ISO 9000 series of quality management standards provides the framework for organizations to install a QMS following certain guidelines and leads to continually improved processes that satisfy customers’ requirements. However, the effectiveness of the ISO 9001 standard in enhancing a firm’s competitive performance is highly controversial (Yeung, Lee, & Chan, 2003) and studies evaluating the impact of ISO 9001 implementation on an organization’s performance show mixed results (Heras, 2011; Singh, 2008). In practice, the performance of the ISO 9001 QMS is often unsatisfactory due to its ineffective implementation. Indeed, the benefits and advantages of ISO 9001 are subject to a company’s conformance to a number of critical success factors (Augustyn & Pheby, 2000). Although there are many cases of successful adoption of the revised versions of the standard, there are still many problems regarding the achievement of sustainable implementation, indicating that the critical success factors require ongoing identification and exploration (Magd, 2008; Sampaio, Saraiva, & Rodrigues, 2009; Zeng, Tian, & Tam, 2007).

Similarly, Hazard Analysis of Critical Control Points (HACCP) is a system which was specifically developed in the food field to assist organizations throughout the food-chain to identify and properly prevent health risk sources in food manufacturing. HACCP is widespread within the food industry, since food product manufacturing is extremely sensitive to hygiene and safety issues at all stages. However, HACCP per se does not make food safe, although its correct and effective application can make a difference (Kafetzopoulos, Psomas, & Kafetzopoulos, 2013). The success and effectiveness of HACCP in preventing food borne diseases and

* Corresponding author. Tel.: +30 26410 74123; fax: +30 26410 74168.
E-mail addresses: dimkafe@yahoo.gr (D.P. Kafetzopoulos), kgotza@uom.gr (K.D. Gotzamani).
[1] Tel.: +30 2310 891568; fax: +30 2310 891565.

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reducing food safety risks to an acceptable level, depends on its correct implementation and application (Kafetzopoulos, Psomas, et al., 2013; Kök, 2009). When a food company adopts the HACCP, it has to assure its performance and assess whether the system is being implemented effectively (Domenech, Escriche, & Martorell, 2008). In order for this to be achieved, the barriers to implementing HACCP should be assessed and their impact evaluated. Taylor and Kane (2005) noted that there is a need to identify the specific hurdles that companies face at each step of the HACCP process and to develop successful intervention strategies. Until these barriers are resolved, the HACCP system will not be effectively implemented and it will not reach its full potential for the international trade of foodstuffs (Eves & Dervisi, 2005).

In 2005, the international standard ISO 22000 was published in order to fill the managerial gap in the HACCP FSS. According to the standard's requirements, an organization has to design and develop all necessary processes for safe food production, assuring the effectiveness of all prerequisite programs and HACCP implementation (ISO 22000, 2005). ISO 22000 (2005) provides a framework for a structured Food Safety Management System (FSMS) and incorporates this system into an organization's overall management activities. Also, ISO 22000 (2005) enables an organization to align its food safety system with other management systems such as QMSs or environmental management systems (Surak, 2007).

The contribution of the above mentioned systems has been thoroughly investigated in literature with both positive and negative reviews. Many researchers conclude that the systems' added value does not depend on the systems alone, but rather on the degree of their effective implementation (Kafetzopoulos, Psomas, et al., 2013; Psomas, Kafetzopoulos, & Fotopoulos, 2013). So far, the effectiveness of the QMS has been measured against the results achieved in an organization's performance (Feng, Terziovski, & Samson, 2008; Koc, 2007; Magd, 2008). However, much more conceptual and empirical work will be needed to examine the CFEI (Magd, 2008; Sampaio et al., 2009; Zeng et al., 2007). Furthermore, there is a gap in the literature concerning the assessment of the effectiveness of the quality and FSS as against their own goals and objectives (Kafetzopoulos, Psomas, et al., 2013; Psomas, Kafetzopoulos, et al., 2013) and the degree to which their effective implementation finally has an impact on the organization's performance (Psomas, Pantouvakis, & Kafetzopoulos, 2013; To, Lee, & Yu, 2011). Thus, many authors (Bas, Yoksel, & Havuooflu, 2007; Kafetzopoulos, Psomas, et al., 2013; Lin & Jang, 2008; Magd, 2008; Psomas, Kafetzopoulos, et al., 2013; Psomas, Pantouvakis, et al., 2013; Sampaio et al., 2009; Wallace, Holyoak, Powel, & Dykes, 2011) suggest future research that would evaluate the relationship between CFEI, ISO 9001 and HACCP effectiveness and a food company's overall performance.

Based on the above, the purpose and main contribution of this paper is; first, to measure the ISO 9001 and HACCP systems effectiveness, based on their stated objectives, when these systems are jointly implemented in a food company. Second, to investigate the CFEI of the ISO 9001 and HACCP systems; and third to examine the degree to which the combined effective implementation of ISO 9001 and HACCP influences the overall performance of the certified food companies. Therefore, we present a model that has been especially designed and tested in food industry enterprises. This empirical finding will help managers to provide the necessary resources and support and develop the necessary policies, practices and procedures.

In the next paragraph a relative literature review is presented followed by a presentation of the proposed model and the research methodology. Empirical results are discussed in the following section and the main conclusions of the study are summarized in the final section.

2. Theoretical background

Food companies implement quality and FSSs to avoid product failures, safety and health problems, customer complaints and failure costs (Van der Spiegel, Luning, Ziggers, & Jongen, 2005). An effective QMS enhances the competitiveness of a company and provides strategic advantages in the marketplace (Anderson, Rungtusanatham, & Schroeder, 1994). In order to assure, control and improve its operations and food quality, a food company has to select an appropriate QMS or a combination of systems that should be applied effectively (Oliver, 2009). That is why more and more food companies are implementing QMSs in order to assure the quality of their operations and thus the quality of their products. The most popular and widespread QMS is the ISO 9001 standard, which has gained widespread attention in both research and practice over the past two decades (Benner & Veloso, 2008). However, companies that establish a QMS according to the ISO 9001 standard should test its effectiveness (Al Nakeeb, Williams, Hibberd, & Gronow, 1998).

On the other hand, an FSMS is responsible not only for producing safe foods but also for demonstrating with transparency how food safety has been planned and implemented. HACCP is part of an FSMS (Al-Kandari & Jukes, 2011), which is widely acknowledged as the best method of assuring product safety while becoming internationally recognized as a tool for controlling food borne safety hazards (Khandke & Mayes, 1998; Wallace, Powell, & Holyoak, 2005). When a food company adopts an HACCP system, it has to assure its performance and assess whether the system is implemented effectively (Cormier, Mallet, Chiasson, Magnusson, & Valdimarsson, 2007; Domenech et al., 2008). In particular, Wallace et al. (2005) claim that it is necessary to establish ways of measuring HACCP effectiveness, that are not based solely on retrospective analysis of outbreak data. Furthermore, Kafetzopoulos, Psomas, et al. (2013) developed a measurement instrument for HACCP effectiveness based on the indicators of the HACCP objectives, in order to facilitate understanding of how the system operates. So, there is a need to establish criteria and assessment methods to identify the effectiveness of the HACCP FSS.

The implementation of quality and safety practises can help food companies to remain competitive in the market. With this aim, food companies have been implementing the ISO 9001: 2008 and the HACCP FSS combined. The requirements of a QMS like ISO 9001, coupled with the development of an FSS like HACCP, contribute considerably to the effective implementation of food business processes (Kafetzopoulos, Gotzamani, & Fotopoulos, 2013). Cao, Maurer, Scrimgeour, and Drake (2004) point out that by adopting a food quality and an FSS and then being able to signal it to the consumers, a company gains marketing advantages and consequently competitive advantages. An FSS can easily be integrated within a QMS. A quick and effective method for achieving this is by treating food safety specifications as an additional element of product and process quality (Chountalas, Tsarouchas, & Lagodimos, 2009).

2.1. CFEI of quality management and food safety systems

It is strongly and extensively supported in literature that despite their anticipated benefits, the implementation of quality and FSSs is not always successful. In fact, many authors have described a number of factors (implementation barriers, constraints, and motives) that may have a direct effect on their successful implementation. In this paper, these factors are called Critical Factors for Effective Implementation (CFEI). In order to detect the CFEI of quality and FSSs, one should identify: a) the usual barriers/difficulties/limitations faced in their implementation, as well as b) the true motives for their implementation, since it has widely been supported in literature that these motives are critical to their overall success and contribution to performance improvement (Fotopoulos, Kafetzopoulos, & Gotzamani, 2011; Psomas, Fotopoulos, & Kafetzopoulos, 2010).

The CFEI of HACCP can be viewed as those factors that should effectively be managed in order to ensure the system's successful implementation and consequently food safety (Fotopoulos, Kafetzopoulos, & Psomas, 2009). Fotopoulos et al. (2009) have assessed and analyzed the CFEI of HACCP and revealed four latent constructs. Attributes such as those of the company, human resources, external environment and the food safety system were considered as the latent constructs of the CFEI of HACCP. Similarly to HACCP implementation, motives and barriers are described in literature as critical factors for ISO 9001 effectiveness, with a great influence on its successful implementation. For example, Psomas et al. (2010) have also investigated the CFEI of the ISO 9001 standard in Small and Medium Enterprises (SMEs) operating in the services sector. They concluded by defining five latent constructs named "internal motivation of the company"; "attributes of the company"; "employee attributes"; "requirements of the quality system"; and "attributes of the external environment". In the present study we adopt the above five latent factors as CFEI for the ISO 9001 and the HACCP systems and we used as measured variables the elements from the extensive list of possible CFEI of HACCP and ISO 9001 given by Fotopoulos et al. (2009) and Psomas et al. (2010) accordingly (indicators are presented in the Appendix).

2.2. Assessment of quality and FSSs effective implementation

It is commonly asserted in literature that effectiveness refers to the degree to which a system's objectives and action plans are achieved (Al Nakeeb et al., 1998; Cormier et al., 2007; Oztas, Guzelsoy, & Tekinkus, 2007). Similarly, the ISO 9001 standard defines "effectiveness" as the extent to which the anticipated results/objectives are achieved (ISO 9001, 2000). Thus, in order for a measurement instrument of ISO 9001 and HACCP effectiveness to be developed, the objectives of the standards, as well as their indicators, should be clearly identified. According to ISO, the ISO 9001 standard aims at: a) focusing on customer satisfaction by monitoring and meeting customer requirements, b) improving the QMS continuously, and c) preventing nonconformities in products and services. Many other authors (Goetsch & Davis, 2005; Gotzamani, Tsiotras, Nicolaou, Nicolaides, & Hadjiadamou, 2007; Heras, Landín, & Fa, 2006; Luning & Marcelis, 2006; Psomas, Kafetzopoulos, et al., 2013; Psomas, Pantouvakis, et al., 2013) also regard "continuous improvement", "prevention of nonconformities" and "customer satisfaction focus", as the main objectives of the ISO 9001 standard. These objectives are measured in the present study through indicators that have been drawn from the studies of Singh (2008), Sadikoglu and Zehir (2010), Kumar, Choisne, and Grosbois (2009), Marın and Ruiz-Olalla (2011), Psomas, Fotopoulos, and Kafetzopoulos (2011), Kim, Kumar, and Kumar (2011), Psomas, Kafetzopoulos, et al. (2013) and Psomas, Pantouvakis, et al. (2013).

In the same way, in order to determine the effectiveness of the HACCP system, its key objectives should be clearly identified. Fotopoulos et al. (2009) point out that there is a general consensus among authors regarding the aims of the HACCP system. Based on the system's own objectives and a review of the relevant literature, many authors (Domenech et al., 2008; Eves & Dervisi, 2005; Kafetzopoulos, Psomas, et al., 2013; Manning & Baines, 2004; Trienekens & Zuurbier, 2008; Van der Spiegel, Luning, Ziggers, & Jongen, 2004) claim that the "identification", "assessment" and "control" of food borne safety hazards are the three main objectives of the HACCP system that affect its effectiveness. The choice of the observed variables of the identification, assessment and control of food borne safety hazards comes from an extensive literature review. More specifically, indicators are drawn from the guidance of the Food and Agriculture Organization (FAO, 2007) and they have also been widely used in previous studies by Ababouch (2000), Mortimore (2000), Wallace et al. (2005), Luning, Bango, Kussaga, Rovira, and Marcelis (2008) and Kafetzopoulos, Psomas, et al. (2013). Summarizing the above, for the purposes of this study, the effective implementation of the standards is defined as the degree to which their respective goals, as described above, are achieved (indicators are presented in the Appendix).

2.3. Business performance assessment

The ultimate goal of the effective combined implementation of the ISO 9001 and HACCP systems is to improve overall business performance. Thus, the ultimate goal of our study is to investigate the degree to which the effective combined implementation of these systems has a positive effect on and makes a contribution to the business performance of certified food companies. Firm performance is considered to be a multidimensional construct that is defined in relation to the quality of the organization's results (Lakhal, Pasin, & Limam, 2006). Several researchers in literature have proposed ways and tools to measure business performance using sub-dimensions such as financial performance, non-financial performance, innovation performance and quality performance (Samson & Terziovski, 1999). Brah, Tee, and Rao (2002) and Koh, Demirbag, Bayraktar, Tatoglu, and Zaim (2007) measured total business performance in two dimensions: operational and financial performance. Garvin (1987) and Sousa and Voss (2002) examined the extent to which quality management practices have an impact on firm performance meaning quality, operational and financial performance. Lakhal et al. (2006) and Psomas, Pantouvakis, et al. (2013) also assessed organizational performance in terms of financial performance, operational performance and product/service quality. For the present study, consistent with prior research (Garvin, 1987; Kumar et al., 2009; Lakhal et al., 2006; Lee, Yang, & Yu, 2001; Psomas, Pantouvakis, et al., 2013; Sousa & Voss, 2002), three performance related dimensions have been chosen, namely: a) "product quality" – the attributes that make food acceptable to the consumers, b) "operational performance" – reflecting the performance of internal operations of an organization on an on-going basis such as cost, flexibility and productivity of facilities (Clegg, Gholami, & Omurgonulsen, 2012) and c) "financial performance" – the achievement of financial and market-related objectives.

The five items of Garvin's product quality dimensions (performance, reliability, durability, perceived quality, and conformance to specifications) are used for measuring product quality because these measured variables have been previously used by many authors (Kafetzopoulos, Gotzamani, & Psomas, in press; Prajogo, 2007; Psomas, Pantouvakis, et al., 2013). As Garvin has been acknowledged as one of the authorities in the area of quality management, content validity of these items is ensured (Kafetzopoulos, Psomas, et al., 2013). Operational performance is usually measured as a composite of several performance dimensions. In this study, the measurement items used for operational performance are drawn from previous studies such as those of Lakhal et al. (2006), Van der Spiegel, Boer, Luningy, Ziggers, and Jongen (2007), Feng et al. (2008), Lin and Jang (2008), Su, Li, Zhang, Liu, and Dang (2008) and Uyar (2009). The indicators of financial performance are drawn from the studies of Lee (2001), Conca, Llopis, and Tari (2004), Lakhal et al. (2006), Feng et al. (2008), Singh (2008) and Han Trienekens and Omta (2009) (indicators are presented in the Appendix).

3. The proposed model – research hypotheses

The improvement of the effectiveness of ISO 9001 and HACCP quality and FSS requires the adoption of the right approaches during the systems' development and maintenance. So, the effectiveness of the quality and FSSs should be examined taking into consideration the company's approach towards critical success factors (Augustyn & Pheby, 2000). Five critical factors are finally selected from the studies of Psomas et al. (2010) and Fotopoulos et al. (2011) as having an actual impact on the effective implementation of both quality and food safety management systems.

Authors such as Bayati and Taghavi (2007), Jang and Lin (2008), Magd (2008) and Psomas et al. (2010) consider internal motivation as a significant parameter influencing the successful implementation of the ISO 9001 QMS. However, many companies still implement the ISO 9001 for external reasons; meaning that their motivation for obtaining the certification is primarily pressure from customers and competitors or their use of the certificate as a marketing tool (Martínez-Costa, Martínez-Lorente, & Choi, 2008). Bayati and Taghavi (2007), Jang and Lin (2008), Magd (2008), Trigueros et al. (2008), and Psomas et al. (2010) also point out the impact of the external environment pressure on the desired benefits from ISO 9001 QMS implementation. In the same way, the original barriers, related to HACCP system implementation, may be internal, such as limited knowledge or other sources within the company, or external, such as inadequate help from the state. These barriers should be recognized and controlled from the initial stages of the system's development. Small businesses, in particular, suffer from a cluster of obstacles and restrictions that prevent the effective implementation of HACCP (Fotopoulos et al., 2011). On the other hand, business motives for HACCP implementation may be legal requirements, the improvement of a firm's reputation, its improved relationship with its customers and the reduction of costs (Khatri & Collins, 2007).

Employee attributes are also regarded as determinant factors of quality and FSSs effectiveness. The systems-based approach concentrates on employees being aware of and empowered to act on quality and safety – related issues and being suitably trained for the jobs they do (Singh & Smith, 2006). Authors such as Magd (2008), Feng et al. (2008), Cheng, Andrew, and Moore (2007), Bhuiyan and Alam (2005) and Psomas et al. (2010) consider that employee attributes influence the ISO 9001 QMS's effectiveness.

Firm characteristics such as company size, industry type or process type are often considered as important contextual factors that may affect whether and how quality and safety management practices are applied in organizations (Zu, Zhou, Zhu, & Yao, 2011). Trienekens and Zuurbier (2008) state that an important factor for developing country producers to take part in international chains and implement standards required in Western markets, is the enabling business environment (institutional and infrastructure facilities). Authors such as Luning and Marcelis (2006), Van der Spiegel et al. (2005), Van der Spiegel et al. (2007), Sroufe and Curkovic (2008), Luning et al. (2008), Feng et al. (2008) and Psomas et al. (2010) also consider that the basic operating characteristics of companies are contextual factors that may affect effective quality and FSSs implementation.

A quality or an FSS may be too complex and inefficient and yet still be certified. Implementation of the ISO 9001 standard or HACCP system may result in the development of a statistics quality and safety system, which increases bureaucracy and reduces flexibility and innovation. In case of bad implementation, the company is more likely to move one step backwards, instead of forwards, because of the general disappointment and resentment that may be caused to employees, as a result of excessive bureaucracy and workload (Gotzamani & Tsiotras, 2002). The attributes of a quality and FSS are also considered by Bhuiyan and Alam (2005), Sroufe and Curkovic (2008), Magd (2008), Feng et al. (2008) and Psomas et al. (2010) as critical factors that influence the effective implementation of the ISO 9001 QMS. Based on the above, the following research hypotheses are formulated:

- H1a Internal business motives have a positive significant impact on the effectiveness of the ISO 9001 and HACCP systems.
- H1b Employees' attributes have a positive significant impact on the effectiveness of the ISO 9001 and HACCP systems.
- H1c Organizations' attributes have a positive significant impact on the effectiveness of the ISO 9001 and HACCP systems.
- H1d The external environment has a positive significant impact on the effectiveness of the ISO 9001 and HACCP systems.
- H1e Systems' requirements have a significant positive impact on the effectiveness of the ISO 9001 and HACCP systems.

Numerous studies have demonstrated that ISO 9001 certification has a positive and significant effect on product quality improvement (Aggelogiannopoulos, Drossinos, & Athanasopoulos, 2007; Liao, Enke, & Wiebe, 2004). In the same line, HACCP implementation improves the food product quality (Khatri & Collins, 2007; Loc, 2006; Scott, Wilcock, & Kanetkar, 2009; Semos & Kontogeorgos, 2007; Trienekens & Zuurbier, 2008). Furthermore, some studies demonstrate that companies that effectively implement ISO 9001 and HACCP systems improve their quality and also have a positive and significant effect on operational performance (Feng et al., 2008; Jang & Lin, 2008; Koc, 2007; Magd, 2006). Many researches have empirically investigated the relationship between ISO 9001 certification and HACCP implementation and business performance. For example, in their study Naser, Karbhari, and Mokhta (2004) found a positive relationship between ISO 9001 certification and financial performance. The results of the study of Sampaio, Saraiva, and Rodrigues (2011) show that companies with higher financial performance do present a greater propensity to implement and certify their QMS. Cao et al. (2004) point out that by adopting a food quality and safety management system and being able to signal it to the consumers, a company can gain marketing advantages and consequently financial advantages. There is also evidence that the companies that implement the HACCP and ISO 9001 systems improve their business performance and gain a competitive advantage (Feng et al., 2008; Jang & Lin, 2008; Kafetzopoulos et al., in press; Singh & Smith, 2006).

Based on the above, this study develops the following three hypotheses to investigate how the effectiveness of the ISO 9001 and HACCP systems influences the performance of food firms based on three facets, namely, product quality, operational and financial performance angles.

- H2 The effectiveness of the ISO 9001 and HACCP systems has a significant positive impact on product quality.
- H3 The effectiveness of the ISO 9001 and HACCP systems has a significant positive impact on operational performance.
- H4 The effectiveness of the ISO 9001 and HACCP systems has a significant positive impact on financial performance.

Many authors support the view that operational performance is positively related to financial performance (Deming, 1986; Flynn, Schroeder, & Sakakibara, 1995; Jang & Lin, 2008; Ou, Liu, Hung, & Yen, 2010). Furthermore, empirical research studies of Heskett, Jones, Loveman, Sasser, and Schlesinger (1997), Forza and Filippini (1998), Ahire and Dreyfus (2000), Fotopoulos et al. (2009) and Psomas et al. (2011) found that operational process management practices have a strong and direct effect on product quality improvement. In addition, Garvin (1987), Du Brin (1995) and Heras, Casadesus, and Dick (2002) report that product quality improvement makes companies increase their market share, product value and price and consequently the financial benefits. Thus, this study develops the following 3 hypotheses:

H5 Operational performance has a significant positive impact on financial performance.
H6 Operational performance has a significant positive impact on product quality.
H7 Product quality has a significant positive impact on financial performance.

Based on the above theory, a model of relations was formed (Fig. 1) consisting of three main parts: a) the CFEI of quality and FSSs, b) the systems' effective combined implementation and c) three business performance dimensions. The relations and interactions among these parts are determined and the research hypotheses are developed.

4. Research methodology

4.1. Research population and sample

In order to answer the above formulated research questions, a research project was carried out within the Greek food industry, using a structured questionnaire as the data collection method. The questionnaire was sent to 840 Greek companies in the food industry sector that implemented both a QMS (ISO 9001) and an FSS (HACCP or ISO 22000) constituting the population size. Questionnaires were sent both through e-mail and fax, while some personal interviews were also conducted. Data was collected in three phases: in the first phase 110 valid questionnaires were received, in the second phase 150 valid questionnaires were received, and in the third phase 87 valid questionnaires were received. Finally, a total of 347 food companies responded, giving a response rate equal to 42.3%. Responding companies belong to the nutrition (59%), agricultural (23%) and beverages (18%) sub-sectors, while 91% of them are SMEs (companies with less than 250 employees).

4.2. Research instrument

All questionnaire measuring variables, based upon the above theoretical model, were defined and narrowed down to the most representative indicators, both through literature review and through reliability and validity testing. The 7-point Likert scale questionnaire was thoroughly examined and improved by: a) a team of experts – consisting of 5 academics, 3 business executives with experience in quality and food manufacturing, 2 consultants and 2 auditors – and b) two pilot studies, the first through personal interviews with 9 top management executives and the second through a pilot postal survey of 50 food enterprises. The results of the pilot survey showed the same trends as the results of the final sample. The survey questionnaire consisted of five parts: 1) General information about the companies' profile, 2) Critical Factors of Effective Implementation (26 variables), 3) ISO 9001 quality system objectives (19 variables), 4) HACCP food safety system objectives (16 variables) and 5) Business Performance (23 variables). The measurement items used in the survey and remaining after data analysis are listed in the Appendix.

4.3. Response bias

To detect non-response bias, the Kruskal Wallis test is used to determine if there are differences between the early, middle and late respondents in terms of their responses to the questionnaire variables. However, no statistically significant differences were found for any of the variables used in the study at $\alpha = 0.05$, indicating that non-response bias is not a problem in this study. To ensure that the respondent sample is not biased towards the sample representatives of the total population of manufacturing food organizations, industry sub division comparisons were made (Mann–Whitney test). Similarly, no statistically significant differences were found between these industries' sub division groups indicating that there is no such bias. Furthermore, the common method bias is checked in order to ensure that the data have no major problems. For this reason, the single-factor test was applied, as in many other empirical studies (Prajogo, 2011; Psomas, Kafetzopoulos, et al., 2013) and the results indicated absence of common method variance in this study.

4.4. Data preparation

All respondents completed the survey instrument individually and independently. Examining each of the variables individually for unique or extreme observations, 12 observations were deleted from the analysis because they were defined as cases with a threshold

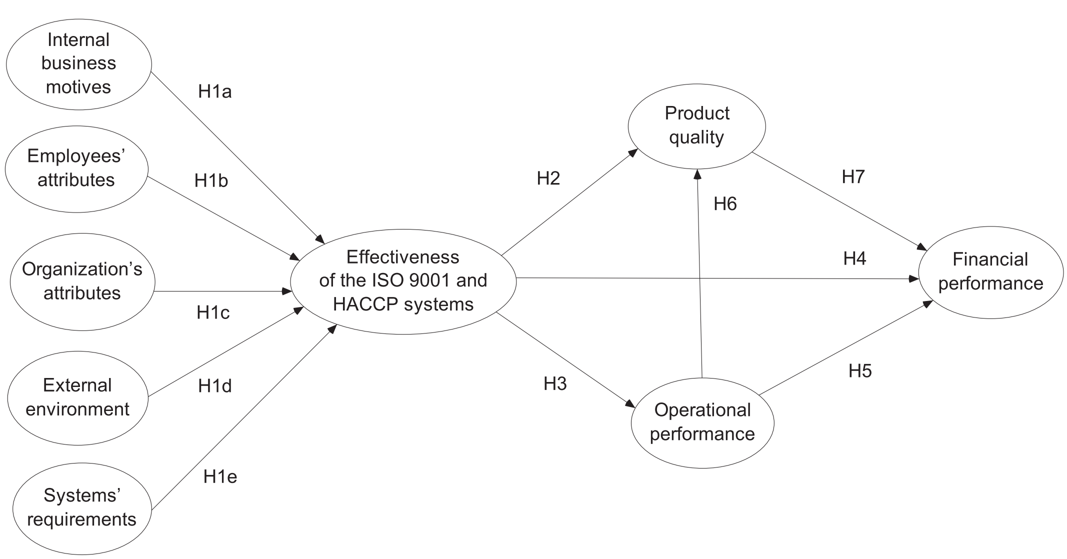

Fig. 1. Measurement dimensions of the proposed model.

value of a standard score up to 3 (Hair, Black, Babin, Anderson, & Tatham, 2006). Consequently, calculating the Mahalanobis d-squared distance, no observations exceeded the threshold value of 3 and so, no more data points were deleted from the analysis. Regarding the normality of the data, all measured variables in this study exhibited univariate normality and did not suffer from skew and kurtosis ($<\pm1$), indicating, but not guaranteeing, multivariate normality (Hair et al., 2006). In addition, the scatter plot showed constant variance of error terms (Homoscedasticity), while the histogram and normal P–P plots of the standardized residuals indicated normality of the error terms.

4.5. Method of data analysis

The analysis adopted in this study includes an initial Exploratory Factor Analysis – EFA (principal component extraction method with varimax orthogonal rotation), to uncover the underlying structure of the variables. Then, Confirmatory Factor Analysis – CFA is used to refine the resulting scales in EFA and to determine if the number of factors and the loadings of the measured variables (i.e. indicators) on them conform to what is expected on the basis of pre-established theory (Narayan, Rajendran, & Sai, 2008). Multicollinearity, unidimensionality, scale reliability and construct validity are undertaken for the study variables as suggested by Lakhal et al. (2006) and Hair et al. (2006). The model and the hypotheses are tested using SEM via path analysis, as it is a multivariate analytic methodology that gives insights into the causal ordering of variables in a system of relationships (Fynes & Voss, 2001). The Statistical analysis software SPSS 16 (Statistical Package for Social Sciences) and AMOS 6.0 (Analysis of MOment Structures) were used for the statistical processing of the data.

5. Data analysis and results

5.1. Construct reliability and validity

First, EFA is applied in order to extract the latent constructs of CFEI. Five latent factors (constructs) are established (Kaiser-Meyer-Olkin = 0.904, Bartlett's test of Sphericity = 3749.789, $p = 0.00$, eigen-value > 1, MSA > 0.80, factor loadings > 0.628), explaining 70.743% of the total variance, and they are named after the items that are loaded on them, as follows: "internal business motives", "external environment", "organizations' attributes", "employees' attributes", and "systems' requirements". EFA is also applied to extract the latent constructs of the systems' objectives. Six latent factors are established (Kaiser-Meyer-Olkin = 0.938, Bartlett's test of Sphericity = 6400.875, $p = 0.00$, eigen-value > 1, MSA > 0.80, factor loadings > 0.644), explaining 76.664% of the total variance, and they are named after the items that are loaded on them, as follows: "continuous improvement", "customer satisfaction focus", "prevention of nonconformities", "hazard identification", "hazard assessment", and "hazard control". Finally, EFA is applied on food firms' performance dimensions, extracting three latent factors (Kaiser-Meyer-Olkin = 0.925, Bartlett's test of Sphericity = 3555,420, $p = 0.000$, MSA > 0.80, factor loading > 0.616), namely "product quality", "operational performance" and "business performance", explaining 66.934% of the total variance.

Six items (V002, V006, V007, V015, V018, V021) related to the CFEI, ten items (V027, V032, V037, V038, V039, V044, V045, V046, V056, V057) related to the ISO 9001 and HACCP objectives and five items (V071, V076, V077, V079, V081) related to the firms' performance, which demonstrated cross-loading greater than 0.4 on more than one latent factor, were dropped, because it was considered that they did not provide pure measures of a specific factor. In addition, variance inflation factors (VIF) coefficients varied between 2.724 and 4.450 and did not exceed the recommended threshold of ten (Fynes & Voss, 2001; Lakhal et al., 2006). Hence, multicollinearity type problems did not appear in the study. The reliability of all the extracted factors is confirmed through Cronbach's alpha coefficients that are higher than 0.850 (Hair et al., 2006; Singh, 2008), indicating that all factors are measured by reasonably reliable items (Table 1).

In order to determine whether the extracted latent factors show acceptable fit to the empirical data (Su et al., 2008), the CFA (maximum likelihood estimation technique) is also applied in addition to EFA in each of the three sub-models (CFEI, systems' effectiveness, firm performance model). Thus, a series of tests are performed to further determine the construct validity of the latent factors (Singh, 2008). In addition, a higher order model is constructed using "ISO 9001 and HACCP systems' effectiveness" as a second-order factor that explains the six first-order factors (the objectives of ISO 9001 and HACCP effectiveness). The fit statistics of the second-order CFA indicate a good fit of the second-order measurement model. In addition, all the second-order factor loadings are positive and statistically significant. The results of CFA confirmed the three sub-models revealed by EFA. Thus, the extracted latent factors show acceptable fit to the empirical data (Table 2). Finally, construct, convergent, discriminant and nomological validity are confirmed indicating strong evidence that the proposed latent factors meet rigorous tests of these types of validities (Table 1).

5.2. Model estimation

In this study, the two-step procedure approach is chosen as the most suitable for testing the hypothesized structural model. Using this approach, the measurement and structural models are performed sequentially (Fynes, Voss, & Burca, 2005). In the first step CFA is conducted, while in the second step the hypothesized model is tested (Singh, 2008). The fit indices of both the measurement and

Table 1
Constructs validity and reliability.

Latent factors	Cronbach's alpha	Average variance extracted[a]	Construct reliability[b]	(Corr)[2c]
CFEI				
Internal business motives	0.922	0.675	0.956	0.284
External environment	0.836	0.638	0.904	0.167
Organizations' attributes	0.821	0.531	0.886	0.380
Employees' attributes	0.809	0.537	0.882	0.380
Systems' requirements	0.790	0.562	0.869	0.272
HACCP objectives				
Hazard identification	0.862	0.629	0.921	0.543
Hazard assessment	0.917	0.695	0.953	0.576
Hazard control	0.920	0.742	0.955	0.576
ISO 9001 objectives				
Continuous improvement	0.899	0.697	0.944	0.416
Prevention of non conformities	0.892	0.680	0.939	0.416
Customer satisfaction focus	0.878	0.647	0.878	0.337
Firms' performance				
Product quality	0.915	0.686	0.916	0.412
Operational performance	0.877	0.504	0.873	0.412
Financial performance	0.897	0.647	0.900	0.310

[a] AVE = $\Sigma\lambda_i^2/n$, (number of items $i = 1\ldots n$, λ_i = standardized factor loading).
[b] CR = $(\Sigma\lambda_i)^2/[(\Sigma\lambda_i)^2 + (\Sigma\delta_i)]$, (number of items $i = 1\ldots n$, λ_i = standardized factor loading, δ_i = error term).
[c] The highest squared correlation between the factor of interest and the remaining factors.

Table 2
The fit indices of the sub-models and the overall measurement and structural model.

Fit indices	CFEI model	Systems' objectives	Second order systems' objectives	Firm performance model	Structural model	Measurement model	Acceptable fit indices[b]
Absolute fit indices							
Chi-square (χ^2)	328.868	501.954	555.561	246.465	2946.580	2768.633	$0 \le \chi^2 \le 2df$
Degrees of freedom (df)	160	260	269	116	1802	1738	
Probability level	0.00[a]	0.00[a]	0.00[a]	0.00[a]	0.00[a]	0.00[a]	$p > 0.05$
Root Mean Square Residual (RMR)	0.045	0.030	0.038	0.036	0.045	0.038	<0.08
Root Mean Square of Approximation (RMSEA)	0.056	0.053	0.056	0.058	0.044	0.042	<0.08
Incremental fit indices							
Incremental Fit Index (IFI)	0.954	0.962	0.955	0.963	0.921	0.929	>0.90
Tucker-Lewis coefficient (TLI)	0.945	0.956	0.949	0.956	0.917	0.922	>0.90
Comparative Fit Index (CFI)	0.954			0.963	0.921	0.928	>0.90
Parsimonious fit indices							
Chi-square/degrees of freedom (χ^2/df)	2.055	1.931	2.065	2.125	1.635	1.593	<3.0
Parsimonious Normed Fit Index (PNFI)	0.842	0.801	0.821	0.795	0.781	0.763	>0.50
Goodness of Fit Index (GFI)	0.913	0.894	0.882	0.917	0.782	0.796	>0.50

[a] Acceptable when $N > 250$, the number of the measured variables range between 12 and 30, RMR < 0.08, RMSEA < 0.07 and CFI > 0.92 (Hair et al., 2006).
[b] Hair et al. (2006); Sadikoglu and Zehir (2010).

structural model fit the data satisfactorily (Table 2) and suggest that the theoretical model has an adequate level of empirical support (Hair et al., 2006). After performing the above tests, the SEM procedures are applied (maximum likelihood method) to estimate the causal relations between the latent variables, in order to confirm or refute the hypotheses presented earlier (H1–H7). Overall, as shown in Table 3, four research hypotheses (H2, H3, H4, H7) are supported, two are rejected (H5, H6), and one (H1) is partially supported (for 3 out of the 5 unobserved factors). The hypothesized structural model is depicted in Fig. 2.

6. Discussion

The present study offers empirical evidence regarding the contribution of critical factors to the combined effective implementation of the ISO 9001 and HACCP systems. More specifically, our study investigates the theory of CFEI and identifies 26 critical measures. From these initial measurement variables, data analysis leads to a model consisting of five unobserved factors that represent the CFEI of quality management and food safety systems, which are: “employee attributes”, “organizations' attributes”, “systems' attributes”, “internal business motives”, and “external environment”. Hypotheses testing revealed that only three of them, “employee attributes” (adequacy, education, commitment, etc.), “organizations' attributes” (documentation, quality audits, equipment, production technology, infrastructure, etc.) and “internal business motives” (quality improvement, cost reduction, process improvement, etc.) make a significant contribution to the effective implementation of the systems. The “external environment” for the systems' implementation (technical consultants, pressure from consumers, etc.) and “systems' attributes” (required time of implementation, volume of paperwork required, etc.) made no significant contribution. It is apparent that the CFEI of the ISO 9001 and HACCP systems examined in the present study are quite similar to the critical factors identified by Augustyn and Pheby (2000), Magd (2006), Wahid and Corner (2009) and Fotopoulos et al. (2009). However, similarly to Psomas et al. (2010) the present study identifies additional latent constructs as being important in the effective implementation of the two systems. The above mentioned results give a clear managerial message to those who want to implement a solid and effective quality and food safety system.

Additionally, this study investigates the theory of the effectiveness of the quality and food safety systems' implementation and describes it as the achievement of their most important goals. More importantly, this paper introduces and tests the combined effective implementation of a quality and an FSS in food companies. Psomas, Kafetzopoulos, et al. (2013) point out that a food company's survival and competitiveness in the long run are not assured. Increasing HACCP and ISO 9001 effectiveness is the parameter that can make the difference, helping a food manufacturing company move a step forward rather than simply conforming to HACCP and ISO 9001 requirements. Data analysis has revealed six factors that represent the main systems' goals that describe their effective implementation and these are: “continuous improvement”, “prevention of non-conformities”, “customer satisfaction focus”, “hazard identification”, “hazard assessment” and “hazard control”. Reviewing the literature, we observe that Psomas, Kafetzopoulos,

Table 3
Results of the basic research hypotheses.

Relationships	Standardized regression weights	Standard error	*p*-Value	Hypothesis test results
H1a. Internal business motives ⇒ Systems' effectiveness	0.324	0.046	0.00	Accept hypothesis
H1b. Employees' attributes ⇒ Systems' effectiveness	0.215	0.060	0.00	Accept hypothesis
H1c. Organizations' attributes ⇒ Systems' effectiveness	0.396	0.074	0.00	Accept hypothesis
H1d. External environment ⇒ Systems' effectiveness	−0.041	0.028	0.441	Reject hypothesis
H1e. Systems' requirements ⇒ Systems' effectiveness	−0.031	0.054	0.636	Reject hypothesis
H2. Systems' effectiveness ⇒ Product quality	0.557	0.086	0.00	Accept hypothesis
H3. Systems' effectiveness ⇒ Operational performance	0.693	0.077	0.00	Accept hypothesis
H4. Systems' effectiveness ⇒ Financial performance	0.062	0.084	0.516	Accept hypothesis
H5. Operational performance ⇒ Financial performance	0.527	0.648	0.00	Accept hypothesis
H6. Operational performance ⇒ Product quality	0.257	0.068	0.00	Accept hypothesis
H7. Product quality ⇒ Financial performance	−0.023	0.027	0.899	Reject hypothesis

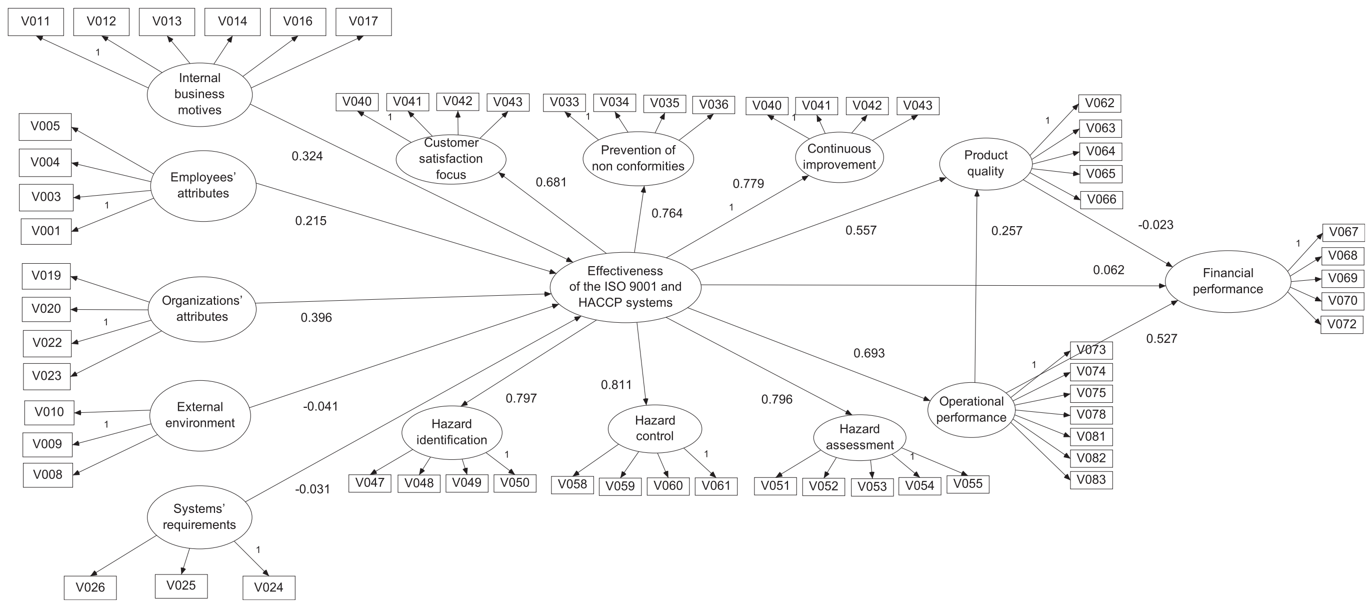

Fig. 2. The hypothesized structural model.

et al. (2013) develop an instrument that measures the effectiveness of the ISO 9001 QMS, based on its components, meaning the ISO 9001 objectives and they validate this instrument in the food manufacturing sector. Furthermore, Kafetzopoulos, Psomas, et al. (2013) in the same way, develop an instrument for measuring the effectiveness of the HACCP system in connection with the extent to which its prescribed food safety targets are met. Nevertheless, this is the first study to propose a multidimensional construct for measuring the combined effective implementation of ISO 9001 and HACCP and its contribution to food companies' performance. This represents the major contribution of this study to the existing literature in the area.

Finally, our study investigates the theory of companies' business performance. Literature review has shown that there is insufficient empirical research concerning the impact of the combined implementation of quality and food safety systems on the performance dimensions of companies in the food industry. Data analysis helped extract three main factors of business performance, which are: "product quality", "operational performance", and "financial performance". Hypotheses testing revealed that the effective combined implementation of the systems makes a significant contribution to firms' "food quality" and "operational performance" but a non-significant direct contribution to "financial performance". Moreover, it is shown that "operational performance makes a significant positive contribution to both "product quality" and "financial performance", while the contribution of "food quality" to "financial performance" was not confirmed by the results of this study. These findings are consistent with many previous researches (Jang & Lin, 2008; Lin & Jang, 2008; Naveh & Marcus, 2005; Ou et al., 2010; Sadikoglu & Zehir, 2010) and enable us to conclude that operational performance is a determinant of financial performance. In addition, these findings are consistent with the work of Fynes and Voss (2001), whose empirical research has not provided strong support for a quality performance – financial performance relationship. In line with the findings of the present study, Singh, Powera, and Chuong (2011) point out that ISO 9001 registration appears to affect only certain types of performance, improving operating performance but not financial performance. On the contrary, Su et al. (2008) concluded that a positive, significant relationship exists between ISO 9001 implementation and financial performance. Following extensive literature review, it is obvious that this study represents the first research project in the food quality management field that introduces the five CFEI, operationalizes ISO 9001 and HACCP effectiveness and empirically tests its relationship with the three dimensions of food manufacturing firms' performance.

7. Conclusions

A main conclusion to be drawn from this study is that there are five critical areas that should be considered by food companies that seek to implement both the ISO 9001 and HACCP systems effectively. These areas constitute the underlying structure of the critical factors that require attention. Furthermore, the empirical research presented in this paper has revealed the positive impact of the effective implementation of both systems (ISO 9001 and HACCP) on food product quality and operational performance, as well as the positive impact of operational performance on food product quality and financial performance. The study offers a theoretically developed and empirically proven reliable and valid model to measure the effectiveness and contribution of the ISO 9001 and HACCP systems to performance for self-evaluation and comparison. Systems' effectiveness is described as a second-order factor in terms of six underlying dimensions. Knowledge of these dimensions can help managers in developing and measuring the effectiveness of the implementation of their systems. The findings suggest that effective implementation of the ISO 9001 and HACCP systems can significantly contribute to realization of improvements in food manufacturing performance, in order to increase companies' competitiveness in the highly dynamic global marketplace. Also, the study offers managers direction regarding the critical factors on which they should focus in order to increase the effectiveness of their systems, providing the necessary resources and support and developing the necessary policies, practices and procedures. Finally, the evidence provided in this study helps managers realize the importance of the effective combined implementation of the systems since it is proved that it contributes significantly to both food product quality and operational performance.

However, the present study also suffers from some limitations. The questionnaires used were mainly gathered through emails.

Cost and time requirements prevented direct personal contact with quality managers on site. Also, there is possible bias on behalf of quality managers or top managers in answering the questions. Thus, future research studies should be conducted with on-site collection of primary data from multiple respondents. Furthermore, business performance of food companies is assessed by specific qualitative variables. Possibly, other measurable variables could alter the relationships among the unobserved (latent) factors. Finally, the limited number of companies per subsector in the sample made it impossible to test the validity of the model in certain food subsectors. Thus, it is suggested that future studies test the proposed model for its validity in specific subsectors of the food industry (agriculture, nutrition and beverages).

Appendix. Model constructs, associated items and squared multiple correlations (R^2)

Dimensions	Items	Code
Employees' attributes		**EA**
	Know-how of employees.	V001
	Involvement of employees.	V003
	Commitment of employees.	V004
	Human resources available.	V005
External environment		**EE**
	Technical consultants.	V008
	Government and authorities.	V009
	Pressure from consumers.	V010
Internal business motives		**IBM**
	Meeting customer needs and expectations.	V011
	Improvement of processes.	V012
	Product quality improvement.	V013
	Costs of production and decreasing waste products.	V014
	Improvement of company's image.	V016
	Commitment and support of senior management.	V017
Organizations' attributes		**OA**
	Prerequisite programmes – equipment.	V019
	Commitment of managers.	V020
	Validation and verification of the HAACP plans.	V022
	Adjustment of instruments and machines.	V023
Systems' attributes		**SA**
	Required time of implementation.	V024
	Financial resources – cost of implementation.	V025
	Volume of paperwork required.	V026
Customer satisfaction focus		**CS**
$R^2 = 0.464$	Customer's understanding of perceived product value.	V028
	Company's focus on customer requirements and expectations.	V029
	Company's assurance of meeting customer requirements.	V030
	Company's activities increasing the level of customer satisfaction.	V031
Prevention of non conformance		**PN**
$R^2 = 0.584$	Company's efficient product and process design.	V033
	Product's conformance to specifications in accordance with audit results.	V034
	Reduced nonconformity problems through quality processing, storage, packaging and delivery.	V035
	Control of products and procedures throughout production steps.	V036
Continuous improvement		**CI**
$R^2 = 0.607$	Drawing up an effective plan for continuous quality improvement.	V040
	Setting measured and explicit goals.	V041
	Developing organizational structure supporting the continuous improvement of the quality system.	V042
	Process of continuously monitoring and improving procedures and products.	V043
Hazard identification		**HI**
$R^2 = 0.635$	Use of brainstorming in order to identify food safety hazards.	V047
	Use of literature data bases to identify food borne safety hazards.	V048
	Experts note the product characteristics that create food safety hazards.	V049
	Evidence is provided regarding the determination of food safety hazards.	V050
Hazard assessment		**HA**
$R^2 = 0.634$	Employees fully recognize the significance and criticality of any food safety hazard.	V051
	Documented procedures are implemented so that safety hazards can be assessed.	V052
	The HACCP team assesses and classifies each food safety hazard according to occurrence probability and its criticality.	V053
	The HACCP team collects data for assessing hazard criticality.	V054
	The HACCP team has the knowledge and the know-how in order to assess the food borne safety hazards.	V055
Hazard control		**HC**
$R^2 = 0.658$	Reliable and valid procedures are used for monitoring and controlling food safety hazards.	V058
	External audit results confirm the suitability of the methods used for monitoring and controlling food safety hazards.	V059
	The programs for monitoring and controlling food safety hazards detect any excess of the limits in the Critical Control Points (CCPs).	V060
	When a new food safety hazard is detected in the product or at any stage of food processing, the HACCP team analyses the CCP and implements suitable actions for monitoring and controlling.	V061
Product quality		**PQ**
$R^2 = 0.575$	Perceived quality of the product compared with that of competitors.	V062
	Product reliability.	V063

(*continued on next page*)

(*continued*)

Dimensions	Items	Code
	General performance of the product.	V064
	Product durability.	V065
	Product conformance to company specifications.	V066
Financial performance		**BP**
$R^2 = 0.311$	Company's profitability.	V067
	Company's financial results.	V068
	Company's net profit margin.	V069
	Company's sales growth during the last three years.	V070
	Company's cash flow.	V072
Operational performance		**OP**
$R^2 = 0.481$	Company's productivity.	V073
	Company's efficiency.	V074
	Company's process effectiveness.	V075
	Employees' satisfaction.	V078
	Company's positive image for the company.	V080
	Company's delivery ability.	V082
	Company's operational cost.	V083

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