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Research Article

A Study of the Effectiveness of a Software HACCP System FoodCheck for the Management of Food Safety

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Abstract

Unsafe food can impact public health and can cause serious issues within food businesses. Therefore, the implementation of a food safety management system is required, and Hazard Analysis and Critical Control Point (HACCP) is an essential system to ensure the safety of food. However, it can be a significant amount of work to maintain, if the system is paperbased. There are many issues, which often arise during its application, and paperwork is one of the biggest challenges, as well as inaccurate information. Other barriers include time needed and effort. Therefore, the main proposal of this research is to examine the effectiveness of software-based HACCP systems, such as the FoodCheck system and determine if can help to solve the issues, which typically result from traditional paper-based HACCP systems. The results outline several solutions offered by FoodCheck, namely, the saving of time and resources.

Keywords: HACCP; Food Safety; Software-Based HACCP; Paper Based HACCP; FoodCheck

Introduction

Providing safe products is a huge challenge for all food businesses. There is a concern about food safety from authorities all around world, as many food-borne diseases exist globally [1]. Centers for Disease Control and Prevention [2] estimates that 48 million people get sick, 128,000 are hospitalized and 3,000 die from foodborne diseases each year in the United States [2]. Therefore, applying a system such as HACCP in the food businesses is required, as it has an important role in providing safe products for consumers from any biological, chemical or physical hazards. The main aim of the HACCP system is to reduce or prevent any risks in food at an early stage in the production system [1].

Moreover, HACCP is an important tool in a Food Safety Management System (FSMS). In light of its systematic approach and benefits, it is widely accepted by governmental agencies, Global Food Safety Initiative (GFSI) and other standard codes of practice [10]. HACCP is a food control system that is based on prevention, i.e. through identifying the hazards that are likely to occur in the process, and setting measures that will help to prevent those hazards, to protect consumers. The HACCP system reduces the need for inspection and testing of the final products (Mortimore, and Wallaco, 2013, p 2).

Furthermore, the HACCP system has many other advantages for the FSMS and it can be applied at all stages of the food chain, from farm to consumer. It focuses on the critical points in food processing and handling required to produce safe products, and facilitates the specific identification of any food safety hazard. Using the principle of risk assessment, prevention may be based on the control program instead of inspection and testing. More effective use of resources and having better information for holding informed discussions make the auditing and inspection processes easier [10].

The HACCP system can be applied by any company operating as part of the food chain. Numerous studies have reported that preliminary condition programs are needed before implementation, codes of practice or other food safety prerequisites. Preliminary condition programs involve aspects such as staff training, cleaning and sanitation, maintenance, chemical control, equipment, waste management, storage and transportation (Uçar., *et al*. 2016, p 16-17).

Despite the huge benefits of a paper-based HACCP system, there are many barriers to implementing an effective program. Similarly, many challenges may be encountered during the implementation process, i.e. managerial, organizational and even technical [3]. Some of these challenges include paperwork or time required of managers and staff in the organization [1].

Therefore, the overall aim of this study was to assess how a software-based HACCP system, such as FoodCheck. Evaluation the effectiveness of a software-based HACCP system could help to find solutions, which may solve the issues, which typically result from using traditional paper-based HACCP systems. In this study, will focus on three organizations, which implemented FoodCheck system, which placed in Saudi Arabia, Ireland and United Kingdom.

Materials and Methods

Material

Three organizations which implement software-based HACCP systems (FoodCheck system) were selected in Ireland, the United Kingdom (UK) and in Saudi Arabia, respectively.

Organization A in Saudi Arabia

This organization applies the FoodCheck system in four sites. All sites serve food for employees, but are different in terms of scale. One site serves approximately 2000 meals per day in two sittings, and the other three serve approximately 360 per day across three sittings.

Organization B in UK

In this organization, the FoodCheck system is applied across 19 units, including kitchens, restaurants, cafes and food halls. This organization serves three meals every day, and provides a wide range of foods including meat, chicken, traditional food and pasta for almost 44,000 consumers every day.

Organization C in Ireland

In this organization, the FoodCheck system is in place in 115 sites, including cafes and restaurants. The total number of staff catered for is 30,000.

Method

Interviews were conducted with three managers of food safety in three different organizations. The first manager was responsible for four sites, another manager was responsible for 19 units and the last one was responsible for 115 sites.

Semi-structured interviews were chosen for this research because they can provide reliable, comparable qualitative data and allow interviewees the freedom to express their own opinions [4]. It is noted a number of benefits of using semi-structured interviews, for example;

- They provide the opportunity to generate rich details;
- They facilitate understanding;

They enable analysis of the data in many ways [5].

The questionnaire is divided to six sections and each section has different number of questions within it. The questions focus on the food safety management system and resource challenges; particularly in an HACCP programme. The questions include closed-ended questions, open questions and Likert-type scales to obtain clear information for understanding previous and current challenges in HACCP systems.

First Section: Site/Operation description

This section include questions to get whole idea about the currently food service in the organization such as the FSMA and the nature of their services and employees.

Second Section: The situation before the use of the Food Check HACCP system.

This section is to find what wad was the food safety system before installed FoodCheck and more details such as advantages and disadvantages, also to know the reason behind implement FoocCheck.

Third Section: The installation of the food check system

It is necessary to know the barriers of install FoodCheck, that reason the third section include questions to explain the issues and the period of install it.

Fourth Section: The current operation of Food Check

This section to assess the FoodCheck system, and its features and how it impacted on many tasks such as internal auditing and find if it replaced using all documents based on paper. Furthermore, it is not only to assess the system but also the impression of staff after dealing with it.

Fifth Section: External standard accreditation

This part to discover if the FoodCheck system has the influence on any external food safety standard.

Sixth Section: Overall views on food check

This section has written to find the evaluation and satisfy of food safety manager regarding FoodCheck related many factors including the management of food safety, food quality and catering operations.

The first interview was held face-to-face with the manager who is responsible for 19 units and it took almost one hour. In this interview, additional questions were added as probes when needed, and it was audio recorded. Another interview was held with the manager who is responsible for 115 sites (face-to-face), which lasted for a similar duration. The final interview could not be conducted face-to-face, so the manager was asked to complete the questionnaire online, after which, he was contacted for further details.

Results and Discussion

The aim of this project was to identify how SHP can help in managing/implementing an effective HACCP system in the food business to solve the issues/barriers associated with using the traditional paper-based HACCP system.

Management of HACCP system

The HACCP system is featured in food safety management as an effective program to implement food safety in food operations. There are have been many studies dedicated to identifying the challenges of the HACCP system. Wilcock., *et al*. [1], reported that the major challenge of the HACCP paper-based system is managing the program, which can make the implementation of this program difficult. In addition, Sözen and Hecer [3] described the HACCP system as a very good system, but to achieve it, it involves a complex mix of managerial, organizational and technical hurdles to overcome. The literature agrees that the paper-based HACCP system has many barriers to implementing it effectively, particularly in managing it.

The results of this study identified that FoodCheck contributes to reducing the requirements for technical, human and material resources to manage the HACCP program. It can be managed on multiple sites of various sizes by an individual manager. Of the three managers interviewed, the highest number of sites managed were 115, which is set to increase very soon.

All three managers confirmed that FoodCheck made implementing their responsibilities easier, and it reduces the time required, as it is very efficient system. The one who manages 19 units and the other who manages 115 sites both reported that it cut down their workload by at least 50%. The last one, who manages four sites, indicated that FoodCheck did indeed reduce time, but did not give a specific figure for the reduction and he added that it helped to deal with any issues in any of the sites more efficiently by permitting corrective action to be taken immediately.

The monitoring feature in FoodCheck provided an effective way to make the management of HACCP easier, and enable the individual manager of food safety to manage multiple sites.

Time required

Previous studies have identified that the time required for implementing HACCP systems is the most critical aspect. Wilcock., *et al.* [1] reported that one of many challenges during the implementation of HACCP is allowing for the time required to understand, write and implement the program. In a different study by Walker., *et al.* [6] in 102 small medium enterprises in the UK, it was concluded that the main barriers to implementation were time and experience. Results of a study, by Bas., *et al*. [7] in 115 food plants in Ankara, reported an 88.7% lack of time. Sözen and Hecer [3] reported that Bertoloni., et al. (2007) also determined that time was the most burdening factor associated with HACCP systems.

This study has shown that time is not a challenge in an HACCP system when applying FoodCheck. The three managers of food safety confirmed that the installation of FoodCheck was easy and very fast compared with paper-based HACCP. One of them reported that the system was used immediately. The time required for managing the system was also reduced by FoodCheck, according to all of them. The manager who manages 115 sites stated that FoodCheck cut the time required for filling-in the documents. Two mangers reported that the traceability (which is required under Regulation 178/2002/EC on the general principles of food law) became much easier than with the paper-based HACCP system. Currently with FoodCheck, it takes only three minutes, which is very efficient. FSAI [9] stated that time is essential in a traceability system for public health and the food business. The same managers also expressed the fact that the speed is considered to be a main advantage of the FoodCheck system.

According to many researchers, the excessive time required for the HACCP paper-based system can be solved by using FoodCheck instead. The results proved that time for implementing the requirements is significantly reduced for managers and other staff when completing their necessary tasks. For example, there is no longer a need to fill-in so many documents, as FoodCheck is an automated system.

Installation of the HACCP system

Installing the HACCP system is complicated, as it requires many elements and technical hurdles to overcome [3]. Also, the design of the facility can make the installation particularly challenging.

All participants in this study confirmed that the installation of FoodCheck was very easy and they are satisfied with it. One of them reported that the Kelsius team needed only one week to install the system in 18 units. The main issue encountered during installations was the Wi-Fi signal, according to all managers. One manager suggested that there should be a separate WiFi log-in for Kelsius. The results indicated that there is only one site not operating correctly in Saudi Arabia from all sites concerned.

The Wi-Fi issue cannot be considered as a major prevailing issue, as it is arising only during installation, and when it is solved, will not hinder progress in implementing HACCP.

Training of HACCP system

Nowicki and Dziadkowiec [8] conducted a study to identify areas in certain enterprises implementing FSMS in Poland, where training leads to increasing the awareness of employees in FSMS. Sözen and Hecer [3] reported from literature that the barriers of HACCP in catering, foodservice and retail industries is due to many factors; one of which is a lack of training. Wilcock., *et al*. [1] noted results revealed in a study that suggested that the main reason for workers not applying HACCP rules was a lack of training. Bas [7] similarly identified a lack of training as one of many common barriers in food business operations.

The main findings of this study are that the FoodCheck system facilitates easier learning of the HACCP system, as it is an electronic system. The manager who manages four sites supported this claim, stating that the understanding of the HACCP system became easier for the workers in their food operations. Also, the manager who manages 115 sites reported that FoodCheck can increase awareness in catering operations.

The aforementioned literature concurred that training is important, and that a lack of training leads to challenges in implementing the HACCP system. The results of this study indicate that FoodCheck can contribute to overcoming common barriers associated with paper-based HACCP; one of which is training.

Training of foodCheck system

The interviewees in this study mentioned that Kelsius provided FoodCheck training to all users. The manager of four sites reported that the length of the training session was two hours per site, and he seemed content with that. However, two managers expressed that they were not happy that, and that more time should have been allocated. One of them, who manages 19 units, claimed that the time was too little for each individual group, and the other felt that it was the greatest weakness of the FoodCheck installation process.

The feedback from these managers suggests that Kelsius should examine their training programme and extend it. The training session time should be longer in order to implement HACCP correctly. Alternatively, they could consider providing video sessions for users to watch again and again, and this will be beneficial particularly for those who do not have local agents.

Documents and records

It is essential to maintain accurate records to ensure that HACCP is applied successfully. The process must be set-up so that documents and records are generated correctly, according to the nature and size of the food business (Stanley., *et al.* 2011).

In relation to this, Bas., et al. [7] found that in a paper-based HACCP system, only 16.5% of organizations were taking and recording temperatures. 76.5% of managers claimed that the volume of paper required was a major barrier to implementing FSMS. In a different study to determine the obstacles in implementing HACCP (which was done by Food Safety Authority of Ireland [9]) the volume of paperwork was also flagged as a prominent factor. Likewise, Sözen and Hecer [3] reported that Jevsnik., *et al.* (2006) reported that excessive documentation is a barrier in the implementation of HACCP.

Another challenge was noted by Nowicki and Dziadkowiec [8]; that is, control of records being one of most difficult elements of FSMS implementation. Wilcock., *et al.* [1] found that workers deem record keeping as a labour-intensive task in a paper-based HACCP system, which requires a great deal of time to implement. The results in this study also confirm that the documentation process is the biggest challenge in HACCP, as a manager stated that manually completing paperwork was an undesirable aspect of paper-based HACCP. However, FoodCheck replaced all paper-based documents, electronically. In addition to eliminating paperwork through FoodCheck, it also enables greater accuracy of information and an easy way to store documents, as conveyed by all managers in their interviews.

Results have strongly suggested that digital systems enable information to be reported in an easier way, and hence it is easier for managers to analyse data and detect any issues related to food safety. Two managers selected the reporting method as the main advantage of the FoodCheck system. FoodCheck has evidently helped in enhancing traceability in the system, making it much easier than with the paper-based system.

Additionally, with these electronic reports, it is possible for all managers to monitor any site at any time, without needing to visit the site.

The results refer to the fact that FoodCheck discourages any fraudulent entries from workers related to time, temperature recordings etc. because of the automatic nature of records. It is not possible to edit or fabricate the details, so managers have a true view of the FSMS status.

One manager who manages four sites highlighted this aspect as a particular advantage.

As discussed, numerous studies have reported that excessive documents and records in paperbased HACCP led to reluctance of adoption and compliance. However, the results in this research have demonstrated that FoodCheck effectively solves these issues associated with paper-based HACCP, such as the forging of results. It is vital for any food business to provide accurate results as part of effective FSMS and take the correct action in a timely manner to provide safe food for consumers and keep the organization safe from any reputational damage. The results showed clearly the implications of the use of software-based HACCP (FoodCheck) system as it is paperless, accurate, required less stress to fill the documents compared with paper-based HACCP and easy review the checklists.

Auditing and foodCheck

Internal auditing is one of the biggest challenges in implementing FSMS [8]. In an auditing program, it is necessary to report the results both accurately and truthfully, which can be considered a challenge because of human interaction and detailed technical requirements [10]. As a part of this research, one objective was to determine if software-based HACCP can assist in auditing or not.

The opinions vary between managers. The manager who manages four sites explained that there are many tasks that can be conducted from the office without it being necessary to visit the site with FoodCheck, which can reduce the time required. Another manager who manages 19 units reported that, with FoodCheck, the time required for auditing was reduced and the process was thus more effective compared with paper-based HACCP. However, the last manager who manages 115 sites felt that there were not any significant differences between FoodCheck and a traditional paper-based system as regards auditing.

Regarding the impact of FoodCheck on performance scores, two managers (of four sites and 115 sites, respectively) did not report any impact on auditing due to the adoption of FoodCheck. On the contrary, the manager who manages 19 units stated that FoodCheck has had a positive impact on the performance and on their rating in Food Hygiene, which has increased from 4 to 5 stars because of FoodCheck's effectiveness.

Internal auditing is required for implementing an effective FSMS and a few reports have highlighted certain challenges in conducting it. The opinions in this study are varied and none of the participants are accredited to any external food safety standard, so it is difficult to establish a firm conclusion. Hence, further research is needed to identify clearly if the software-based HACCP system can impact on the performance of auditing and the external standard or not.

FoodCheck and financial factors

The implementation of FSMS requires investment and funding resources [8]. The cost required to implement such a system was also named as one of the major barriers in prior research [7]. Many researchers have highlighted the burden of cost, which is a greater challenge for small and medium enterprises [1]. According to Sözen and Hecer [3] a study was conducted by Demirbas and Karagozlu in 2007 which also found that the cost required for implementing an HACCP system was the main factor for not adopting it.

The results in this study are not conclusive, as the manager of four sites felt that the system saved money by removing the need to travel around each of the sites. Another manager (who manages 19 units) rated the financial impact as 6/10, on the basis that the number of hours dedicated to the HACCP system were reduced compared with the paper-based version. The manager who manages 115 sites felt that there is no financial benefit of applying FoodCheck and refers to the system as a quite expensive.

However, one manager commented that, although FoodCheck has no direct positive financial impact, it reduces the time required for HACCP activities (confirmed by all managers) and enabled the possibility of assigning only one manager to multiple sites. This clearly suggests that FoodCheck has a positive financial impact in terms of resource efficiency. It could be a small impact, relatively speaking as the installation and maintenance costs must also be considered for net financial impact.

Impact of foodCheck on FSMS

The question was asked of all managers to state how FoodCheck impacts Food Safety. All managers have indicated that FoodCheck improves food safety. A similar question was asked, regarding the impact on management of food safety and catering operations.

Two managers feel that FoodCheck makes no difference to food quality, and there is only one manager (who manages 115 sites) who felt otherwise and that could be because the operation of the organization C which is catering operation where food was held hot for relatively long durations before consumption, so the correct temperature is very important.

In general, the results provide clear details supporting the argument that FoodCheck has an ability to improve food safety, the management of food safety and catering operations. However, FoodCheck appears to have no significant impact on food quality, with the exception (from the results) of a deli environment, as it can help workers with less experience, and that there is a greater potential for the future, as the technology improves and can enhance quality in different aspects.

Conclusion

Implementing a good FSMS in food business operations is required to provide safe products for consumers, as it helps to reduce the chance of microbial, chemical and physical risks. An HACCP system can help to implement that. However, to achieve it, it is necessary to carry out many tasks which are considered as barriers and challenges in paper-based HACCP systems by many researchers. These barriers include time required, management responsibilities and documents/records. Therefore, this study was conducted to identify how software-based HACCP can help in implementing an effective HACCP system.

From a food safety perspective, FoodCheck has solved many issues by providing positive elements for the food business. It reduces the time required for both managers and workers by replaced manual checklist papers with digital capture. Moreover, it prevents fraudulent records in a food operation, offering a real picture and greater accuracy/reliability for management.

FoodCheck also enables a single manager to manage multiple sites by providing a monitoring feature. This study has demonstrated that each manager is responsible for multiple sites and that, if applied effectively, the system can offer real advantages for the manager.

As a further recommendation, there is still a need for further research to explore if the software-based HACCP system can help in auditing and in improving the score rate of external standards.

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