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Synergizing an ecosphere of lean for sustainable operations

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ABSTRACT

The concept of lean is important to sustain operations management. Workers are treated as important assets in lean. In this study, a 'lean-ecosphere' management system is developed for a manufacturing company by using interpretive structural modeling (ISM) and analytical network process (ANP). In the first phase of the methodology, a unified index to set a common objective of people is developed for horizontal integration. In the second phase, a hierarchical relationship model is developed to identify relationships between challenges of lean. This model facilitates the building of a strong foundation of lean to promote the depth of human integration. In the end, the results achieved are compared with the current situation of the company. The results indicated that the scientific methodology for lean management system is very beneficial for the company. This paper adds knowledge to the operations management literature by addressing the human resource factor to create a sustainable operation.

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1. Introduction

In order to deal with increased competition in the global market and the need for higher production efficiency and lower operational cost to achieve better performance and competitiveness, companies must search for innovative ways to do business. Due to advances in technologies and an increasing importance of communication and information systems, companies have been forced to focus on operations management (Cheng et al., 2010; Wisner et al., 2008). In addition, with the social and environmental issues being given close attention nowadays, operations management sustainability becomes more difficult to be managed. According to Gladwin et al. (1995), there is a "triple bottom line" underpinning sustainability: people, planet, and profit. These three elements must be satisfied at the same time to attain a better position in the market. Traditionally, organizations have been focusing on profit, but not much consideration was given to people and planet (Khor, 2012). The conflict of interest among these entities have further aggravated the decision making process of organizations, thus making operations management sustainability more difficult to manage.

Fortunately, the existence of lean has offered a way to sustain operations. In lean, a company focuses on producing high quality products in the most efficient and economical way while incorporating less human effort, less inventory, less time to develop products, and less space and yet highly responsive to customer demands. Elimination of material waste directly meets the sustainability objectives (Fliedner, 2008). By cutting down unnecessary wastes in all resources, organizations will have more reserves of these resources to be used in the future prolonging sustainability. Strengthening this argument, Mollenkopf et al. (2010) supported lean is meant for sustaining operations. There are also several real cases of organizations that have embraced lean methods in order to maintain competitiveness in the global market (Womack and Jones, 2003; Ohno, 1988). Companies such as Honda and Toyota have successfully sustained their operations through the lean approach.

Despite successful "lean" applications in many organizations, the journey to implement lean is not easy and is bound to encounter various challenges. These challenges include: uncertainty in demand, pressure from customers and top management, non-effective method, knowledge and information transfer, and training. Moreover, human integration poses a great challenge and has become the top priority for lean-adopting companies to sustain their operations (Genaidy and Karwowski, 2003; Allen and Peter, 2009). As the most important intangible capital and the key factor in organizational success, employees (humans) must be

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managed well to ensure high performance and achievement of lean objectives, which will eventually lead to a sustainable operation.

This paper aims to develop a framework to address human integration in lean for sustaining operations. Interestingly, the concept of 'ecosystem' is adopted to build this framework. According to the ecosystem concept, sustainable development will only be achieved through global optimization of resources (i.e., in this case, human is considered as a resource). Human issues need to be addressed from a holistic view that covers the 'breadth' and 'depth' of the subject matter. Thus, our framework will consist of two stages; the first stage addresses the 'breadth' perspective. Based on the argument that achieving cohesiveness among various departments in lean is extremely difficult due to the lack of a common focus, therefore, in the first stage, we will develop a unified index using the Analytic Network Process (ANP) technique to integrate humans horizontally. In the second stage, the 'depth' of human integration will be addressed. Depth of integration needs to be addressed through vertical alignment of lean implementation. Therefore, in the second stage, a set of antecedents for lean and their interrelationships will be identified using the Interpretive Structural Modeling (ISM) technique. Identification and examination of the relationships of these critical success factors would enable managers to have a deeper understanding of what makes a strong foundation for lean. These insights would further help managers to integrate humans in lean for operations management sustainability.

The rest of this paper is organized as follows. In Section 2, a literature review related to lean and operations management sustainability is discussed. The details of the development of the 'lean-ecosystem' framework are illustrated in Section 3. In Section 4, a case study is presented. Then, in Section 5, managerial implications, containing some important issues and limitations are discussed. We conclude this paper in Section 6 with suggestions for future research.

2. Literature review

This section reviews the literature on sustainable operations, the association of lean with sustainable operations, and the methods that have been used in the sustainable operations management context.

2.1. Sustainable operations

Numerous definitions have been given to the term sustainable operations. A sustainable operation is a system of aligned business activities throughout the lifecycle of products that creates value to stakeholders, ensures ongoing commercial success, and improves the well-being of people and the environment (Business for social responsibility, 2007). Carter and Rogers (2007) defined sustainable operations management as an integration of social, environmental, and economic issues in traditional operations management. Alternatively, Srivastava (1995) defined sustainable operations management as the potential for reducing long term risks in operations management associated with resource depletion, fluctuation in energy costs, product liabilities, and pollution and waste management. Sustainability must also integrate issues and flows that extend beyond the core of operations management: product design, manufacturing by-products, by-products generated during product use, product life extension, product end-of-life, and recovery processes at end-of-life (Linton et al., 2007). Another definition given by the New Zealand Business Council for sustainable operations management is the management of raw materials and services from suppliers through manufacturers and service providers to customers and vice versa, with improvements to

social, economic and environmental impacts explicitly considered (NZBCSD, 2003). In addition, NZBCSD (2003) stated that in general, operations management is considered as the interactions between a business and its customers and suppliers. Hence, the greatest benefits of sustainability are derived by extending the focus as far as possible upstream towards the source of raw materials, downstream towards the consumers and then back again as the products and wastes are recycled.

Intuitively, all definitions of sustainable operations management given by past researchers point towards the direction where operations management needs to embrace a broader adoption and development of multiple objectives for social, economic and environmental sustainability. For social sustainability, products should ensure that the needs of a population are met. For economic sustainability, the goal of operations management optimization is maximizing profits, i.e. maximizing product values with minimum raw material, inventory and production costs. For environmental sustainability, non-renewable resource consumption should be minimized, resource utilization should be efficient to minimize waste generated and permanent environmental damage should be prohibited (Zhou et al., 2000).

2.2. Lean

Lean is frequently defined as the elimination of waste or "muda". The seven principles of lean are related to the elimination of waste in the form of overproduction, waiting time, transportation, process, inventory, movement and defective products. Organizations are striving to be lean in order to remain globally competitive. Moreover, lean has been engraved in the heart of manufacturing practices as one of the corporate strategies to bring an organization to the forefront of business excellence. Various researchers have also viewed lean as a philosophy, an organization and a set of specific techniques (tools) whereby its implementation is guided through value stream mapping (VSM) (Dinesh and Vaibhav, 2005; Rother and Shook, 1998), i.e., an approach that uses structures to delineate between 'value' points and maps them based on relationships.

2.3. Association of lean with sustainability

Though lean is not initiated based on the reason of sustainability, both approaches have a lot of elements and end results in common. Flidner (2008) argued that a by-product of lean principles is green or environmental performance. For example, if a work environment is kept clean using the 5S concept (sorting, straightening, systematic cleaning, standardizing and sustaining), hazardous spills and leaks may be noticed more quickly and can subsequently be addressed more rapidly. Leaner operations typically require less floor space for operations and storage which can translate into decreased energy needs. The production of fewer defects reduces energy and resource needs. Hence, lean initiatives have the ability to promote substantial environmental benefits.

In a similar vein, sustainability addresses how processes and operations last longer and have less impact on ecological systems, and particularly relates to concerns on major global problems such as climate change and resource depletion. Sustainable processes reduce ecological impacts and may eliminate wasteful depletion of scarce resources. Without waste reduction and elimination, processes and operations are less likely to be sustainable as resources are increasingly scarce. Based on the above arguments, we can say that lean is associated with sustainability and therefore, lean is important for sustainable operations. This view is also supported by Mollenkopf et al. (2010), who had emphasized the link of lean

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