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Review

Statistical process control readiness in the food industry: Development of a self-assessment tool

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ABSTRACT

Background: The increasing pressure from the customers, governmental regulations and fierce market competition forced food companies to pursue powerful quality improvement technique. Although Statistical Process Control is widely known for its effectiveness in process control, many food companies faced difficulties to adopt such technique, where being in the state of not ready has always been the reason. There has been a debate about the importance of deciding the state of readiness of a company to initiate their CI techniques such as SPC towards the successful implementation and sustainability of such technique.

Scope and approach: This paper emphasises the importance of SPC readiness towards its implementation in the food industry and determines its factors. The SPC readiness factors were identified based on the current literature review and complemented with a three-round Delphi study involving the SPC experts (academics, industry and consultants).

Key findings and conclusion: The SPC readiness factors identified are top management support, sense of urgency, measurement system, employees involvement and organisational culture readiness. The developed conceptual self-assessment readiness tool enables food practitioners to identify the current state of organisational readiness and facilitate the companies to plan strategic changes and preparation activities for the adoption of SPC in their businesses.

1. Introduction

Food safety and quality are of vital importance in today's food manufacturing industry and are therefore the subjects of much attention from researchers and practitioners alike. In the present competitive market, one weak link in the food manufacturing process can bring problems for manufacturers (Luning & Marcelis, 2007; Snyder-Halpern, 2001). Stakeholders, (e.g. consumers, inspectors, auditors, regulators) are increasingly demanding that food manufacturing firms minimise risks to food safety and improving the quality of food products (Kafetzopoulos & Gotzamani, 2014). As a result, there are now several internationally acknowledged systems and certifications for guaranteeing food quality and safety. These include various, Hazard Analysis Critical Control Point (HACCP), the British Retail Consortium's (BRC) principles, Safe Quality Food (SQF) certification, International Organization for Standardization (ISO) 9001 series and ISO 22000.

SPC has been implemented with great success elsewhere in the manufacturing industry (e.g. the automotive, electric and semiconductor. However, it has not been implemented widely in the food industry, which brings concerns to the food practitioners and academics (Grigg & Walls, 2007; Lim, Antony, & Albliwi, 2014; Surak, 1999). When similar concern was expressed at the failure to implement continuous improvement (CI) efforts (e.g. Lean, Six Sigma and Total Quality Management), one of the reasons was the companies were not yet ready for the implementation of the technique (Antony, 2014; Lameei, 2005; Radnor, 2011) and based on the case studies, this critically applies in the food industry. Several number of papers in the SPC literature address the importance of CSFs, which was popularised by Rockart (1979). However, the authors argue that organisational readiness be equally important, as this is a key criterion for the management team to consider when deciding to invest in SPC adoption. In this sector particularly, attempts to introduce SPC company-wide falter because of

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employees' resistance to changes from the conventional practice (Surak, 1999). Organisational readiness theory posits that a company readiness can reduce such resistance (Smith, 2005). Kotter (2008) suggests a failure to establish sufficient organisational readiness is why half of all efforts to affect organisational change are unsuccessful. It is, therefore, vital to consider whether organisations are prepared to take SPC on board through the self-assessment on the SPC readiness factors (Antony, 2014; Lagrosen, Chebl, & Tuesta, 2011; Smith, 2005).

Failure to assess organisational readiness may result in managers spending a considerable amount of time dealing resistance to change (Lee, Wong, & Yeung, 2011; Self & Schraeder, 2009). By ensuring organisational readiness before attempting the adoption of SPC, the need for later actions to cope with aforementioned resistance may be largely avoided and adoption behaviours improved (Armenakis, Harris, & Mossholder, 1993; Kotter & Schlesinger, 2008).

1.1. What outcomes result from the organisational readiness for change?

One of the most under-researched areas in the CI literature is organisational readiness. Organisational change theory posits that greater readiness increases the chance that new techniques will be implemented successfully (Antony, 2014; Armenakis et al., 1993). While, social cognitive theory suggests that when organisational readiness for change is high, employees are more likely to initiate change (e.g. institute new practices such as SPC), exert greater effort in support of change, and exhibit greater persistence in the face of obstacles or setbacks during implementation (Bandura (1993); Weiner (2009). Herscovitch and Meyer (2002) cite motivation theory to argue that when organisational readiness is high, employees will exhibit actions supporting change that exceed their job requirements or expected role. Resistance to change has been a critical challenge for the uptake of SPC in the food industry (Lim et al., 2014). Therefore, through a concerted theories explained above, organisational readiness is claimed to be significant to reduce the resistance to change (see Fig. 1).

By ensuring organisational readiness before attempting the adoption of new technology in the company, the need for subsequent actions to cope with resistance may be largely avoided (Self & Schraeder, 2009). The literature posits that the positive force goes into creating readiness for SPC adoption and, consecutively, there can be a significant improvement in adoption behaviour. This paper is a part of a four years research project on the SPC application in the food industry, which includes the status of its implementation in this industry (Lim et al., 2014), the implementation roadmap in the food industry (Lim, Antony, Garza-Reyes, & Arshed, 2015) and finally the readiness of food companies to embark SPC. This paper offers detailed answers two critical information for the food companies to embark their SPC initiatives; the status the company's SPC capability and identified the changes must be in place prior the uptake of SPC.

2. Methodology

Readiness is an understudied topic in the CI literature; nuances can be easily misinterpreted and require detailed clarification and more empirical research to be carried out (Antony, 2014; Radnor, 2011). A conventional quantitative survey would not have provided sufficient insights into real practice, while an isolated case study would have yielded exhaustive information but would have been unlikely to deliver generalisable results (Miles, Huberman, & Saldaña, 2013). Since the goal of this research is to improve understanding, a literature review was conducted where literature on SPC in Six Sigma, Lean Six Sigma and Total Quality Management was carried out. Following the exploratory nature of this study, the result of the literature was combined with the outcome in the first round Delphi study. Delphi study is used to managed, structured and analyse the comments from the experts, and it can be used to validate the result of the literature. Experts in this study refer to the individuals with knowledge and authority in the topic research area (SPC), aim to achieve a consensus on the topic (Heras Saizarbitoria, 2006); the validity of the findings derives from the interaction and combination of these expert opinions and the validation of its usage as an assessment tool through real application in the food companies (Malhotra, Steele, & Grover, 1994).

2.1. Development of an anonymous expert panel

Experts were nominated for the panel according to predetermined criteria. They had to be: (1) associated with an institution/organisation that either conducting research, delivering SPC training or applying SPC; (2) personally involved with the application of and/or research in SPC; (3) able and willing to participate in the study; and (4) authoritative on this topic. Thirty SPC experts invited to participate, 20 experts took part in the first round and the second and third round. They were drawn from a range of backgrounds (e.g. academics, consultants and food industry practitioners) from different countries (e.g. UK, USA, India, Malaysia, Netherland) to reduce the risk of sample bias. Martino (1993) recommended eleven expert members, while Okoli and Pawlowski (2004) suggested 10–18 experts are sufficient. Results are unlikely to vary significantly between panels as long as they are truly representative of the expert community (Martino, 1993).

2.2. Questionnaires to collect experts' opinions on SPC readiness in the food industry

The aim of the questionnaire was to identify SPC readiness factors by validating the results from the literature review. The purpose of each round of Delphi study was as follows.

- Round 1: SPC experts to suggest readiness factors
- Round 2: SPC experts to re-assess the collected SPC readiness factors in previous round and results from the literature review (e.g. maintain, modify or delete) and suggest the SPC readiness sub-factors
- Round 3: SPC experts to re-assess and finalized the readiness sub-factors in the previous round (e.g. maintain, modify or delete)

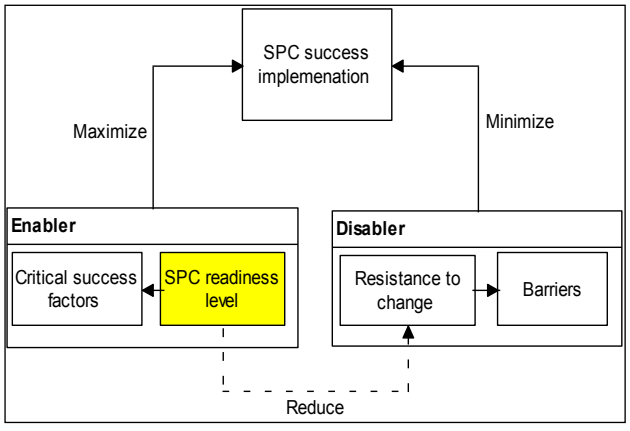

Fig. 1. Positioning SPC readiness study in the framework of SPC implementation in the food industry.