Original scientific papers UDK 663/664:658.562]:005.96
DOI 10.7251/COMEN1902190N

APPLICATION OF GOOGLE SOLUTIONS FOR EVALUATION OF EFFICIENCY AND COST OF APPLICATION QUALITY AND FOOD SAFETY MANAGEMENT SYSTEM

Brane Novaković[1*], *Igor Grujić*[2]
[1] ABC Project, Prijedorski put bb, 78000 Banja Luka, Bosnia and Herzegovina
[2] Nova banka a.d. Banja Luka, Kralja Alfonsa XII 37a, 78000 Banja Luka, Bosnia and Herzegovina

Abstract: This paper presents the results of research carried out in companies engaged in the production and distribution of bakery products, which relate to the advantages, disadvantages and costs of implementing the system for quality and food safety management. In focused companies, a quality and food safety management system has been applied, which, after development, has been certified by independent certification bodies. The methodology for collecting data using the Google questionnaire that was created and through which the data from the surveyed companies was obtained.

The highest initial costs during the introduction of quality and food safety management systems relate to the elucidation of infrastructure deficiencies (66.6% of surveyed enterprises) and consulting services (33.3% of surveyed enterprises). A key advantage of establishing a company's quality management system is to improve document management and product quality improvement (4.55).

The applied quality management systems and food safety systems offer companies numerous advantages, savings in business and represent a model by which applications and other companies can improve their own performance. Determining system efficiency methodologically using google questionnaires is a very simple and useful tool that can be used for similar research with minimal knowledge of online programming techniques.

Keywords: Google, QMS; HACCP.

1. INTRODUCTION

Bread has traditionally been an integral part of the dining table of most people from Bosnia and Herzegovina, regardless of their social position, ethnicity, education or age. The past twenty years have seen the significant development of bakery and the production of a large number of different types of bakery products. This development is mainly caused by the use of special food additives and other raw materials, which were not used in traditional bakery production, as well as the use of modern technological equipment, which significantly improved the technological processes of production of bakery products.

Bakery products must, first of all, satisfy food safety requirements, then quality requirements, and have appropriate sensory characteristics. With the right combination of additives, it is possible for consumers to achieve adequate sensory acceptability

In addition, it is important to note that the addition of certain ingredients, such as modified fibers, can significantly increase the nutritional value of bread, after which it can be classified as a functional food [2].

Although the above elements are significant, it is necessary to provide a systematic approach to ensuring the safety of bakery products and to manage quality in all business processes. Applying food quality management system standards is one possible way to ensure this systematic approach.

According to research conducted in the meat industry in Serbia, significant effects have been achieved in the application of the HACCP (Hazard Analysis and Critical Control Point) system. The results obtained show that the number of negative findings of microbiological safety of workplace swabs, equipment and workers' hands is significantly reduced after the introduction of mandatory application of the HACCP system in the meat processing plants [3].

[*] Corresponding author: branenovakovic@gmail.com

Data obtained from research into the effectiveness of the HACCP system implementation in the catering industry in Hungary indicate that the management of the catering company generally does not accept the HACCP concept as an effective food security system and does not include elements of the HACCP system in its management activities. As stated by Bánáti and Lakner (2011), there is a real danger that the implementation of the HACCP system will be so simplified as to become the sole formal satisfaction of administrative legal requirements [4].

The research, carried out at manufacturing companies in Greece, showed that there are three dimensions to the effectiveness of a quality management system based on the requirements of the ISO 9001 standard: preventing the occurrence of non-compliance, continuous improvement of the quality management system and a focus on customer satisfaction. According to this research, a high degree of internal motivation and attributes possessed by employees have a significant influence on the efficiency of quality management systems in companies [5].

The implementation of quality management and food safety systems in the meat industry in Serbia has resulted in numerous positive effects. In addition to improving the safety and quality of meat and meat products, the application of quality management systems has contributed to increasing customer satisfaction and enhancing the competitiveness of the meat industry in Serbia, which has resulted in increased sales of meat and meat products produced in the surveyed enterprises [6].

On the other hand, there is a very low level of use of modern tools and techniques for improving the quality management system.

As a separate segment of the food safety management system, activities related to the protection of the food chain from deliberate contamination, i.e. food defenses, can be considered [7]. International Featured Standards (IFS) define the protection of food products from intentional contamination by biological, chemical, physical or radiological agents. According to the IFS Food standard, all food-producing establishments have an obligation to carry out a risk assessment of intentional contamination and to identify key safety zones to be controlled [8].

Notwithstanding a large body of research around the world regarding the effectiveness of HACCP or food quality and safety management systems, very few papers have been published on the costs of preparing, implementing, and putting into practice these systems. There is very little information in the scientific and professional literature regarding the way in which these costs are financed and the impact of the application of the system on the financial performance of the enterprise. The aim of this paper is to determine the effect of the implementation of quality management and food safety systems in bakery production facilities in Bosnia and Herzegovina, to identify the most significant costs related to the implementation and application of these systems. In addition, the authors' desire was to provide guidance that would help businesses, with cost reductions, improve quality and safety management systems for food and bakery products.

2. MATERIAL AND METHODS

In order to determine the advantages, importance, costs of implementation and implementation of quality and food safety management systems in bakeries, a survey was conducted among representatives of companies in this industry. The survey was conducted in companies that have established and certified a quality management system and/or food safety management system based on HACCP principles, by independent certification bodies. The survey included nine bakeries in Bosnia and Herzegovina, six from the Republic of Srpska and three from the Federation of Bosnia and Herzegovina (Table 1). To avoid commercial effect, the authors omitted company names.

The collection of information in the surveyed companies was done in two ways: by interviewing the responsible persons in the observed bakeries and by completing the questionnaires by the responsible persons in the enterprises through a web application created with Google solution.

Before the start of the research, a structured questionnaire based on the available literature [1,6,9,10,11] was prepared, in which similar research was conducted.

Issues relating to prerequisite programs for the protection of production facilities from cases of intentional contamination have been specifically defined [12, 13].

The questionnaire included the following groups of questions:

– general questions about the company,

– issues related to the implementation of quality and food safety management systems,

– questions regarding the effectiveness of the quality management system,

– questions regarding the effectiveness of the food safety management system,

– questions regarding the fulfillment of the requirements for a prerequisite food protection program against intentional contamination.

The answers provided are ranked according to a five-point Likert scale [14].

Using Google solutions in conducting a survey requires you to have a Google Account. The questionnaires were created on the Google Drive platform where survey questions were defined. Each question has a text section that provides additional explanations regarding the question. Several categories of questions were asked: questions with text answers, questions with completely offered answers, questions with check boxes and questions where it is possible to select answers from the list of offered answers. By setting options, it is defined that the answers to each question are required in order to complete the questionnaire. The questionnaires were sent to the e-mail of the interviewed persons in the companies and after completing the questionnaire they were notified by e-mail that the questionnaire had been successfully completed.

The questionnaire was limited to a certain period of time when filling it was no longer possible. The answer database can be statistically processed in Google tools or any other statistical data processing solution.

Based on the data on the number of employees and the classification defined in the Law on Development of Small and Medium-Sized Enterprises of the Republic of Srpska [15], the surveyed enterprises are classified into different categories (Table 1): small enterprises (4), medium-sized enterprises (4) and large companies (1). Also, all surveyed companies that produce bakery products have a represented product distribution process, as 4 companies have more than 250 customers, 3 have 100 to 250 customers, and 2 companies have up to 50 customers (Table 1).

Out of 9 companies surveyed, 5 companies are export oriented. The main export markets for bakery products are those of the European Union (EU), Turkey, the United States of America (USA), Montenegro, Serbia, Macedonia, Switzerland and Albania. Of the 9 companies surveyed, 5 companies produce products under the customer's trademark.

At the time of the survey, all surveyed companies applied a HACCP system certified by Codex Alimentarius guidelines [16]. In addition to the HACCP system, the surveyed companies were certified according to one or more of the following standards: ISO 9001 (seven companies), HALAL standard (three companies), ISO 22000 (two companies), IFS Food (one company).

Table 1. Data on surveyed bakery companies

	Number of employees	Number of customers	Share of export in total revenue	Export markets	Do you produce products the customers trademark	Certificate
Company 1.	37	From 100 to 250 customers	We do not export	/	Yes	ISO 9001 ISO 22000 HACCP
Company 2.	37	From 5 to 50 customers	We do not export	/	No	HACCP
Company 3.	94	Over 250 customers	We do not export	/	No	ISO 9001 HACCP
Company 4.	212	From 100 to 250 customers	11 – 25 %	Turkey	No	ISO 9001 HACCP
Company 5.	343	Over 250 customers	We do not export	/	No	HACCP HALAL
Company 6.	80	Over 250 customers	11 – 25 %	EU SAD	Yes	ISO 9001 ISO 22000 HACCP HALAL
Company 7.	46	Over 250 customers	41 – 55 %	Montenegro Turkey	Yes	ISO 9001 HACCP
Company 8.	130	From 100 to 250 customers	56 – 70 %	Serbia Montenegro North Macedonia EU	Yes	ISO 9001 IFS Food HACCP HALAL

	Number of employees	Number of customers	Share of export in total revenue	Export markets	Do you produce products the customers trademark	Certificate
				SAD Switzerland Albania		
Company 9.	21	From 5 to 50 customers	26 – 40 %	EU	Yes	ISO 9001 HACCP

3. RESULTS AND DISCUSSION

An important resource of every business is related to people. According to the data obtained during the survey, it is evident that a significant number of low-skilled workers (12.39%) and unskilled workers (2.95%) work in the surveyed companies (Table 2). These data certainly indicate that additional efforts are needed to educate employees within the companies themselves. On the other hand, if we look at the data from the surveyed companies that have higher competitive ability and export their products, it can be seen that the average number of employees with a university degree is 15.87%, which is significantly higher than the average number of employees with a university degree in all surveyed companies (10.70%) (Table 2).

Respondents from the consultancy services were asked to express a degree of agreement with certain findings regarding the consultant's work. Only one of the nine companies that produce bakery products did not use consultant services to implement a food safety and quality management system. Six surveyed companies use the services of a consultant after the implementation of the management system. As the biggest disadvantage in providing consulting services, respondents cited poor knowledge of the processes in their company by consultant's (mean rank 4.10) (Table 3). The highest mean rank was given to assess the consultant's compliance with the contracted costs (rank average 4.80) (Table 3).

Table 2. Overview of the qualification structure of employees in the surveyed companies engaged in the production of bakery products

	Number of employees	% of employees with university degrees	% of employees with higher education	% of employees with secondary education	% of low-skilled employees	% of employees without education
Company 1.	37	8,11%	5,41%	81,08%	0,00%	5,41%
Company 2.	37	2,70%	2,70%	94,59%	0,00%	0,00%
Company 3.	94	4,26%	0,00%	85,11%	10,64%	0,00%
Company 4.	212	14,15%	2,36%	23,58%	54,25%	5,66%
Company 5.	343	2,04%	2,92%	41,69%	37,90%	15,45%
Company 6.	80	18,75%	6,25%	75,00%	0,00%	0,00%
Company 7.	46	19,57%	0,00%	71,74%	8,70%	0,00%
Company 8.	130	7,69%	11,54%	80,77%	0,00%	0,00%
Company 9.	21	19,05%	9,52%	71,43%	0,00%	0,00%
Average values	111,11	10,70%	4,52%	69,44%	12,39 %	2,95 %

Table 3. Data on consultants' evaluation and consulting services used by the bakery companies surveyed (1 - I disagree; 5 - I absolutely agree)

Evaluation consulting services	**Rank[1]**
The consultant is expert and possesses adequate knowledge	4,30
The consultant knows the processes in our company	4,10
The consultant had a defined work plan	4,20
The consultant met the deadline for completion of the project	4,20
Consulting reports are accurate and clear	4,20
Costs of consultant services were in accordance with the contract	4,80
I would recommend the consultant to other companies	4,10

[1] Mean rank obtained based on the responses of the surveyed companies

The costs of implementation of a quality and food safety management system in the surveyed bakeries mostly range between 5,000.00 and 10,000.00 Convertible Marks (BAM), with only one company having costs higher than that (Table 4). The major part of the costs is related to infrastructure repairs (66.67%) and consultancy costs (33.33%) (Table 4). Audit costs by certification bodies on an annual basis in most cases range from 2,000.00 to 4,000.00 BAM, and in only one of the companies surveyed did these costs amount to more than 6,000.00 BAM (Table 4). Of course, these costs also depend on the size of the company and the number and type of certified management systems.

When it comes to co-financing the costs of certification and implementation of quality and food safety management systems, only 3 out of 9 companies surveyed that produce bakery products had financial support from institutions. The amount of financial support for co-financing the costs of certification and implementation of the quality and food safety management system ranged from 50% to 70% of the total cost of the process (Table 4). The surveyed companies received financial support from the European Bank for Reconstruction and Development program, and it mainly concerned the co-financing of consultancy costs.

In the answers, which were to answer the questions about the key advantages of the implementation of the quality management system, the representatives of the surveyed companies needed to sort the 10 offered answers by importance. Representatives of the companies surveyed said, that the most significant advantage of the implemented system is the improvement of product quality and safety (mean rank 2.92). The lowest average rankings of significance of the implemented system are given for reducing business costs (mean rank 6.47) and assistance in introducing new workers to the job (mean rank 7.79) (Table 5).

Table 4. Data on costs of implementation of quality and food safety management system in the surveyed companies producing bakery products

Information regarding cost of implementation of quality and food safety management system	% participation in the total number of surveyed bakery companies
Costs of implementation of quality and food safety management system from 3,000.00 to 5,000.00 BAM	11,11 %
Costs of implementation of quality and food safety management system from 5,000.00 to 10,000.00 BAM	77,78 %
Costs of implementation of quality and food safety management system more then 20,000.00 BAM	11,11 %
Share of consultancy costs in the cost of implementing a quality and food safety management system	33,33 %
The share of infrastructure repair costs in the cost of implementing a quality and food safety management system	66,67 %
Audit costs annually from 2,000.00 to 4,000.00 BAM	66,67 %
Audit costs annually from 4,000.00 to 6,000.00 BAM	22,22 %

Information regarding cost of implementation of quality and food safety management system	% participation in the total number of surveyed bakery companies
Audit costs annually more then 6,000.00 BAM	11,11 %
Obtained financial support for the implementation of quality and food safety management systems	33,33 %
The amount of support for co-financing in relation to the costs of implementing a quality and food safety management system	50 to 70 %

Table 5. Key advantages of the implemented quality management system in bakeries (1 - very significant; 10 - last in importance)

Description of advantages	**Rank[1]**
Improving product quality and safety	2,92
Improved workflow	4,29
Improved documentation	4,50
Improved organizational structure	5,21
Increased productivity	5,42
Improved company reputation	5,95
Enhanced communication	6,05
Increased sales of bakery products	6,39
Reduced costs	6,47
Assistance in introducing new workers to the business	7,79

[1] Mean rank obtained based on the responses of the surveyed companies

In the group of questions where the respondents were asked to express their degree of agreement with certain findings regarding the effects of the implementation of the quality and food safety management system, the offered answers were ranked according to the Likert scale in five sections. Representatives of the companies surveyed cited increased quality and food safety and improved documentation in the company as a key effect of the implementation of the quality management system (mean rank 4.55) (Table 6). The lowest effect of the implementation of the quality and food safety management system, in the opinion of the surveyed companies, is reflected in the reduction of costs (mean rank 3.11) and decrease in the fluctuation of working staff (mean rank 3.22) (Table 6).

One of the basic principles of quality management is the continuous improvement of the quality management system. In order for the process of continuous improvement to have a systemic character, it is necessary to apply some of the many quality tools. To the group of questions regarding the use of quality tools as tools for improving the quality management system, the representatives of the surveyed companies ranked their answers according to the Likert scale in five sections regarding the use of quality tools. The most commonly used quality tool is the process flow diagram (mean rank 4.22), which is expected because the process flowchart is required as a step in the development of the HACCP plan. In addition to process flowcharts, occasionally used tools are a list of errors collected (mean rank 3.66) and SWOT analysis (mean rank 3.11). All other quality tools are very little applied (Table 7).

Table 6. Assessment of the effect of the implementation of the quality and food safety management system in bakeries (1 - I disagree; 5 - I absolutely agree)

The effect of implementing a quality and food safety management system	Rank[1]
Increased product safety and quality	4,55
Improved company documentation	4,55
Improved customer relationship	4,33
Increased customer / consumer satisfaction	4,33
The process of internal audits leads to improvements	4,33
Increased efficiency of work process	4,22
Reduced quantity of non-conforming products	4,22
Enhanced product and document coding system	4,22
Improved decision-making system	4,11
Enhanced internal communication	4,11
Reduced number of customer / consumer complaints	4,11
Improved teamwork	4,00
Increased productivity	3,88
Reduced staff turnover	3,22
Reduced costs	3,11

1 Mean rank obtained based on the responses of the surveyed companies

Table 7. Quality tools and the level of their use in bakeries surveyed (1 - I don't use it at all; 5 - I use it very often)

Quality tools	Rank of level of use[1]
Flowcharts	4,22
Check sheets	3,66
SWOT analysis	3,11
Histogram	1,88
Ishikawa diagram	1,88
Pareto diagram	1,55
Benchmarking	1,55
Brainstorming	1,55
FMEA analysis	1,55
Tree diagram	1,44
Scatter diagrams	1,33
Control charts	1,33
Affinity diagrams	1,33
The matrix diagram	1,33
L matrix	1,22
Diagram of arrows	1,22
Process decision program chart	1,22

1 Mean rank obtained based on the responses of the surveyed companies

After the terrorist attacks in the United States in 2001, as well as several food incidents due to deliberate food contamination, as reported by Busta and Kennedy [17], an increasing focus in developed countries around the world is on the application of food defense procedures against deliberate contamination. In the US, requirements for prerequisite food safety programs - FSMA, Sec.108 (4) [13], were included during the review of food law. In a group of questions related to 25 requirements for pre-requisite programs for the protection of food from deliberate contamination, representatives of surveyed bakeries responded to the requirements of their facilities. Only 4 of the 25 requirements are fully met in all businesses. The minimum degree of compliance of the requirements relates to parking spaces for visitors 'and employees' vehicles, to the reception of raw materials, to the prohibition of the introduction of cameras and cell phones into production premises and to the inadequate inventory of hazardous chemicals used in bakeries (Table 8). The average degree of fulfillment of the requirements for prerequisite food protection programs against intentional contamination is 90.67% (Table 8).

Table 8. Fulfillment of requirements of pre-requisite programs (PRP) for protection of bakery products from intentional contamination in the surveyed companies (1 - Failure to fulfill the request; 2 - Partially fulfill the request; 3 - Fulfillment of the complete requirement)

Request from the PRP to protect bakery products from intentional contamination	% fulfillment of requirements[1]
The factory building is adequately lit so that it is possible to monitor the building during the night / early morning	100,00 %
In the event of an emergency and an emergency when there is a power outage, there is a lighting system inside the factory	100,00 %
Access to the information system is protected by a code	100,00 %
Access to unloading / loading ramps is under control	100,00 %
The plant (factory) circuit is secured so that no unauthorized persons can enter without registering	96,30 %
Products returned from the market are stored separately at the factory until their condition is checked	96,30 %
The factory has a camera system that covers the inside of the factory	96,30 %
All employees, visitors and contractors were identified in some way during their stay at the factory	96,30 %
Our factory has an up-to-date evacuation procedure	96,30 %
The factory has a burglar alarm system and it is tested at defined intervals	92,59 %
Visitors, guests and other unemployed personnel are prohibited from entering the manufacturing areas without accompanying your staff, registering and making a health statement.	92,59 %
Checks on information on employed workers and occasionally hired workers before recruitment are always carried out	92,59 %
There are firewalls to protect your computer network	92,59 %
The back-up data system is set up off-site	92,59 %
Access to internal and external storage of hazardous chemicals is protected in a certain way so that only authorized personnel are allowed access	92,59 %
There is a procedure for receiving and storing hazardous chemicals	88,89 %
We regularly inspect / control the wardrobes used by our employees on a regular basis	88,89 %
Entry into the plant of the factory under the control of the guard / security and registration of all entries	88,89 %
Goods carried by service contractors are loaded and otherwise protected by seal or otherwise	85,18 %

Request from the PRP to protect bakery products from intentional contamination	% fulfillment of requirements[1]
We maintain vehicle inspection records when loading products into a transport vehicle	85,18 %
The inventory of hazardous chemicals is regularly carried out and there are up-to-date stock information	81,48 %
The factory premises where the production takes place prohibit the introduction of cameras and cell phones for employees, visitors and contractors	81,48 %
We do not accept deliveries from suppliers after business hours	77,78 %
Parking spaces for employees' vehicles have visual identification within the factory	77,78 %
Parking spaces for visitors' vehicles entering the factory circle are appropriately marked	74,07 %
Average score	90,67 %

1 The mean of the percentage of fulfillment of the request based on the answers of the representatives in surveyed companies

4. CONCLUSION

Based on the data obtained during the research, it can be seen that the application of quality management and food safety systems has numerous advantages. Since changes in the business environment are happening very quickly, the application of a quality and food safety management system may be an adequate response of businesses to the requirements for maintaining and / or improving the market position. Also, companies that have applied more stringent requirements of the standard, such as IFS Food or ISO 22000, are definitely more competitive in the export market (export share in total turnover is 50% or more).

Also, it is evident that companies that have invested in human resources and employ more highly educated personnel have greater competitiveness in the export market.

The most significant costs of implementing a food quality and safety management system relate to investments in infrastructure, which should meet the requirements of the standard and the services of consultants necessary to adapt the business operations of the company to the requirements of the standard. The scope of implementation of quality and food safety management systems in bakeries would be greater if there was significant support from institutions in co-financing the costs of system implementation and certification.

In addition to increasing the level of product quality and safety, the most significant advantage of the implemented quality and food safety management system is the following: improvement of company documentation, improvement of work process and improved customer relationship.

A very low use of quality tools in the surveyed companies can be mentioned as a potential problem for the improvement of the system, which indicates that the process approach during the implementation of the management system was not adequately applied. It is certainly necessary to invest additional resources to train employees on the use of quality tools in order to make the quality and food safety management system even more efficient.

When it comes to measures related to the prerequisite program for the protection of food from deliberate contamination, it should be emphasized that there are no requirements directly related to this area in the legislation of the Republic of Srpska and Bosnia and Herzegovina. However, it is evident that the bakery companies surveyed meet most of these requirements, but also that additional financial resources are needed to fully meet the requirements for prerequisite food safety programs.

From all of the above, it is evident that the modern approach to managing and ensuring food safety has no alternative and that it is necessary to take steps aimed at extending the application of this management system in most enterprises.

Determining system efficiency methodologically through a google solution is a very useful tool that can be used for similar research with knowledge of online programming techniques.

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ПРИМЈЕНА GOOGLE РЈЕШЕЊА ЗА ОЦЈЕНУ ЕФИКАСНОСТИ И ТРОШКОВА ПРИМЈЕНЕ СИСТЕМА УПРАВЉАЊА КВАЛИТЕТОМ И БЕЗБЈЕДНОШЋУ ХРАНЕ

Сажетак: У раду су презентовани резултати истраживања проведеног у предузећима која се баве производњом и дистрибуцијом пекарских производа, а односе се на предности, недостатке и трошкове имплементације система за управљање квалитетом и безбједношћу хране. У фокусираним предузећима у примјени је систем управљања квалитетом и безбједношћу, који је након развоја сертификован од стране независних сертификационих тијела. Коришћена је методологија за прикупљање података преко google упитника који је креиран и преко кога су добијани подаци од анкетираних предузећа.

Највећи иницијални трошкови током увођења система за управљање квалитетом и безбједношћу хране односе се на отклањање недостатака у инфраструктури (66,6% анкетираних предузећа) и консултантске услуге (33,3% анкетираних предузећа). Кључна предност успостављања система управљања квалитетом предузећа види се у унапређењу управљања документацијом и побољшању квалитета производа (4,55).

Примијењени системи управљања квалитетом и безбједношћу хране предузећима пружају бројне предности, уштеду у пословању и представљају модел чијом примјеном и друга предузећа могу побољшати властите перформансе. Утврђивање ефикасности система методолошки путем google рјешења је веома користан алат који може да се користи за слична истраживања уз познавање техника онлајн програмирања.

Кључне ријечи: Google, QMS, HACCP.

Paper received: 14 August 2019
Paper accepted: 9 October 2019