A Critical Assessment on the Implementation of Statistical Quality Control Tool Among SMEs Food Industry in Malaysia

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Abstract
A competitive market environment requires enterprises from the food industry to emphasize quality aspects in improving the process, quality and performance of the company. This goal is achievable by implementing a statistical quality control tool through a quality management practice program. However, a literature review on quality management and quality improvement from this industry in Malaysia is still unclear, especially on the assessment tool for statistical quality control (SQC). The main purpose of the study was to contribute in terms of review and observation of the statistical quality control implementation through tools or techniques of quality management. Research begins with a question of relationship quality improvement with the implementation of statistical quality control among small medium enterprises in the food industry. A questionnaire approach was conducted to obtain responses among food industry consisting of microenterprises, small and medium in northern Malaysia. The statistical analysis found that the knowledge and application of SQC tool implementation are moderate with score 39.87 (knowledge index) and 35.12 (application index). This study helps to SMEs in knowledge transfer activities through the technical support and guidance needed as a preparation in facing the future market challenges that is more competitive.
Keywords: Small and medium enterprises (SMEs), Food Industry, Statistical Quality Control (SQC), 7 QC, New 7QC

1. Introduction

Small and medium enterprises accounted for 36.6 per cent of the gross domestic product (GDP), 65.3 per cent of employment and 18.6 per cent of exports in 2016 is seen rising positively compared to 2015. The latest statistics in Malaysia is a total enterprise 920,878 enterprise that is active and still in operation and from the total of 98.5 per cent (compared to 97.3% in 2011) is the enterprise from the category of micro, small and medium enterprises involved in the service sector (89.2%) manufacturing (5.3%), the construction (4.3%), agricultural (1.1%) and 0.1% for the quarrying sector (Depatment of Statistics Malaysia, 2016 and SME Corporation Malaysia, 2016). The contribution of this industry in the context of economic development of the country is seen high especially in the production of food products that meet the specifications of the international standard. Thus, the enterprises in the business to create job opportunities, increase incomes and provides an important base towards more advanced multinational enterprises. *As such, the category of micro, small and medium enterprises need to prepared in readiness the new economy that exists today, such* as expanding the potential market size by complying with international standards, implementing best management practices and efficient governance, sovereignty and food security to continue to compete in the regional and global markets.

Improvements in quality and productivity with enable the country to produce a variety of high-yielding food products by adopting several new mechanisms such as the use of innovation, technology and better quality management practices in the business (Abdullah and Rosli, 2015). This reflects the importance of management and quality assurance towards industrial development is to focus on the management of materials and efficient workforce planning and effective through a systematic quality management system such as the use of statistical quality control tools or the implementation of process control (Abdul Halim Lim, Antony, Garza-Reyes and Arshed, 2015, Idris, Ab Aziz and Zailee, 2012). Rapid economic changes to the current market environment is seen crucial to business of product-based to meet customers' needs. These include steps in reducing production costs, emphasis on innovative thinking in every aspect of the operations of the enterprise and the importance of enhancing products, services and performance process.

This study aims to find an early solution to small and medium enterprises in addressing management and quality issues throughout the supply chain process to ensure that each product developed is reliable, secure and meets the specification of international standards. According to Lim, Antony and Albliwi (2014), continuous improvement, monitoring and control of process quality can be implemented by practicing quality management planned through a long-term innovation approach called statistical process control or statistical quality control. The implementation of this control using several tools or management techniques in order to manage, monitor and control the quality at various stages of production starting from the raw materials to the finished product to be delivered to the customer. Implementation of quality tools or techniques such as checklists, histograms and control chart are commonly used in several manufacturing and service sector, but it is also seen to the food processing sector in control and maintain the quality which was introduced in 1950 by the leading quality gurus (Pereira, Aspinwall and Pereira, 1991).

2. Literature Review

Literature review describes the basis for the scenarios that occur in the food processing industry, especially to small and medium enterprises, emphasis on aspects of quality management development covering the control and quality assurance and total quality

management. Furthermore, the discussion includes the use of statistical quality control techniques commonly used in quality measurement solutions. The study discusses several key topics on the implementation of quality control activities towards improving enterprise quality performance in the food industry.

Today, challenges to SMEs is very big, where the government puts high expectations in the development of SMEs by focusing on the SMEs development to be more competitive and innovative in the international level. This is reflected in the government commitment through the trans-Pacific partnership agreement (TPPA) which would open for trade and regional integration to SMEs after the coordination rules towards international standards (SME Corporation Malaysia, 2016). Therefore, SMEs must be prepared in a competitive environment at the international level and the measures taken by the Government is to provide assistance through support agencies under various ministries such as MOA, MATRADE and MITI to improve capabilities, business efficiency, increase productivity and innovation, branding and also compliance with the international standards. Study by Abdullah and Rosli (2015), Alpay et al., (2002), Yodfiatfinda et al., (2012), explain the importance of productivity growth to the economy very closely in supporting the development agenda and create a country that is advanced and inclusive through the use of technology and innovation, efficient quality management and good practices in business.

For that purpose, the various parties are given the responsibility to jointly assist SMEs through training, support and guidance towards quality and productivity enhancement. Statistical quality control (SQC) is also known as statistical process control (SPC) with the use of the same equipment and practiced in alternating replace. This is supported by Beardsell and Dale, 1999, Xie, Goh and Cai (2001), which the tools or techniques used during quality control activities at the process or quality is involves data collection, analysis and interpretation for the purpose of detecting, controlling and managing quality control. Statistical quality control means to control the quality using statistical methods for the purpose of monitoring and control of a process to maintain the quality required by certain standards and regulations (Zaharuzaman Jamaluddin, Ahmad Mahir Razali and Zainol Mustafa, 2012). However, Abdul Halim Lim et al., (2016) specifies the statistical quality control is an assessment of a process output that occurs in every stage of production either during the provision of raw materials or product is ready. Statistical quality control tool is a tool developed based on the widely used Shewhart concept from various manufacturing or services sector for the purpose of maintaining quality.

The main purpose of implementing SQC tools is to detect and prevent the occurrence of defects to the products and this method has long been practiced and utilized extensively in the quality aspect to the manufacturing sector, in particular in the food and beverage industry. Quality control of the food and beverage processing industry scientifically related to technology, the characteristics of sensory, physical, safety, chemical composition and nutritional value to the consumers. There are several SQC tools or techniques commonly used in quality control activities, however, in this study the researchers only examine fourteen (14) quality control tools as appropriate from the study Abdul Halim Lim and et. al, (2015) and Zaharuzaman Jamaluddin, Ahmad Mahir Razali and Zainol Mustafa, (2012). The tools used are seven quality control tools (7QC) – check sheet, histogram, pareto chart, bar or pie chart, scatter diagram, control chart and cause-effect diagrams; and seven new quality control tool (new 7QC) – affinity diagram, relations diagram, systematic diagram, matrix diagram, arrow diagram, process decision program chart (PDPC) and matrix data analysis.

Knowledge and application for the implementation of statistical quality control requires that training to operators and quality practitioners. However, there are obstacles due to lack of understanding, knowledge, awareness of top management and the approach used are technical (Mohd Rohani and Teng, 2001, Zaharuzaman Jamaluddin et al., 2012). The significance of the implementation of statistical quality control in the food industry is seen focused on food safety management improvement, reduction of product damage and due to the increased operating cots. Enterprises in the food industry are among the contributors to the field of agro-business in Malaysia which this field gives great business returns to the economy of the country. As such, emphasis on quality and management aspects is important for the Organization to manage in a proper and controlled way to be an effective approach in integrating the development of quality activities.

There are two reasons why the use of statistical quality control tools should be implemented in the small and medium enterprises of the food industry. First, the demand for quality products by large-scale enterprises, second reason is enterprise requirements to be more proactive and able to compete in good quality control to create a competitive business environment (Ab Rahman, Mohd Zain, Mohd Alias and Mohd Nopiah, 2015). Typically, the lack of product quality in the industry will affect the capability of the industrial market. The application of statistical quality control tool is a complex technique in which it involves a change in the overall work culture that will affect the performance of an organization (Norhasni et al., 2015). Literature review has found that the implementation of statistical quality control is very useful to improve quality because the enterprise is able to detect abnormalities in the processes, meet the timeliness, checking critical parameter, reduce variation and maintain the process stability. As a result, the enterprise has managed to reduce customer complaints, increase profitability and productivity enhancement.

3. Methodology

Targeted research is to investigate the implementation of statistical quality control whereby researchers will review through the use of quality control tools most commonly practiced and has interests in the food industry for the purpose of the early development rule-based model on the implementation of statistical quality control for enterprises directly involved in food processing. Researchers use quantitative methods to study the knowledge and application level of quality control tools through techniques practiced in the quality control program. The research instrument used was a questionnaire adapted from literature by publishing quality practitioners and academicians. The questionnaire is an appropriate instruments for obtaining views and understanding the relevance of the implementation of statistical quality control in the food industry(Scott et. al, 2009).

This study was adapted from several literature published in the production sector and food processing (Abdul Halim Lim and Antony, 2013, Mohd Rohani and Teng, 2001, Grigg and Walls, 1999, Zaharuzaman Jamaluddin et. al, 2012). The draft questionnaire is reviewed by representatives from the food industry and quality practitioners to verify and test the content of the questions submitted to be understood by the actual respondent. Since the survey questions was developed from the non-food industry survey, some of the recommended questions have been modified to enhance the understanding of the respondents and achieve a higher response rates. There are several types of questions in the study developed i.e. structured questions, open-ended questions and likert scale (Sekaran, 2013).

A pilot study was conducted to evaluate the validity and reliability of the survey instruments developed. A total of 30 respondents carried out in questionnaire at this level.

The pilot test respondents consisted of 20 entrepreneurs in the food and beverage sector, while 10 respondents were from the group of experts, including academics, consultants and advisors of entrepreneurs in the government sector. Each information, suggestions and comments expressed by respondents were examined to confirm the content of the questionnaire and ensure that the rate of response can be increased to achieve the objective of the study. For that purpose, cronbach's alpha is used to examine the validity and reliability of the items within each scale used in the questionnaire. Cronbach's alpha is a coefficient of reliability that determines the items as a set that are linked to each other. Statistical analysis of pilot tests for each item of questionnaire shown in table 3-1. From the table below shows cronbach's alpha of test pilot is at an acceptable rate, namely the value of the coefficient of 0.893 to 0.939.

Table 3-1:
Summary of statistics for each item in pilot test

Part	Item	No. of item	Cronbach's alpha
I	Knowledge of SQC tool	14	0.939
II	Application of SQC tool	14	0.901
III	Quality Improvement	10	0.893

4. Analysis and Results

The data obtained from a questionnaire survey will be analyzed with quantitative analysis based on the descriptive and inferential statistics using SPSS (*IBM SPSS Statistics verse 23*). The information collected as a result of the survey is recorded and coded into the software for the analysis purposes. This research was conducted to interpret the commonly practiced in quality control (QC) of 7QC tools and new 7QC Tools, which affects the performance of the enterprise, particularly in enhancing the quality of the food industry to SMEs in Malaysia. The findings of the study showed that quality control tools can be used in all phases of the process at the product development stage to the management processes in a more systematic way. Generally, this study can help researchers form a new core of future research focusing on research based on statistical quality control through the implementation of tools or techniques of quality control in the food industry, especially among Malaysia SMEs. The findings, discuss that lead to the two main questions in the study of which is formed:

- Status of implementation of statistical quality control among Malaysia food industry enterprises.
- Implementation of statistical quality control tool (basic 7 QC tools and new 7 QC tools) adopted at the level of SMES in the food industry in Malaysia.

Based on Table 4-1 respondents from Penang recorded the highest percentage of 43 respondents compared to Kedah (29 respondents) and 21 respondents and 7 respondents respectively from Perak and Perlis. This study takes the approach of respondents' needs and different considerations in terms of location, size of the enterprise and diversity of business cluster in the food industry. SME from medium-sized category showed the highest respondents of 41%. This category is classified under the small and medium enterprises (SMEs) with the full-time employees between 75 people to 200 people, as well as from small-sized category (the number of full-time employees between 5 to 74 people) and micro-size (number of employees full time less than 5 people) were 31% and 28% respectively. This indicates that, the involvement of a popular enterprise in the food processing industry in

northern Malaysia is Penang, the second highest percentage is the enterprises from Kedah, which the sectors that began to develop in the food processing industry especially from agro-based products such as ketchup and soy sauce.

Table 4-1:
comparison of the respondent based on the size of the enterprise and location

SMEs/State	Penang	Kedah	Perak	Perlis	Percentage (%)
Microenterprise	12	7	4	5	28
Small	15	10	4	2	31
Medium	16	12	13	0	41
Total	43	29	21	7	100.0

Table 4-2 below shows the seven types of business cluster classified according to priority areas in the food processing industries as published by MATRADE in books titled *Malaysia Exporters Directory of Food & Beverage*. A business cluster included in the list of the study was the first-category (25%) of prepared food (ready to eat, frozen food product, bakery and confectionery products, spices and condiments, the second-category (22%) were the product of noodles, pasta, sauce, paste and pickled, third-category (15%) from the snacks and candy products, the fourth-category (20%) and fifth (8%) of the beverage and health drink products, while in the sixth-category (10%) are products other than above such as traditional products (chips, dodol, traditional cakes, pasteurized coconut milk, mineral water, dyes etc.). If the observed at the results from the SMEs category, it shows that the majority of enterprise is more focused on the first products that is seen as synonymous with Malaysian society today who like to provide faster and more convenient cuisine through frozen food products. In addition, the food industry enterprises show more focused business based on fast food or ready to eat and drink compared to other products.

Table 4-2:
Main product category in the northern Malaysia food industry based on size of enterprise

		Size of enterprise			Percentage
		Micro	Small	Medium	(%)
Main product category	Prepared food (Ready to eat, frozen food, bakery and confectionery products, spices & condiments)	6	7	12	25
	Pasta, noodles & pancakes, sauce & paste, pickel	8	7	7	22
	Snacks & candy	4	3	8	15
	Beverages (Carbonated drinks, juices & cordial, coffee, tea & cocoa)	3	8	9	20
	Health drinks	3	3	2	8
	Others	4	3	3	10
Total		28	31	41	100.0

From the results of the analysis, the survey questionnaire has produced the required research outputs through an assessment on the statistical quality control implementation as shown in table 4-3 below. A summary of the findings of this study is coherent to answer the

questions that would like to achieve in the next review, and assessing the effectiveness of the implementation of statistical quality control among SMEs in Malaysia food industry.

Table 4-3: Summary of the findings on SQC implementation in food industry

Topics	7QC tool (Basic)	New 7QC tool
Knowledge	• To all SMEs have a basic knowledge of tools, especially knowledge about check sheet, histogram and Pareto. • Knowledge about these tools to SMEs is good. • Able to be increased with Government support to encourage SMEs to set up at least quality groups (e.g. Team excellence or ICC) with appropriate guidance.	• Lack of knowledge in the implementation of new 7QC tools in food industry. • Requires support and assistance from the Government or consultants in quality to understand in depth the needs of this new method. • Knowledge is still less promising except for a handful of SMES from the medium-size.
Application	• The use of this method is in low level amongst SMES food industry. • The use of control charts in the food industry is > 70% in which its use to fix problems in a stable and meet user specifications (vendor selection, compliance with process or product specification, calculation of defects and waste). • SMES use this method for collecting process/quality performance, identify the cause of the problem, checking the raw materials, control of quality and processes.	• The use of this method is very low among the SMEs food industry. • Relations diagram are tools used frequently by SMEs to help solve complex issues related to quality, business, system, or process. • This method is more emphasis at management level because its development requires more information and efficient prior to data collection and analysis.
Quality Improvement	• The performance of SMEs in the reduction of customer complaints is more effective when implementing quality control tools, followed by reputation of company image and increase product quality. • SMEs that use SQC tools rather than not use SQC tools are particularly great, especially for micro-enterprises, the results show the advantage of SQC tools users to process management performance such as reducing the impact of damage and defect on the product.	
Effectiveness	• Flexible compared with new 7 QC tools because the majority of SMES understands the SQC and know the benefits of 7 QC tools. • Each tool is useful for implementation in the food industry, primarily for the purpose of product/process quality improvement.	• Requires a long period of time when using the new 7 QC tools. • Requires monitoring and frequent training because design and translation of analysis require a creative and critical thinking in generating ideas.

• The period of time taken to resolve the problem by using this tool is not too long to the efficient quality operators.	• Brainstorming in groups is more efficient.

5. Conclusion

The study provides a preliminary description of the current status of the statistical quality control implementation in the food processing industry through the evaluation of fourteen (14) quality control tools to the enterprise from among SMEs. This study found a new mechanism for the Malaysian food industry, which previously only focused on the manufacturing sector, namely through improved in guidance support to SMEs by encouraging the use of SQC as a new alternative for innovative stigma. This is to ensure that the quality of a product issued is guaranteed in accordance with the guidelines and standards set by the relevant agencies in Malaysia on food safety internationally. Implementation of statistical quality control is highly influenced by the status of the enterprises, where enterprises of medium-sized categories are more capable to provide training and courses to the employees in quality control programs compared with enterprises from the microenterprise and small category. It is hoped that this research will benefit to SMEs especially in the food industry as well as assisting advisors/consultants to deliver service guidance through training provided by government agencies to ensure SMEs performance in quality and productivity practices can be enhanced.

6. Recommendation and Research Agenda

The findings the study found appropriate solutions to quality practitioners that will benefit SMEs development in the food industry in Malaysia, especially in order to improve the efficiency of enterprise by focusing the activities of quality control. This research agenda will benefit to SMEs in Malaysia that venture into the production of food products. The awareness of SMES on the implementation of statistical quality control is highly effective if it has received support from various parties from the Government or the private sector through:

- Promotion and transfer technology activities – Government agencies should be more prepared to promote and publicize quality and productivity programs for SMEs through exhibition activities, seminars, workshops or continuous monitoring of enterprise. Such Organizing seminars and workshops, for example, will be a gathering field among SMES to get input and ideas towards solving the problems faced, and improve skills and competencies to SMEs.
- Team excellence development - The establishment of the group management level amongst SMEs food industry is seen to be vital to ensuring that quality control activities are always practiced. It is intended to support improved the knowledge of SQC in generating creative and innovative thinking and willing to solve problems and make decisions critically.

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