The Current Status of Thai Food Manufacturing Plants Certified to BRC Standard

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Abstract—Food Safety Standards have become an inevitable aspect of food businesses worldwide over recent decades. In Thailand, the British Retail Consortium (BRC) is the main food standard that has been implemented by food operators. This study used a questionnaire survey method, involving data gathered from 217 BRC certified firms. The data were then analyzed through descriptive and inferential statistical analysis. The main features of food managers, their manufacturing plants, and certification bodies (CBs) were characterized. Thai food companies were also classified into groups on the basis of their different categorical context factors. Furthermore, the influence of interval context factors on the effectiveness of the firms was examined. The results of ANOVA indicated that there are no significant differences in the effectiveness of firms between average effectiveness of some context factors, i.e. existence of Quality Management System (QMS) division, company type, and plant location. Regression analysis revealed that the size of food safety team was positively related to its effectiveness. Moreover, finding revealed that there was high correlation between the food safety team size and the firm size.

Index Terms—BRC (British Retail Consortium), context factors, effectiveness, manufacturing, Thai food industry

I. INTRODUCTION

Over recent decades, worldwide concern over food safety has grown among public health authorities, consumers and the food industry itself, following the significant increase in the incidence of reported foodborne diseases in many countries, e.g. BSE (mad cow disease) in the UK in 1987 [1], the dioxin crisis in Belgium in 1999 [2], the melamine case in China in 2008 [3], and the outbreak of Botulism from canned bamboo shoots in Thailand in 2014 [4]. Governments have become increasingly concerned about the fact that existing safety requirements have been ineffective in reducing the growing burden of food-borne illnesses [5]. Global consumers are nowadays more concerned about food safety [6] across every step of the global food supply chain [7]. As a result, the food industry should

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focus on the quality and safety of its food products, and the effectiveness of Food Safety and Quality Management systems should be emphasized to create a competitive advantage in the market.

To enable the country to continue growing trade in processed food products, both domestically and internationally, and to strengthen the competitiveness of the marketplace and justify the sobriquet of Thailand being 'The kitchen of the world', Thai food manufacturers must not only implement the Good Manufacturing Practices mandated by the Thai Food and Drug Administration (FDA), but must also implement additional voluntary standards to ensure that their food products are safe. Thai food processors must now focus on assuring the quality and safety of their food production.

A. What Is a Food Standard?

Food safety standards or food safety management system (FSMS) are conceptualized as two concepts: food safety and quality management. Food safety is defined according to the Codex Alimentarius [8] as the assurance that food will not harm the consumer when it is prepared or eaten according to its intended use, which in reality is not always the case [9]. Quality management refers to all activities that organizations use to direct, control and coordinate quality. including formulating and implementing a quality policy, quality objectives, quality planning, control, assurance and improvement [10]. A food safety standard involves that part of the Quality Management standard that is specifically focused on food safety [11], [12].

Several private food safety standards, which include the Hazard Analysis of Critical Control Point (HACCP) principles as a part, have been introduced by the food market. These standards enable business to improve and control the quality of their product and also improve supplier and retailer trust while consequently supporting consumer objectives [13]. These systems are the most effective and economic way of ensuring a safe food supply especially in light of the worldwide food safety problems that many countries have been enduring.

Table I shows that most Thai food manufacturing plants achieved BRC certification as of 1 October 2016.

No.	Country of	Standard	No. of Thai
	origin		certified sites
1.	England	BRC Food Technical	454
		Standard/ Global Standard	
		for Food Safety	
2.	Switzerland	ISO 22000:2005	385
3.	Netherlands	Food Safety System	219
		Certification (FSSC)	
4.	Germany	IFS Food	79
5.	United States	Safe Quality Food (SQF)	13

 TABLE I.
 LIST OF VOLUNTARY FOOD SAFETY STANDARDS

The BRC standard was developed following the concerns of British retailers about the variations characterizing the different requirements and approaches to third party auditing with the intention of becoming recognized as a common minimum standard for food safety. The seventh and current version of the BRC standard came into effect on 1 July 2015. All certificates issued against audits carried out prior to the commencement of these latest standards remain valid for the coverage as specified in the certificate [14]. Since it is issued with an expiry date of 12 or 6 months, depending on a grade, the 7th edition of the BRC standards should be implemented by all certified food manufactures as of 1 October 2016.

The ISO 22000 standard is a food safety system that completes, complements, and reinforces the effectiveness of HACCP by adding emphasis to traceability, interactive communication, and emergency preparedness and response for situations that might affect food safety [15]. BRC is similar but the difference between those two standards is that ISO 22000 applies to everyone in the food chain, whereas BRC does not cover the whole food chain. However, the firms adhering to the BRC system are able to take advantage of the more prescriptive requirements and audited checklists that work for certain parts of the food chain, i.e. food manufacturer.

A lot of specific aspects related to food safety standards have been studied. However, there has been a paucity of research conducted with respect to the BRC guidelines concerning food manufacturers, both within Thailand and overseas. The authors selected BRC standard for three reasons: importance and global adoption of the standard, the public access to the information of the BRC certified sites, the specific interest of the certification body which has collaborated to the study [16]. The current status of BRC certified firms and the relationship between company profile and the integrative effect of standard should be investigated. The results and findings of such an investigation would provide better understanding of the Thai food manufactures and determine which of the firms' context factors could affect the implementation.

B. Context Factors vs Food Standard Practices

The output of food standard practices frequently depends upon the broad context in a country and sector, the narrow context in a company level and activities in the system. The narrow context factors comprise charactristics of product, production, organization and chain [17]. Product includes initial materials and final outputs. Production refers to the conditions during primary production, processing or handling. Organization refers to administrative conditions, such as human characteristics company structure and information systems, which affect decision-making behavior. The chain refers to the conditions during supply and relationships with other companies and organizations in the chain [18]. Quality Management depends upon organizational factors such as the size, the type of suppliers and customers, the degree of automation, the type of products, and, quality assurance requirements. It was also found that that the contribution of different QM practices to performance depends on organizational structure and environmental context factors [19].

In the context of quality management in the bakery sector, Ref. [20], [21] consider that the basic operating characteristics of companies are context factors that may affect quality and effective implementation of Food Safety systems. The context factors which impact quality management activities in the bakery industry were classified on the basis of four factors: the type of QA systems employed, organizational size based on number of employees, degree of automation, and type of products. The levels of quality management activities were studied at the indicator level to explain the relations between context factors and quality management activities. The results revealed statistical differences within the subgroups of bakeries [22].

C. Effectiveness of BRC Standard Implementation

It is commonly asserted in literature that effectiveness refers to the degree to which a system's objectives and action plans are achieved. Ref. [23] used the term "goals" to define the effectiveness of activities aiming to achieve quality. As far as food companies are concerned, Ref. [24] mentioned that the effectiveness of a quality assurance system refers to the actual contribution of the system to food quality assurance. Ref. [25] aimed to explore the impact of such systems on HACCP effectiveness. In a questionnaire developed to measure these impacts, they included one question regarding "the whole effectiveness of the HACCP system", with the extent to which the system achieved its objectives rated by the respondents on a scale ranging from strongly effective to strongly ineffective. This means that the evaluation of a system's effectiveness could be gauged through self-assessment. In the BRC context, effectiveness means compliance with the BRC requirements in order to gain certification upon completion of an audit process by a third party auditor.

Alternatively, the independence and effectiveness of schemes could also be assessed by compliance to the Food Safety Management system. This means that the interdependent organizations that determine the level of compliance with the private assurance schemes are the Certification Body. The third party organization will be involved in the certification process which is the activity of assessing the performance and effectiveness of a QMS with respect to a set of given objectives. Thus, the assessment of the effectiveness of the food safety management elements of an assurance standard should be determined against a set of predetermined objectives, i.e. quantitative rather than qualitative measures [26]. This study used both self-assessment and the BRC grading scale by CBs to evaluate the effectiveness of BRC standard implementation.

D. Proposed Hypotheses

The extent of efficiency with which food manufacturing firms implement the food safety standards is determined by many factors. The following hypotheses concerning the positive and negative factors affecting implementation have been set:

H1: The higher the number of migrant workers, the lower the level of effectiveness in BRC standard implementation

Migrant workers may be problematic due to issues with communication. For those who are non-Thai speaking, the language barrier will adversely affect understanding regarding the standard.

H2: The lower the number of plants operating under the entity, the higher the degree of effectiveness in BRC standard implementation

In cases of a high number of plants being operated under the same entity, it seems that the plants face problems arising from the complexity of the organization and the allocation of funds for implementation.

H3: The number of years a plant has been operating is positively related to the effectiveness of BRC standard implementation

Plants that have been operating for many years are likely to be familiar with several versions of the BRC standards and their infrastructure and facility should be adequate and appropriate.

H4: The size of the food safety team is positively related to the effectiveness of BRC standard implementation

The food safety team is comprised of those who work closely on many aspects of implementing the BRC standard. A high number of team members involved in the process can contribute to the effectiveness of system implementation.

II. METHODOLOGY

A flow chart of research design is presented in Fig. 1. The methodology of this research was divided into three stages as follows:

A. Questionnaire Development and Improvement

To answer the research objectives and questions, a structured questionnaire was developed, drawing from existing literature on food safety standards research in other countries [27] as well as from the written requirements of the BRC standard. A first draft questionnaire was developed in English and Thai. The questionnaire was further reviewed by requesting the input of three food experts and two practitioners [28]. To reduce ambiguities, some questions were added to ensure sufficient coverage of certain areas and some items were rewritten to increase clarity based on the

recommendations of the experts and practitioners. After the pre-testing, all questions in the questionnaire were confirmed by the index of item objective congruence (IOC) which was evaluated by three food experts based on their experience in food standards to ensure content validity [29]. Finally, the questionnaire was distributed to the participants, who were comprised exclusively of Food Safety and Quality managers.



Figure 1. Research design (Modified from Ref [30])

B. Data Collection

The target population and the sample was Thai food processors certified to the BRC standard by 30 September 2015 [31]. The BRC Directory is a database that contains information of BRC certified sites (e.g. plant addresses, contact persons, phone numbers, emails) in Thailand and overseas. A purposive or judgment sampling method was used. The criteria for selection of plants for participation in this research were to have BRC certification and to have implemented the BRC standard. The questionnaire was distributed by e-mail to Food Safety and Quality manager in each of 371 selected firms. The survey, including follow up e-mails and calls with respondents, was carried out over a period of 3 months. The fieldwork was accomplished by the end of the first quarter of 2016.

C. Data Analysis

All statistical analyses of the data were undertaken using SPSS Version 21. Statistical significance was set at p < 0.05. The study conducted inferential statistical analysis (one-way ANOVA) to compare any difference in the average effectiveness among subgroups of categorical context factors (existence of QMS section, company type, and plant location). The relationships between some interval context factors, i.e. percentage of migrant workers, operating years, number of plants in the same entity, and size of the food safety team, and the effectiveness of BRC implementation as the dependent variable were revealed through linear regression analysis. The impact of the context factors on the effectiveness of BRC implementation were also examined. The Pearson's correlation coefficient allowed for the inspection of the relationships between context factors. Conclusions were drawn based on the outcome of the findings and analyses.

III. RESULTS AND DISCUSSIONS

The number of completed questionnaires returned in this study was 231, of which 217 were considered valid for analysis. This represented 58.5% of the sample size. The reasons for some firms not responding to the questionnaire were mostly due to the time constraints of the managers. Furthermore, some companies were about to abort the BRC standard because of the slowdown in the European Union (EU) market. In addition, a few respondents wanted to protect their company's confidential information, even though they were given assurances that all information collected in the research would be treated in strictest confidence.

The participating plants produced food in a variety of food categories, e.g. raw and processed meat and seafood (30%), dried foods and ingredients (16%), canned and glassed foods (13%), fruit and vegetables (9%), cereals and snacks (5%), beverage (3%), confectionary (1%), dairy and liquid egg (1%), oils and fats (1%), bakery (1%). The others produced more than two categories.

A. Respondent Profiles

The majority of the 217 responding managers were female (63.6%), and the others were male (36.4%). The largest age group of the respondents was 31-40 years old, which accounted for 48.9 % of the total respondents. The second largest age group was 41-50, with 32.2%, followed by the under 30 and over 50 age groups with 12% and 6.9% respectively.

The highest level of education for the majority of the managers' was university graduates (65%), whereas 32.7% had pursued a Master's degree. In the minority were those who had attained a Vocational Certificate (1.8%) and a Doctoral degree (0.5%). With regard to the managers with a Bachelor's degree, most respondents had majored in a field of study that was related to various kinds of operations at the plants, e.g. Food Science and Technology, Biotechnology, Nutrition, Agro Industrial, Food Engineering and Microbiology, etc. These fields are deemed to be applied sciences, whilst further graduate studies were mostly related to the managerial field, for example, General Management; Business Management; and Functional Management of Production, Engineering and Marketing etc.

With respect to the number of years of BRC involvement, more than half of the managers had been involved in the BRC standard with their firm for more than four years. Numbering 124 managers, this group accounted for 57.1% of the total sample, and was followed by those with 1-2 years of experience (15.2%), 2-3 years (12.0%) and 3-4 years (11.5%). From these data, it can be concluded that individuals of an optimal age with a high level of education and long experience have

been recognized and assigned to be involved in implementing the standard.

B. Managers' Responsibilities

Referring to Table II, nearly half of the respondents took responsibility for the Quality Assurance department, and 35% were in charge of Quality Control. The remainder of the above section were also from Document Control, Production Planning and Quality Management System.

TABLE II. RESPONSIBILITIES OF FOOD SAFETY MANAGERS

Task	Responses		Percent of
	Ν	Percent	Cases
Quality Assurance	107	24.5%	49.3%
Quality Control	76	17.4%	35.0%
Research & Development	32	7.3%	14.7%
Hygiene	29	6.6%	13.4%
Production	15	3.4%	6.9%
Maintenance	7	1.6%	3.2%
Other	171	39.1%	78.8%
Total	437	100.0%	201.4%

Based on the above information, it could be implied that managers were mostly in the position of middle-level management, followed by top-level management and frontline management respectively.

Further to routine tasks, the extra roles of managers pertaining to food safety and quality standards are exhibited in Fig. 2. Food Safety Team Leader (FSTL) is a standard position of BRC, for which the person in this position should typically have in-depth knowledge of HACCP and be able to demonstrate competence and experience, whereas Quality Management Representative (QMR) is a task pertaining to ISO 9001 whereby top management appoints a member of the management team. Of the sample, one-fourth of the managers (24.9%) of BRC certified firms hold 2 positions for reasons of standardization and quick responsiveness to the food safety issues and for better coordination among various operations.



Figure 2. The system position(s) of managers in addition to their duties related to BRC food safety and quality standard

The majority of the plants participating in this paper (67.1%) employed more than 200 employees, which is classed as a large sized organization according to the enterprise size breakdown defined by the Ministry of Industry.

The firm' demographic factors displayed in Table III categorize the firms by the existence or not of a QMS department, the type of company, and the location. From this table, local or Thai companies made up the largest

group of respondents (86.2%), whereas 8.3% and 5.5% of the sample sites were owned and operated by multinational companies (MNCs) and Joint Ventures (JV) respectively. This contradicted the finding by Ref. [32] who proved that there is a significant positive correlation that the most important positive factor from the environment was the type of place where the company was located. The closer a company is to well developed and urbanized zones, with better infrastructure, communication, and other facilities, the greater the degree of implementation of the food quality and safety management system.

TABLE III.	FIRMS'	CONTEXT FACTORS	AND EFFECTIVENESS
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Categorical	N	Percent	Average	
Context factors			Effectiveness	
Type of company				
Joint Venture	12	5.5%	3.458ª	
Local (Thai) Company	187	86.2%	3.444ª	
Multinational Company	18	8.3%	3.722ª	
Plant location				
Industrial Promotion	9	4.1%	3.778ª	
Zone				
Industrial Estate/Park	24	11.1%	3.563ª	
Neither	184	84.8%	3.440ª	
Existence of QMS department				
Yes	203	93.5%	3.463ª	
No	14	6.5%	3.536ª	

Those items with the same superscript are not significantly different at p = 0.05

Out of firms participating in this study, the vast majority of the sample (93.52% or 203 sites) already had a QMS department in place, whilst the remainder of the companies (6.48%) had not established such a department yet. The results in Table IV show that the highest proportion of company type (86.2%) was Thai company. It can also be seen that the largest distribution of the firms (84.8%) were located on neither an Industrial Promotion Zone nor an Industrial Estate/Park.

The average effectiveness of BRC implementation in each subgroup of categorical context factors was determined and their effectiveness were compared. However, there were no observed differences in the average effectiveness among the subgroups of company type, plant location and the existence of a QMS department for Thai BRC certified companies.

In order that the firm achieve proper implementation of food standards, the effectiveness and factors influencing implementation must be investigated. To this end, the interdependence of some context factors in this study to the effectiveness of BRC implementation were analyzed, i.e. the percentage of migrant workers, the number of years of operation, the number of plants under one entity, and the number of members in the FST.

As shown in Table IV, the relationship between the percentage of migrant workers, the number of years of operation, and the number of plants under one entity were insignificantly related to the effectiveness of BRC standard implementation. The regression analysis found only significance in the relationship between the number of members in the FST and the effectiveness of BRC implementation, which supports H4 in Table IV.

Finally, the significance model was expressed as the following equation:

BRC effectiveness =
$$0.106*FST$$
 size + 3.11 (1)

The members of the Food Safety are individuals who directly contribute to food safety in the manufacturing plants. They are responsible for quality/technical control, production operations, engineering and other relevant functions. Surprisingly, we also found a high correlation between food safety team numbers and the firm size as represented by the number of staff.

C. Certification Bodies in Thailand

Each CB's popularity was ranked as presented in Table V. It is revealed that the highest proportion of firms chose SGS (Switzerland), accounting for 35.9%, followed by 17.5% and 12.4% selecting Intertek (UK) and BVQI (France) respectively. Given that no local body provides certification services in BRC Thailand, everv participating firm had attained BRC certification from an international CB. These results were close to the findings of a similar study in the context of Zimbabwe, where the standard of most of the companies which had implemented FSMS had been certified by a foreign body. It was interesting to note in a separate case that multinational companies (MNCs) and their headquarters tended to be situated in the same country as their chosen certification board [33].

Third-party CBs have played an important role in the implementation of these schemes. They can provide added value with their audit and inspection services, and are important for enterprises to continuously improve their own food safety management system [34]. Ref. [35] concluded that third-party certification is emerging as a prominent and influential mechanism to ensure food safety in the public and private spheres in a food standard profoundly affected by globalization.

TABLE IV. RELATIONSHIPS BETWEEN INTERVAL CONTEXT FACTORS AND EFFECTIVENESS

Relationships	Standardized	SE	<i>p</i> -value	Squared multiple	Hypothesis test
	regression weights			correlations	results
<i>H1</i> . the number of migrant workers \rightarrow	-0.007	-0.222	0.745 ^{ns}	0.000	Reject hypothesis
effectiveness of BRC standard implementation					
H2. the number of plants operating under the entity	0.035	0.059	0.389 ^{ns}	0.003	Reject hypothesis
\rightarrow effectiveness of BRC standard implementation					
H3. the years the plant has been operating \rightarrow	-0.001	-0.001	0.987 ^{ns}	0.000	Reject hypothesis
effectiveness of BRC standard implementation					
<i>H4.</i> the number FST members \rightarrow effectiveness of	0.106	0.171	0.012*	0.029	Accept hypothesis
BRC standard implementation					

Notes: ns, not significant *Significant at p < 0.05

No.	Certification Body	Frequency	Percent
1.	SGS (Switzerland)	78	35.9
2.	Intertek (UK)	38	17.5
3.	Bureau Veritas (France)	28	12.9
4.	SAI Global	24	11.1
5.	BSI	19	8.8
7.	Moody	7	3.2
8.	TUV NORD	7	3.2
9.	CERT ID	6	2.8
10.	NSF Asia Pacific	5	2.3
11.	TUV SUD	3	1.4
12.	CMi & NSF-CMi	2	0.9
	Total	217	100.0

TABLE V. THIRD PARTY AUDITORS SELECTED BY THE FIRMS

IV. CONCLUSIONS

In selecting the sample study group, this study placed emphasis on firms which had been certified to the BRC standard. BRC is the most popular standard in Thailand as well as in the UK [36]. The results revealed that the certified plants in Thailand produced a diversity of food category products. The profiles of the managers were predominated woman, with the majority in the 31-40 age group. Also, most of the managers had been involved in the BRC standard for more than four years. It was also found that most of the food safety managers worked in the quality department, which indicated that safety and quality are considered inseparable.

Regarding the sample firms, the context factors that were studied in this research include the existence or not of a QMS department, the plant location, and the company type. Almost three quarters of the firms were local companies. Most of the firms were local companies, located on neither an Industrial Promotion Zone nor an Industrial Park. The majority of firms had a QMS department already in place. Furthermore, there was no differences in the average effectiveness when comparing among the subgroups of company type, plant location and the existence or not of a QMS department.

In addition to the categorical context factors of the company, some interval variables pertaining to the plants were added in the hypotheses to investigate whether they were related to the effectiveness of BRC implementation. FST numbers was found to be one out of four variables that affect the implementation of the BRC standard. We also found a high correlation between the number of food safety team members and the plant size in this study.

V. IMPLICATIONS

The findings of this study have important implications for food managers and academicians who desire to learn more about the status of food industries certified to the BRC standard and how to improve the effectiveness of implementation from their context factors. Food companies can change suitable context factors as depicted in this research to achieve more effective food safety and quality systems. For academic researchers, this paper highlights the relationship between the various context factors and the degree of effectiveness in terms of BRC implementation. The research outcomes will make a contribution to the current extensive field of knowledge on food safety, quality assurance, food standard implementation and food handlers' attitudes.

VI. LIMITATION

This study has several limitations. First, the inferential statistical results cannot be generalized to firms certified to other FSMSs, such as ISO 22000, FSSC 22000, IFS etc. because the non-probability sampling technique used in the purposive data collection was not suitable to utilize the statistical analysis to project the data outside of the sample. Second, The BRC database was also not up-todate on the date of search and some information was incomplete. Third, a minority of the respondents were top management, such as owners, Chairmen, Managing Directors, and General Managers, which might have resulted in biased responses to some of the questions. For example, to evaluate the effectiveness of their sites, some respondents ranked the degree of effectiveness far higher than a third party body evaluated it. Another limitation was the diversity of food companies participating in this study and the subjective character of the collected data.

VII. FURTHER RESEARCH

A number of limitations associated with this study give rise to future research proposals. Ideally, future research could be extended to other settings to cover companies from across the whole food chain, which includes raw material suppliers, distributors and the food retail sector. If databases are available, the firms certified to other food standards should also be studied. Applying this research to other FSMS to compare the result with this study could also be conducted. Furthermore, replicating this study with certified food firms in other countries should be done in order to enhance the quality of the research results. Further research could pay more attention to the small and medium sized firms which may face more problems in implementing a food safety standard. Other than the limitations, an investigation of the cost and benefits of attaining BRC certification would also be interesting to study from time to time in order to consider whether the standard should be maintained, aborted, or replaced by an alternate food safety standard.

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