International Journal of Engineering & Technology, 7 (4.14) (2018) 319-321

International Journal of Engineering & Technology

Website: www.sciencepubco.com/index.php/IJET

Research paper

A Systematic Review of Lean Six Sigma Implementation in Food Industry

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Abstract

Lean Six Sigma (LSS) is the most current quality management approach being applied recently in many industries to improve food quality and subsequently process excellence in the businesses. The objectives of this paper are to determine the barriers and resistance to change factors of implementing LSS approach in the food industry. This study was conducted as to determine the benefits of applying LSS and comparing the trend of quality management being used in the food industry. It is also based on the application of systematic review of 113 LSS articles, involving a structured approach of data collection and data extraction. The listed barriers and resistance to change factors shown are top management support, lack of quality improvement knowledge, poor training and insufficient skills amongst employees and lack of financial budget thus causing the limitation of LSS approach in the food industry. The result mapped the current quality management approaches implemented in the food industry. The academics and the food industry practitioners may have an insight from this paper by considering their critical success factors, barriers and resistance to change factors that could facilitate towards a successful LSS implementation.

Keywords: *lean six sigma, food industry, quality management*.

1. Introduction

Continuous improvement had been used widely in all industries in conjunction to achieve business process excellence while reducing and eliminating waste, reduce variation and adding on value in process streamlines. Food industry is not excluded from grabbing all the benefits, positive impacts and experiences by using continuous improvement such as lean, six sigma, taguchi, kaizen and even many more continuous improvement that are available. The industry is strategically planning to reduce production cost and thereby increase the company's revenue by using continuous improvement method.

Started in 1930s with the Toyota Production System combined with just in time concept is the foundation for lean production. Zarei et al. (2011) stated that the lean management can be adapted in food processing system. Besides, productivity improvement that focused on producing high quality end products and adding on value in the processes are the concept of lean thinking. Six sigma is the statistical method used to reduce the variation in the processes thus lead to effective processes. Six sigma had been popularized by American electronic industry that aiming to save time, improve products quality and lower the production cost. Hung and Sung (2011) stated that the Define, Measure, Analyse, Improve, Control (DMAIC) approach which is the six sigma improvement model had been used to reduce the process variation and high defects rate in food industry quality program. This perfect combination between lean and six sigma had been practicing since early 2000s (George, 2002). According to Dora and Gellynck (2015), the lean six sigma application helps in reducing the overfill and rework processes in food processing Small Medium Entreprises environment.

However, the need for the food industry to acknowledge the state of their quality management practices can be considered through the factors from their barriers and resistance to change that could help in implementation of continuous improvement method. The food industry can consider the list–on pros and cons before implementing the lean six sigma application in the industry. Therefore, this paper is aiming to discuss about the barriers and resistance to change that faced by the food industry to implement lean six sigma application. On top of that, listing on every benefit that may grab from the implementation of lean six sigma in food industry may give better insights for the practitioners. The trend and preferred quality management being used in the food industry also being discussed in this paper.

This study is also aiming to achieve the following research objectives; (1) to identify the barriers and resistance to change in implementing lean six sigma in food industry, (2) to investigate the trends of quality management being used in the food industry and (3) to identify the benefits of implementing lean six sigma in food industry.

2. Research Methodology

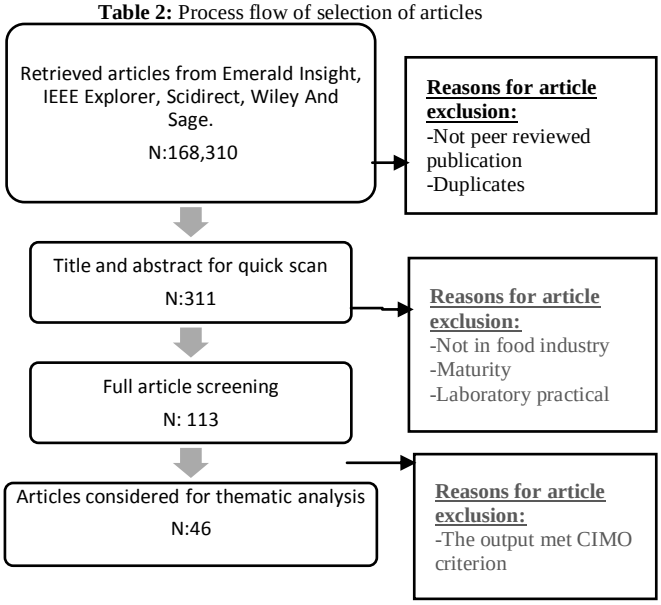
The journal search was done by selecting the journal articles from databases such as Emerald Insight, IEEE Explorer, Science Direct, Wiley and Sage. The most common themes that emerged in the literatures are barriers, benefits of implementation, limitations and types of quality management being used. The selections of 113 articles are based on the Context Intervention Mechanisms Outcomes (CIMO) criterion. The data process by synthesizing 113 articles after undergone data extraction. Data analysis software which is Nvivo 10 are used for data extraction. The Context In-

tervention Mechanisms Outcomes (CIMO) are considered for the inclusion and exclusion criterions for the expected outcomes:

Table 1: CIMO criterion

Inclusion	Exclusion
Critical barriers	Maturity
Resistance to change	Laboratory practical
QM practices before LSS	Food Services
	Other than food industry

Table 2: Process flow of selection of articles



3. Findings

The results for the barriers and resistance to change that occurred in food industry were discovered after extracting and analyzing the data . The trend of common quality management being used by the food industry have also been determined:

3.1. Barriers

There are many barriers that may give limitation and impact the implementation of quality management practices in food industry. The most top barrier is lack of support from top management. This is shown by limited implementation of quality management being used in the food industry (Nguyen, Wilcock, & Aung, 2004; Besseris, 2014; Čiarnienė & Vienažindienė, 2015; Psomas, 2016). This barrier may affect the implementation of quality management used in food industry as the top management need to convince themselves with the benefits that can be obtained (Nguyen, Wilcock, & Aung, 2004) by influencing the employee participation on practicing new quality management (Putkiranta, 2012). Secondly, the other common barrier faced by the food industry are lack of financial support (Thakkar, Kanda, & Deshmukh, 2012; Gazova, Papulova, & Papula, 2016; Psomas, 2016). Financial support limitation may distract the implementation of new quality management as money acts as a token to support for new technologies needed and even training for employee's skills enhancement. On top of that, the lack of understanding and knowledge in quality management practices limit the implementation of quality management practices in the industry (Adebanjo, Abbas, & Mann, 2010; Thakkar et al., 2012; Čiarnienė & Vienažindienė, 2015). The awareness from the management regarding on the benefits that can be grabbed from the implementation of the quality practices is still low that shown the lack of understanding in the management (Abdulrahman Alsaleh, 2007). Knowledge in quality management is needed as it can make the implementation process flow working smoothly without hesitations. However, there are many other listed barriers such as cultural issues (Belhadi, Touriki, & El Fezazi, 2018; Shaaban & Awni, 2014; Salonitis & Tsinopoulos, 2016), lack of resources and technologies capabilities (Abdulrahman Alsaleh, 2007; Thakkar et al., 2012; Psomas, 2016), lack of experience (Rauch, Dallasega, & Matt, 2017) and lack of quality training and specialist (Gazova et al., 2016; Salonitis & Tsinopoulos, 2016; Sahoo & Yadav, 2018). While other barriers that minimally being discussed are lack of motivation from the employee (Čiarnienė & Vienažindienė, 2015) and thus impact the interest on employee (Psomas, 2016) and variation of process, products and raw materials (Besseris, 2014; Krotov & Mathrani, 2017) as well as fear of documentation (Nguyen et al., 2004). High investment cost (Erwin, Patrick & Dominik, 2017), human barriers (Psomas, 2016), high expectation on short outcome (Sahoo & Yadav, 2018) and high inventory levels (Thakkar et al., 2012) also can be categorized as barrier in implementation quality management practices.

3.2. Resistance to change

There was also evident that resistance to change was the obstacle faced by the food industry (Nguyen et al., 2004; Gerolamo, Poltronieri, Yamada, & Cintra, 2014; Gazova et al., 2016; Čiarnienė & Vienažindienė, 2015; Krotov & Mathrani, 2017). The food practitioners believe there is no need to implement new quality management practices plus being comfortable with recent or traditional practices (Krotov & Mathrani, 2017). The resistance to change is related to human factors and management which are the soft aspects (Gerolamo, Poltronieri, Yamada, & Cintra, 2014). According to Čiarnienė & Vienažindienė (2015), **t**he resistance to change are representing people related barriers' group .

3.3.Common quality management practices

The most common quality management practices in food industry are being tabulated in Figure 1 below:

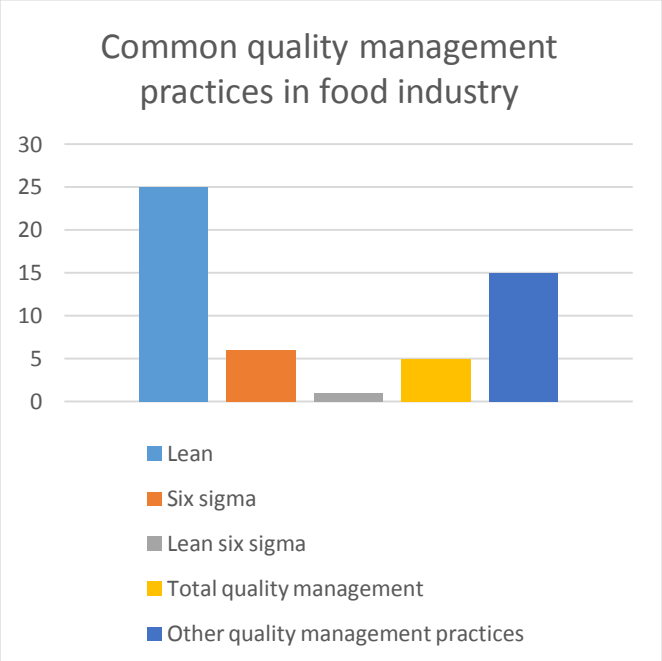


Figure 1: Common quality management practices in food industry

The result shows that the most common quality management practices in food industry is lean manufacturing followed by other quality management practices such as Agile manufacturing, Benchmarking, Business Process Reengineering, Gemba principle, Gemba-Kaizen, Good Agricultural Practices, Hazard Analysis Critical Control Points, Hoshin Kanri, ISO9000, Just in times, Kaizen, Kanban, Total Quality Management, Six sigma and Lean six sigma. As in Figure 1, Lean six sigma practised in food indus-

try is the lowest and the least common for implementation. It shows that there are many quality management being practiced by food industry in order to meet the customer expectations by providing good quality of end products.

3.3. Benefits in implementing Quality Management Practices

The most common benefits being discovered by implementing good quality management practices in food industry are:

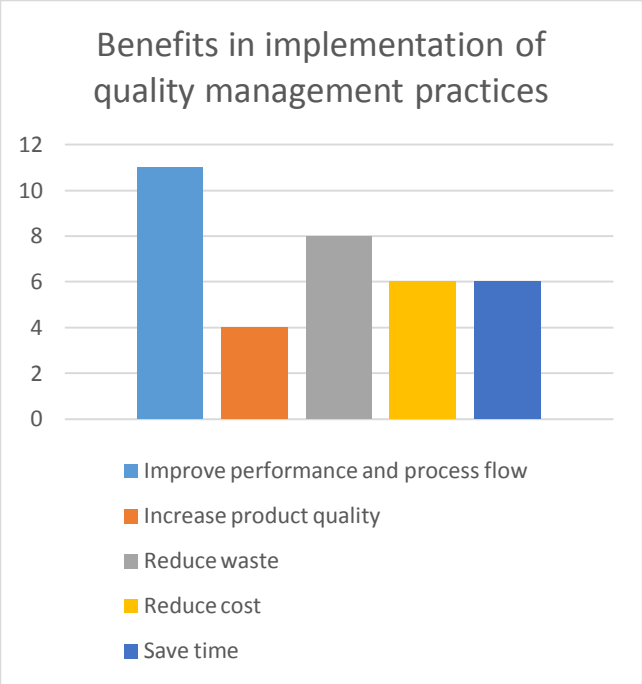


Figure 2: Benefits of implementation of quality management practices in food industry

Figure 2 shows the benefits in implementing quality management practices in food industry. Through quality management practices, the operational performance and process flow could be improved. This is followed by the reduction of waste, cost reduction, save time and increase the product quality. The results shows that the most common benefits in implementation of quality management practices is improving the performance and process flow. It is followed with the reduction of waste, cost reduction and time saving. The increasing of product quality is the least common benefits in implementation of quality management practices. The food industry practitioners may consider those benefits before implementing new quality management practices.

4. Conclusion

In conclusion, the barriers, resistance to change and benefits gains listed above can be used as a reference for the future researcher before considering to implement lean six sigma application in the food industry. The most common quality management practices in food industry is lean compared to lean six sigma. The implementation of lean six sigma should be applied by food industry in conjunction to grab the benefits and better continuous improvement practices in improving the perfomance and process flow, reduction of wastes, cost reduction, save time and increase the quality of the product. The limitation for this study is this study is only focusing on quality management practices in food industry. The future research should be done in other industries as they may show difference factors that may contributing to the implementation of lean six sigma.

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