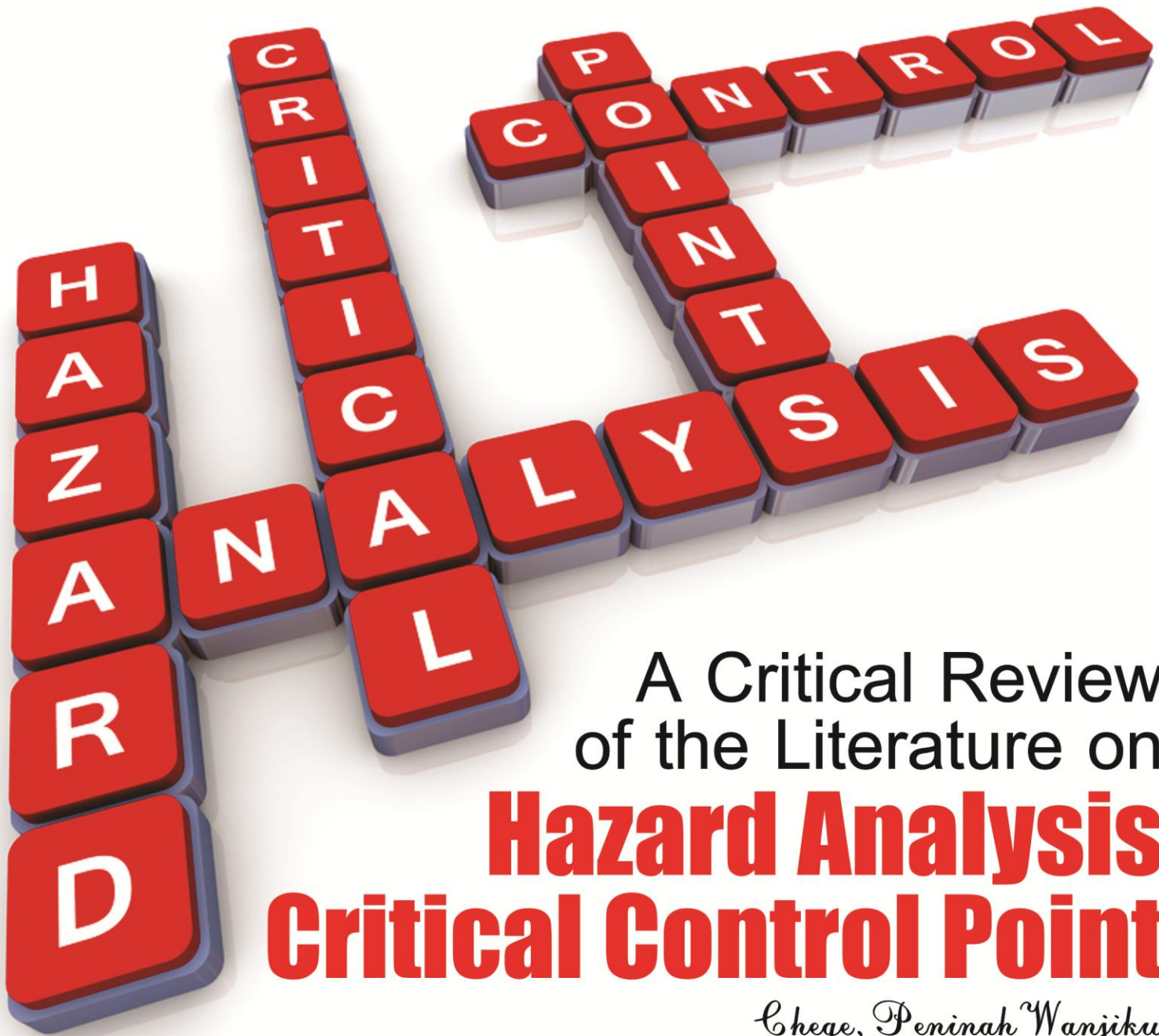


# SOCIAL SCIENCE



A Critical Review  
of the Literature on

## **Hazard Analysis Critical Control Point**

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*Review Paper*

# A Critical Review of the Literature on Hazard Analysis Critical Control Point

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This article presents a critical review of the literature on the concept of Hazard Analysis Critical Control Point (HACCP) concept. The study focuses on different dimensions of the concept starting with its origins, factors contributing to its adoption and key industry settings with HACCP practices. The article further analyzes key definitions of HACCP by different authors, its various models and key empirical studies. The study also reviews existing challenges on HACCP conceptualization. Finally the article suggests the way forward on the HACCP concept with a focus on suggested comprehensive definition of HACCP and its implications on future research and managerial practices.

**Key words:** Food Safety, Critical Control Point, HACCP

## INTRODUCTION

The concept of HACCP originated from USA and stands for "Hazard Analysis Critical Control Point". HACCP was first coined by National Aeronautics and Space (NASA) of the USA in 1958, and in 1959, it was advanced as a way of assuring 100 per cent safety of food used in space (Airey, 2004). Later HACCP was officially published and documented as a food safety management system in USA in 1971. Its recommendation for usage by the National Academy of Science (NAS) dates back in 1985 and it thereafter became a global food safety management tool (Codex, 2009). In 1950s, HACCP was utilized by the US Military to remove potential hazards in the production of military drugs (Kane & Taylor, 2003); and its adopted by NASA in 1959, has achieve 'zero-defects' for ensuring safety and quality assurance of food eaten by astronauts. In 1980, World Health Organization (WHO) reported HACCP as an international system of choice in food safety management. In Europe, HACCP was recommended for use in 1983, as an effective way of controlling food borne disease.

Food is considered to be safe if there is reasonable demonstrated certainty that no harm will result from its consumption under conditions of use but Kenya lacks a

defined and published policy on food safety as part of a wider national food and nutrition policy and that is why according to Oloo (2010) food borne diseases are still a major problem in Kenya with food industry accounting for 80%. Further hygiene controls are still rudimentary and as a result up to 70% of all episodes on diarrhea are attributable to ingestion of contaminated food and water.

Over the last two decades there have been significant changes in national and international regulation of food. Codex has been adopted by the World Trade Organization (WTO) as the source for international food safety standards (WTO, 2010). Codex was created in 1963 by FAO and WHO to develop food standards, guidelines and related texts under the Joint FAO/WHO Food Standards Programme. The main purposes of Codex are protecting health of the consumers, ensuring fair trade practices in the food trade, and promoting coordination of all food standards and work undertaken by international governmental and non-governmental organizations (Codex, 2011). It has three steps which include applying good hygiene practices, establishing preliminary procedures and applying HACCP principles (Mariam et al., 2014). The first five steps in the HACCP

**Table 1:** The first five Steps and Principles of HACCP.

Steps in HACCP implementation	
1	Assemble HACCP Team
2	Describe the product
3	Identify intended use
4	Construct flow diagram
5	Carry out on-site verification of flow diagram
Principles of HACCP implementation	
6	Principle 1: List hazards at each step and consider preventative measures
7	Principle 2: Identify CCPs
8	Principle 3: Establish critical limits for each CCP
9	Principle 4: Establish a monitoring system for each CCP
10	Principle 5: Establish a corrective action
11	Principle 6: Establish verification procedures
12	Principle 7: establish record keeping and documentation

Source: Codex Guidelines (2008); Semos and Kontogeorgos (2007)

implementation and its seven principles are exhibited in table 1.

**FACTORS CONTRIBUTING TO ADOPTION OF HACCP**

Several health agencies and scientists who have worked on food related diseases have noted that because of getting different serious diseases of prime concern such as diarrhea (Wilson 2005, Argudin *et al.*, 2010). Food poisoning or food borne infection are the illnesses caused by consumption of food containing bacteria, viruses or other pathogens (Humphrey *et al.*, 2007, Tribe *et al.*, 2002). Every year, an estimated 9.4 million illnesses, 55,961 hospitalizations and 1,351 deaths result from consumption of foods contaminated with known disease agents (Scallan *et al.*, 2011b). In UK and Canada there is increase in reported *Cyclospora* cases, this highlights risks of gastrointestinal infections through travelling hence the need for improved hygiene in the production of food consumed in holiday resorts (Nichols *et al.*, 2015). In UK alone it is estimated that a million people suffer from food borne illnesses each year; 20,000 people are hospitalized and 500 die because of food borne illnesses (FSA, 2011). The number of confirmed cases of human campylobacteriosis in the European Union followed a significant increasing trend in the period 2008–2012, and continued to be the most commonly reported (Andrea *et al.*, 2016). Gormley *et al.* (2011) noted a decrease in food borne outbreaks between the years of 1992-2008 for England and Wales; however, the outbreaks linked to food service establishments had increased. The food service sector therefore needs to adopt appropriate control measures, in order to reduce the risk of infection. For instance according to Steffen *et al.* (2012) the HACCP based program, has proven to reduce the incidence of travelers’ diarrhea infections significantly this reduction was in the range of 23.22% to 5.31% by 2012.

Apart from safety of food other factors contributing to benefits of HACCP uptake according to Sayed (2015) include improved product quality, increased employee skills, improved company image, increased product sales, increased market share, and access to new markets. Further increase in sales in domestic and international markets while the government is able to reduce toll of food borne illnesses and reduce the public burden of human losses, job losses and finally avoid economic losses also contributes to the adoption of HACCP. Steffen *et al.* (2012) states that using HACCP is seen to have tremendous benefits to the hotel properties as it provides leverage for the company and is a huge plus for all hotels embracing HACCP. Another benefit is that it is recognized by the Tour and Travel Agencies that send guests to such properties as it provides a means of assurance against outbreaks and subsequent legal actions. Indeed international Food Safety Management Specialists established in 1995 that adopting HACCP system increases buyer and consumer confidence. It also gives a step to step account of all parts of the process that relate to food safety (Mariam *et al.*, 2015).

HACCP is the priority system that provides benefits to all stakeholders in hotels (Juthamas 2014). A study carried out by Jeya (2014) established that HACCP system is not only feasible and attainable but also cost-effective and it also ensures food is prepared in hygienic manner. In addition Shaina (2011) observed that implementation of the Menu-Safe HACCP system in UAE Subway stores had seen improvement in knowledge, attitude and behavior amongst store managers and their staff with benefits such as achievement of perfect inspection scores and international HACCP certification.

Semos and Kontogeorgos (2007) acknowledge HACCP adoption as the most secure and cost-effective method for controlling hazards during food production. It improves food safety, business success and excellence (Codex,

2008). Since HACCP is an evolving system, it is designed for any organization including large, small and medium size enterprises (SMEs) in the food chain including hotels (ISO, 2007).

### CONCEPTUALIZATION OF THE HACCP CONCEPT

This section reviews the existing conceptual constructs, models and theories of the HACCP concept.

#### Key definitions of the HACCP concept

According to Al kaabi *et al.* (2015). Hazard Analysis and Critical Control Point (HACCP) is a system designed specifically for this purpose because it records all deviations and how the problem was corrected. Taylor, (2008) asserts that HACCP is a food safety strategy globally recognized to address food safety problems through the analysis of critical control points from the points of ordering food raw materials, receiving, production, processing, storage and consumption. HACCP is an internationally recognized system of managing food safety and its use has been extended to control the full range of biological, chemical and physical hazards (Taylor, 2008). Finally WHO (1980) states that Hazard Analyses Critical Control Point is a food safety system designed for the identification, evaluation and control of food security and safety hazards

#### Key Models and Theories on HACCP

Various models of HACCP have been developed by different authors to describe relationships between HACCP and various variables. This section reviews one model and two theories namely the Behavioral Adherence Model, Food Safety Management system adoption theory and Quality Assurance Management in the Food Industry Theory.

#### The Behavioral Adherence Model

This model was developed by Taylor (2001) to determine solutions for implementation of HACCP by categorizing the potential challenges into behavior, attitude and knowledge. It describes behavioral challenges to HACCP implementation firstly as external factors (such as customers insisting upon their own HACCP methodology or documentation), secondly as guideline factors, that HACCP system guidelines are difficult to use), thirdly as lack of competence (in terms of skills or ability of the HACCP user to carry out HACCP according to its guidelines) and lastly, lack of cueing mechanism, (which are reminders to prompt appropriate action). The other cited categories are attitudinal factors namely motivation, outcome expectancy, self efficacy and agreement. The model also cites knowledge and lack of awareness as critical components of HACCP implementation (Taylor 2001, Gilling and Taylor 2001).

The behavioral adherence model is the most relevant research project in the area of implementing HACCP and has been replicated in several countries and sectors (Katherine 2012). Figure 1 depicts the Behavioral Adherence Model

#### Food Safety Management System Adoption Theory

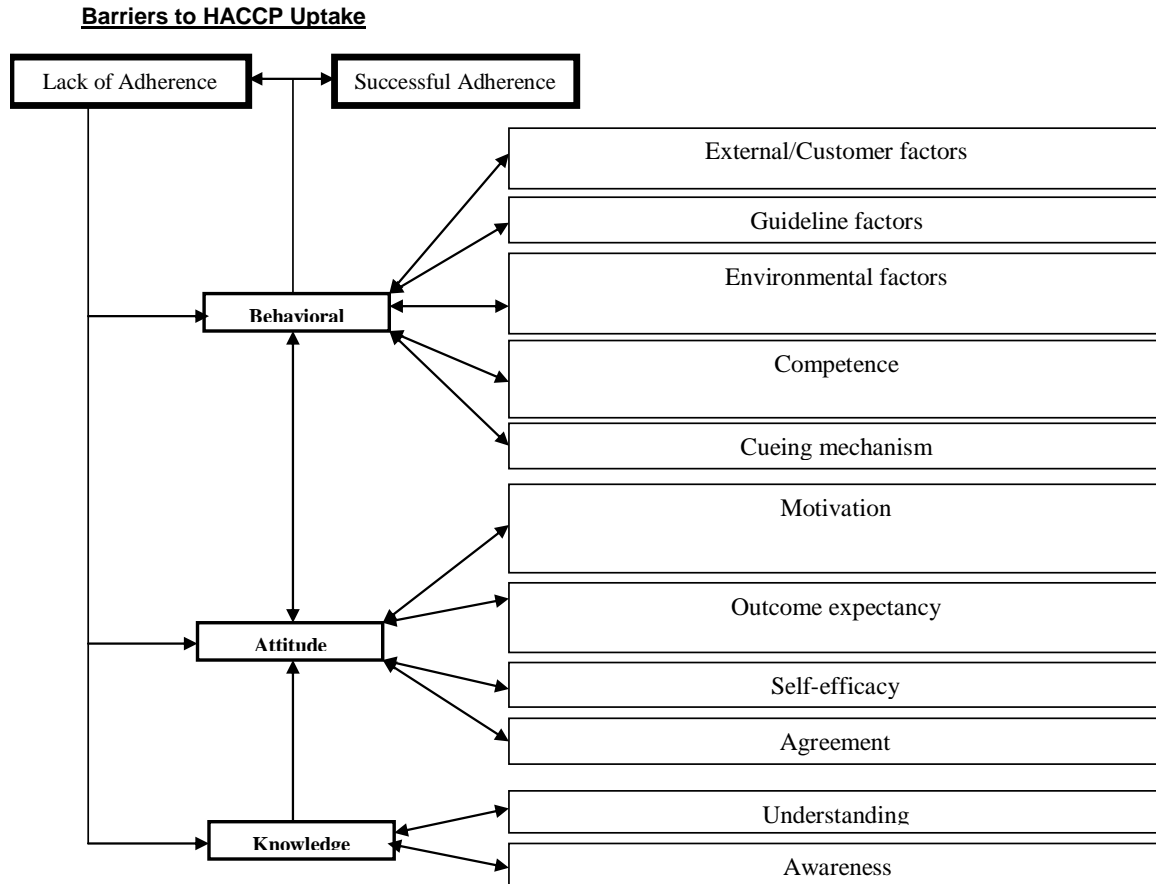
This theory attempts to explain adoption of food safety management systems and states, that level of food safety management system adoption could be predicted by seven factors namely management commitment; perceived importance of external stakeholders; expected gain in economic competitiveness; expected gain in social legitimacy; percentage of export sales; and finally the number of employees. It can also be predicted by the degree of interconnectedness or the extent to which the firms have food safety relationships, in terms of information and knowledge exchange, with other stakeholders. The interrelationship between these food safety management system predictive factors is depicted in figure 2.

#### Quality Assurance Management in the Food Industry Theory

This model was developed by the International Life Sciences Institute (ILSI) to illustrate levels of quality assurance management in the food industry. At the baseline level is the essential management of food safety incorporating the HACCP risk assessment and management systems. The model also includes good manufacturing and hygiene practices (GMP/ GHP) as laid down in relevant codes of practice. The model also advocates use of ISO 9000 standards in quality management. The European directive (93/43/EEC) that introduced the principle activities of HACCP also recommended that the activities be embedded within a documented system along the lines of ISO 9000. HACCP principles are increasingly becoming mandatory in food and beverage industry at international level. The diagram representation of the Quality Assurance Management in Food Industry Theory is depicted in figure 3.

#### A REVIEW OF THE EXTANT LITERATURE ON HACCP

A substantial body of literature on the concept of HACCP exists. For instance a study carried out in Philippines by Azanza and Zamora-Luna (2005) investigating food handlers awareness of HACCP system found out that only 40-50 per cent were aware of its existence. Peter *et al.* (2013) revealed that there is a relationship between level of Education and implementation of HACCP policy and adherence with food preparation guidelines. This study also revealed that majority of food operators (83.3%) were not aware of HACCP policy as part of food safety guidelines. Roncesvalles (2010) study established



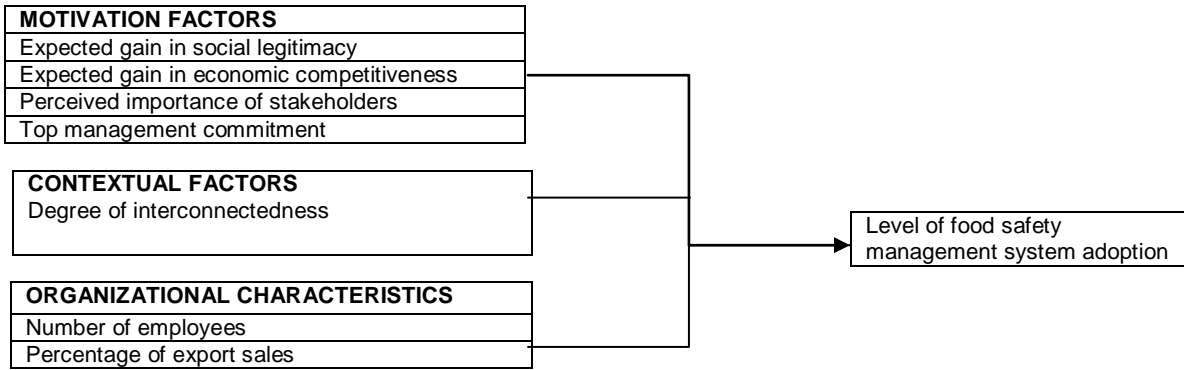
**Figure 1:** Behavioral Adherence Model  
 Source (Gilling & Taylor), (Taylor 2007), (Catherine 2012)

that only 41.9% of people interviewed were informed and/or trained regarding HACCP, despite the fact that 79% of them considered implementation of this system to be necessary in order to ensure food safety. Attitude barrier due to lack of educative courses were making it more difficult for workers to adhere to HACCP system. These observations confirm the need to improve education in the basic pillars of hygiene practices, in order to understand the goal of HACCP implementation and the adequate selection of CCPs to ensure food safety.

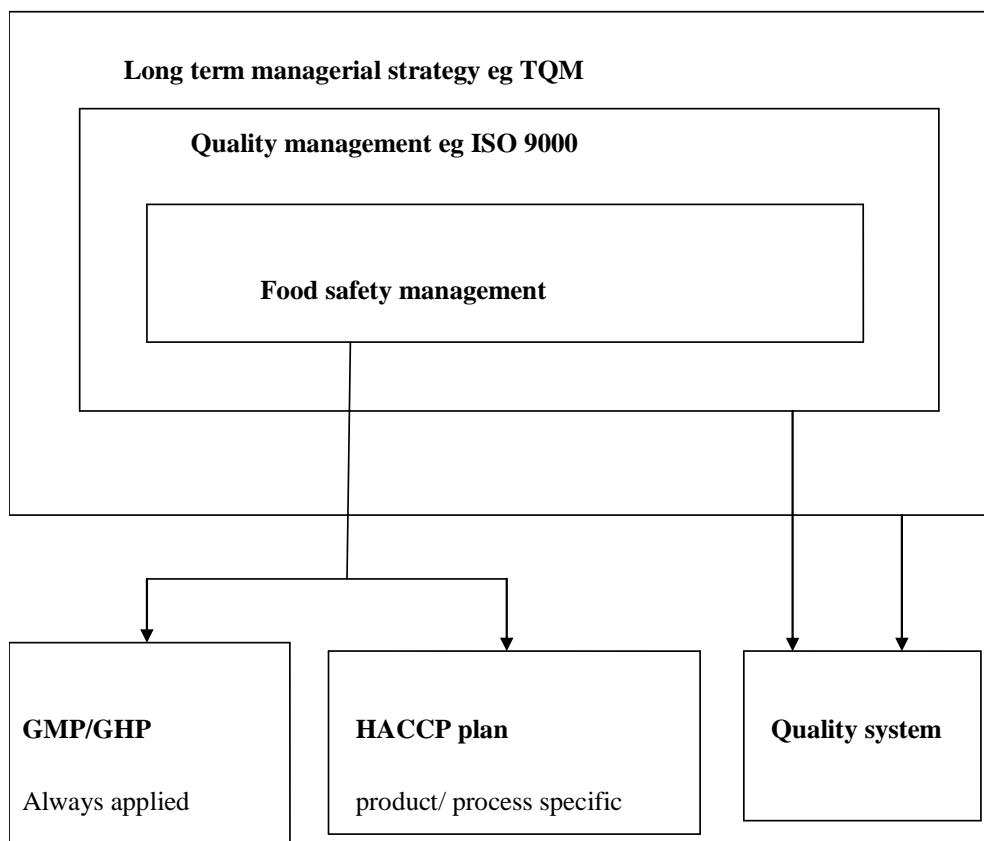
Joanna *et al.* (2016) concurs with previous observations that the level of hygiene compliances with inspection criteria was unexpectedly low in fish selling processes. The highest percentage of compliance was 44% in the store while personal hygiene was at 18%. Neither the size of the store, nor its location and type affected the compliance rate. Hamidreza (2015) aimed at was to establishing status of prerequisite programs for the implementation of HACCP system in chain restaurants in Iran and found out that HACCP programs

in the evaluated restaurants was in the highest level but only 17% of restaurants were in a proper level of compliance and 95% did not have any documentation about hygienic practices. Further, the status of storerooms, cold storage and refrigerators was improper. Patricia *et al.* (2016) study revealed that the mandatory requirement by Food Laws for persons in supervisory positions was not stringently complied with as 31% of kitchen matrons reported not to have hygiene qualification in the Ashanti Region of Ghana and 82% of 180 staff sampled had never received hygiene training. The absence of mandatory hygiene training for all food handlers, kitchen managers/matrons with requisite hygiene knowledge and qualification and rigorous enforcement of these is a challenge to good hygiene practices.

HACCP uptake in hotels varies depending on various factors and especially benefits that come with its implementation. Milios (2013) found that companies identifying the benefits of HACCP implementation as very important had the best results as regards HACCP



**Figure 2:** Food Safety Management System Adoption Theory  
**Source:** Pornlert A. et al. (2009)



**Figure 3:** Quality Assurance Management in the Food Industry  
**Source:** Nigel P. et al. (2001).

evaluation while companies that do not identify the benefits as important had poor score in HACCP evaluation. Businesses with HACCP certification for longer periods and especially those that were certified than one standard had better performance in HACCP evaluation. Suling (2013) revealed that there is a

relationship between motivating factors and food safety strategies and that hotel food safety strategies depend significantly on the attitude of employees and their capability. Employee attitude also depends on customers' demands which determine behavior towards food safety. Hootan et al. (2015) observes that many in-flight

caterings have met their passenger's demands which are high quality hygienic food services by implementation of hazard analysis critical control point (HACCP) system in their airlines.

In a study of HACCP uptake in small and medium-sized enterprises Suphattra (2016) notes that sales volume increased by about 50% in 2014 after applying HACCP compared to the previous year while the production cost was reduced by about 10%. By deploying HACCP, the case study enterprises could meet customer needs and expand their businesses by retaining existing customers and winning new ones.

A further study by Herath and Henson (2010) in Canada investigating the HACCP uptake amongst meat processors revealed that 39 per cent had fully implemented HACCP, 19 percent had partially implemented it while 37 per cent had no plans at all to implement HACCP. Ramnauth *et al.* (2008) study in Mauritius food exporters revealed that 7 out of 11 (64 per cent) of the food companies had HACCP. In Spain, 57 per cent of all the food manufacturers had HACCP in place (Celaya *et al.*, 2007) while 18 per cent of all food businesses in Turkey had HACCP (Bas *et al.*, 2007). A similar study in UK found out that 42 per cent of managers had heard of HACCP but only 26 per cent of food businesses had HACCP records in place (Walker *et al.*; 2003). There is also a small number of hotels that has implemented HACCP concept in Montenegro (Vesna V. *et al.*, 2013). A study carried out in Tanzania indicated that 22.9% employees in food industry had knowledge on HACCP and that 27.1% are trained in HACCP (Bright 2016). HACCP adoption across the food sectors therefore vary as reflected by literature review above with the lowest level of implementation reported among food service sector between 18 and 34% (Violaris *et al.*, 2008), (FSA, 2001), and Szponar *et al.* (2005). In a more recent study Katherine (2012) notes that the level of uptake by catering and small food processing businesses was only 1% in contrast to the industrial sector that was 31%.

However lack of capability to implement HACCP system is a challenge towards HACCP uptake. Garayoa *et al.* (2010) stated that information provided by persons in charge of kitchens showed that there was HACCP system established in all of the kitchens studied. However, recovered data confirmed that the implementation of these systems was incorrect in 70% of the kitchens, despite the fact that all of them had a manual on HACCP procedures. The principal weaknesses were the lack of guidelines for good hygienic practices and incomplete prerequisites programs (95%), or the noncompliance with the established system to record activities (50%). Only 45% of the kitchens were successful in procedures and in the recording of dish

temperatures.

### **CHALLENGES ON HACCP CONCEPTUALIZATION AND EXECUTION**

Review of food safety literature indicates a number of challenges that influence the successful implementation of HACCP. Generally hazard analysis is usually poorly comprehended and requires a lot of technical expertise which is lacking in food service (Taylor & Taylor, 2007b). It further requires high initial costs (Vesna, 2014). During the creation and verification of HACCP system flow diagram, there is a problem of operational staffs not being involved (Taylor & Taylor, 2007a). According to Panisello (2001), HACCP system implementation is very time consuming. In addition Abhay *et al.* (2016) identified the major challenges of adopting food safety laws as understanding of law, cost of implementation, timeline for implementation, employee preparedness, absence of quality culture, and employee willingness.

HACCP has lengthy and hectic procedures for registration and therefore hotel staff are not motivated to produce HACCP certified foods (Pradip M. 2014). In addition, HACCP system monitoring procedures require time and personnel in different shifts which may not be so in hotels especially during busy periods of service (Eves & Dervisi, 2005). In cases of errors in the system, establishing corrective actions is always not detailed enough and rely on frequent reporting to the top management (Scott, 2005). Majority of obstacles have been constantly blamed on resource related problems. They include time, money and knowledge of HACCP (Clayton *et al.*, 2002; Hwang *et al.*, 2001; Ehiri & Morris, 1995 and Taylor, 1994), cost of hiring external consultants, staff training and documentation (Henson *et al.*, 1999) and access to technical assistance and expertise.

According to Jevsnik *et al.* (2006) approximately 50 per cent of the obstacles are related to human resources such as planning, training, knowledge and competence, and the top management commitment. In a study carried out by Hielm *et al.* (2006) most difficulties were seen in establishing an own-checking HACCP plan, choosing the critical control points, committing the firm's entire workforce and organizing the documentation of monitored results. One of the major problems is that the food workers often lack interest or they have a negative attitude toward food safety programs (Griffith, 2000). Giampoli *et al.* (2002) study revealed three types of barriers: resource management, employee motivation, and employee confidence as major barriers towards successful implementation of HACCP. In addition staffs fear taking HACCP certification examination (Ball *et al.*, 2010; Ball *et al.*, 2009; Clayton & Griffith, 2008; Hinsz *et al.*, 2007). The results of a study carried out in four star

hotels in India, indicated that illiteracy and lack of knowledge about HACCP practices acted as a barrier (Heena *et al.*, 2016).

Finally, Renan (2012) argues that the major obstacles in engaging food safety system are difficulties in employing well-trained personnel required for food safety systems, insufficient training facilities for employees intended to aid in the implementation of food safety systems as well as deficiency of infrastructure and financial support from government and non-government organizations. Nicola *et al.* (2016) results showed that managers perceived the benefits derived from application of HACCP as being greater than the costs as it is impossible to achieve food safety without HACCP application, although high turnover of staff was a great barrier to HACCP efficiency.

## CONCLUSIONS

Given the existence of varied definition of HACCP, it is suggested more a comprehensive definition of HACCP is 'The most appropriate food safety system to address food safety problems through the analysis of critical control points from the points of ordering food raw materials, receiving, production, processing, storage and consumption.' Finally the article has presented a review of literature on HACCP concept. It has considered how HACCP conceptualized and its implementation in solving the problem of food poisoning. Further the article highlights the following research and managerial implications.

### Implications on future research

The literature reviewed has demonstrated that HACCP is important tool for controlling food hazards, however there many challenges that come with its uptake and hence many establishments have not implemented it. Further research is therefore needed in order to address the barriers for HACCP implementation in different food businesses as well as examine whether different nations face the same challenges so as to recommend a comprehensive food system that is applicable to different nations.

### Managerial implications

The best practice in food industry today in control of food safety hazards is the implementation of an appropriate food safety system and its effective management. According to Anon (1997) demonstrating a real commitment to food safety through HACCP compliance can transform a hotel's brand and act as an effective entry-to-market tool. Thus use of appropriate HACCP methodologies in the kitchen is important although its ultimate effectiveness relies upon the knowledge and skills of both management and staff (Al Yousuf *et al.*, 2015).

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