Volume: 3 Issues: 7 [March, 2018] pp.45-54]
Journal of Information System and Technology Management
eISSN: 0128-1666
Journal website: www.jistm.com

THE MEDIATING ROLE OF MANUFACTURING PERFORMANCE ON THE RELATIONSHIP BETWEEN LMP AND SUSTAINABILITY

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Accepted date: 2 December 2018 **Published date:** 10 April 2018

To cite this document:

Hasan, M. Z., Asaad, M. N. M., & Iteng, R. (2018). The Mediating Role of Manufacturing Performance on the Relationship between Lmp and Sustainability. *Journal of Information System and Technology Management*, 3(7), 45-54.

Abstract: *The achievements in manufacturing performance is able to enhance a firm's manufacturing competitive capabilities and sustainability. In fact, sustainability has turned out to be the most vital strategic of the new millennium in the manufacturing organizations. Sustainability is not just to sustain present operational levels and break through the new markets, however it is very wide-ranging. Inversely, it will go advance than that by getting growth so that a company remains in business thriving into the future and keep on sustain the competitive advantages of business. Previous literature stated that the process through which organizations go to embrace sustainability so that can increase the development of the business. Lean manufacturing practices (LMP) can lead to competitive advantage by boosted the productivity and quality and as well as reducing the cost. LMP also considered as a manufacturing philosophy that engaged to global manufacturing excellence by adopting in the organizations. However, numerous studies found that some challenging relating the orientation of lean manufacturing operations system with sustainability goals and practices. For now, abundant of researchers found that manufacturing performance can arouse sustainability in the long term. Therefore, manufacturing performance (MP) is proposed as potential mediator on LMP and sustainability in the present study.*

Keywords: *Lean Manufacturing Practices (LMP), Manufacturing Performance, Sustainability*

Introduction

Manufacturing performance is explained in terms of various dimensions such as manufacturing plant's, labor efficiency, machine efficiency, conformance quality, manufacturing plant

productivity , schedule attainment, on time delivery, inventory management , production volume flexibility and manufacturing cost efficiency (Wickramasinghe & Wickramasinghe, 2017). Overall, the achievements in manufacturing performance enhance a firm's manufacturing competitive capabilities and sustainability (Jabbour, Junior, & Jabbour, 2014; Wickramasinghe & Wickramasinghe, 2017). Consequently, the role of Manufacturing Performance as potential mediator on the relationship between Lean Manufacturing Practices (LMP) and sustainability has been explored in manufacturing organizations in Malaysia.

Sustainability is gradually become a crucial component of most company strategies in the organizations. However, the invention and employment of operations strategies that embrace sustainability still ambiguous and become remain open issues (Hasan, Mohd Assad, & Iteng, 2017). Thus, the manufacturers need to take proactive steps by incorporating sustainability concepts into their company's strategy and actions (Abdul-Rashid, Sakundarini, Raja Ghazilla, & Thurasamy, 2017). According to Stoughton & Ludema (2012), based on previous literature on the process through which organizations go to embrace sustainability so that can raise the growth of the business. In fact, sustainability is becoming an important element and a key business imperative in an organization (Longoni, Golini, & Cagliano, 2014). For instance, King & Lenox (2001); Hasle, Bojesen, Jensen, & Bramming (2012) indicated that it was obviously can see that the challenging relating the orientation of a traditional lean manufacturing operations system with environmental and social sustainability goals and practices in the current manufacturing organizations. Most of the past studies are concentrating on some of the aspects of sustainability and fewer studies present a simultaneous approach which takes into account the economic, environmental and social aspects of sustainability (Abdul-Rashid et al., 2017).

The connection between lean manufacturing and environmental and social sustainability is currently under discussion and both interactions and trade-offs between these factors have been suggested (King & Lenox, 2001; Hasle et al., 2012; Longoni, Pagell, Johnston, & Veltri, 2013). On the other hand Ferro, Padin, Svensson, Carlos, Varela, Wagner and Hogevold (2017) stated that the impact of companies activities on the physical environment, society and economy is inarguable and most of the companies are being driven by the profit objective rather than concern about sustainability holistically (three pillar model). Meanwhile, according to Bulgacov et al., (2015), stakeholder theory highlighted that the common of stakeholders (clients, suppliers, governments, employees, etc.) are drive for sustainability. Therefore, this study will employ the role of Manufacturing Performance as potential mediator on the relationship between Lean Manufacturing Practices (LMP) and sustainability as suggested by Nawanir, Teong, & Othman (2013) and Fullerton & Wempe (2009). Referring to Narkhede (2017), by reducing manufacturing outputs such as the cost, quality, delivery time and delivery time reliability, flexibility and innovativeness, it can increase the capabilities of manufacturing performance. For that reason, the recommending Manufacturing Performance as mediator variable would have significant consequences on sustainability.

Literature Review .

Sustainability has been the focus of deep discussions due to the important role of the manufacturing activities in value creation in national economies and their environmental and social impacts (Lucato, Santos, Paulo, & Pacchini, 2017). The most accepted definitions of sustainability offer accessible dimensions, such as the triple bottom line, the applicable domains of human activity are subject to interpretation. As a result, professions differ in their

conceptualization and application of sustainability depending on how they approach the question of what is sustained (Hasan et al., 2017). Previous literatures define sustainability as enduring or long-term objective that should be strategic in nature (Ferro et al., 2017). Meanwhile Barron & Chou (2017) viewed sustainability as a triple bottom line which will be measured by three pillars model which is economic, social and environment. These dimensions gained popularity from the triple bottom line concept by Elkington (1997), also known as the three pillars (profit, planet and people). From the social perspective, meeting the needs of human remains the fundamental objective of sustainability. Economically, it indicates the requirement for economic growth where basic needs are not met. But from the environmental perspective, sustainability indicates that natural systems and quality of life should not be endangered at the expense of development.

Furthermore, the theoretical standard of business sustainability should reflect a level of business sustainability that requires ongoing improvement. This level entails practices that meet our needs, but also ensure that future generations are able to meet their needs (Eriksson & Svensson, 2016). Notwithstanding the often exaggerated and even abusive usage in marketing jargon, sustainability in fact belongs to the original cultural heritage of mankind. Its underlying strategy and principles to balance economic, environmental and social interests have been established on every continent in the world (Graubner, Pelzeter, & Pohl, 2016)

LMP and Sustainability

Lean manufacturing practices is refer to an incorporated system that includes pertaining fundamentals and varied organization practices whereby it goals to upsurge productivity, diminish lead time and cost and as well as increase quality (Abdelhadi, 2016). Historically, Krafcik (1988) has invented the term of lean in order to portray a production system that uses fewer resources of the whole thing compared to mass production. Krafcik is a chief researcher in the International Motor Vehicle Program (IMVP) executed at the Massachusetts Institute of Technology (MIT). However, many researchers define lean contrarily but with the same meaning (Hasan et al., 2017). Subsequently, Bhamu & Sangwan (2014) has reviewed on the lean studies and summarized the term that had been used to define lean. The result from the review shows that lean had been define as a way; a process; a set of principles; a set of tools and techniques; an approach; a concept; a philosophy; a practice; a system; a program; a manufacturing paradigm; a model. Nevertheless, even though there are many definition of lean but there were one aim which is to eliminate waste (Shah & Ward, 2007). In fact, the frequent cited list of lean principles found in the literature was suggested by Womack & Jones (1996). However, Liker (2004) extended the principles that created by Womack and Jones (1996) by highlight on the 'matters of people' in his principles.

Lean is a counter-intuitive alternative to traditional mass production, which is suitable for standard products and high volume production. It entails an integrated system involving many tools and techniques with a focus on waste elimination and adding value. The implementation of lean may bring companies many potential benefits, such as lot size reduction, lower inventories, improved quality, reduced rework, increased productivity and flexibility, reduced space requirements, lower overheads, decreased manufacturing costs, reduced lead-times, and so on (Zhang, Narkhede, & Chaple P., 2017). This study had been combined several lean manufacturing practices in order to investigate the relationship between sustainability such as TQM, TPM and small lot production.

Total Quality Management

According to Zahraee (2016), total quality management (TQM) is a method of non-stop development using participative management to address the core requests of consumers based on the supposition that incompetency is not formed by people but rather, by systems. In fact, the key elements are used for participation and preparation, problem solving, arithmetical methods, long-term aims and detection.

Total Productive Maintenance

Shah & Ward (2003) defined TPM as by using maintenance techniques, utilize of equipment effectiveness through scheduled and preventive maintenance that should be focuses to. TPM is enables waste reduction by reducing the chances of idle down time during operation because it is one of the lean manufacturing pillars. Furthermore, TPM is a system of maintenance that administers the whole life of the equipment in every section such as planning, manufacturing, maintenance, and others in order to increase the overall performance of this equipment.

Small Lot of Production

The key to Ford's mass production system ia making large lots of single part that is punching out a large quantity of parts without a die change. (Taiichi Ohno, 1988). Furthermore, batches are made as small as possible in contrast to traditional mass production, where bigger is considered better in production levelling. According to Chen & Tan (2011), small lot size is typical practice in JIT system. Reduce lot size enables JIT systems to operate effectively so that it benefits from less work-in-process (WIP) inventories, less space required and increased flexibility

Meanwhile, Ho (2010) mentioned that LMP is the most important practice in an organization which is important driving force for conserving the environment and sustainability. In fact, lean practices also play the role in order to sustain the environmental performance (King & Lenox, 2001; Shah & Ward, 2003). For the meantime, lean manufacturing can also have an impact on environmental and social sustainability practices (Longoni & Cagliano, 2015). Yet, sustainability is about not only concerning about to sustain current operational levels and penetrating new markets in order to replace lost ones, likewise attempt to achieving development so that organization can be well growth. Henceforward, the organization must be able to support the manufacturing operations by LMP implementation in order to achieve sustainability in the organization. Therefore, the present study hypothesizes that:

H_1: LMP is significantly influence Sustainability.

The Role of Manufacturing Performance as a Potential Mediator on the Relationship beween LMP and Sustainability

Manufacturing performance is refer to the strength of firm is ascertained based on the capability or output provided such as cost, quality, delivery time and delivery time reliability, performance, flexibility and innovativeness to satisfy customer (Narkhede, 2017). Meanwhile according to Hon (2005) Manufacturing performances are commonly used to observe and manage operational efficiency, reflect the current state of manufacturing conditions, lead to upgrading programs and engage to the effectiveness of manufacturing decisions. Therefore,

this study is use quality, flexibility, time, delivery and cost reduction in order to measure manufacturing performance. Manufacturing performance usually discussed in multi facet base on particular research. Operational performance and manufacturing performance using the same metrics in order to monitor and measure the performance and efficiency in the particular organization (Tan & Wong, 2015; Hon, 2005). Furthermore, Voss, Ahlstrom, & Blackmon (1997) also using the term manufacturing performance in order to describe about operational performance. In addition, according to Narkhede (2017), the capabilities of manufacturing performance can be improved by reducing manufacturing outputs such as the cost, quality, delivery time and delivery time reliability, flexibility and innovativeness. Based on these studies, the KPIs most frequently mentioned in literature and used in manufacturing performance measures were identified, namely time and cost.

Time

The aspect of time in this is refers to average batch processing time, average lead time, changeover time, cycle time, machine downtime, mean flow time, on-time delivery, setup time, takt time, throughput time in the production process (Hon, 2005). The cycle time, also called manufacturing lead-time, flow time (FT), sojourn time, delay time, throughput time, turnaround time (TAT). The cycle time is the time taken to produce the final product. It embraces value-added and non-value-added activities. In the ideal situation, the cycle time is equal to the Takt time which is includes time spent processing, as well as transport time and time spent waiting in queue for both processing and transportation (Abdelhadi, 2016).

Cost

Cost is about the required payment to produce product. A success in worldwide marketplaces entails products of high quality at low cost, and a first class customer services (Abdel-maksoud, Dugdale, & Luther, 2005). The cost pertaining the workers' productivity, production and reduction in inventory are used in measuring the manufacturing performance in the manufacturing industry. The lesser the labor cost used to produce an output, the greater the workers' productivity.

According to variable Xu, Cavusgil, & White (2006), it is common to adopt third variable such as moderator perspective or mediator perspective when hypothesizing the effect of one variable on another variable is contingent on a third variable. There is positive relationship between lean practices, operational performance and business performance in study conducted by Nawanir, Teong, & Othman (2013) in the manufacturing organization. Likewise, it indicated that operational performance or manufacturing performance was partially mediated the relationship between lean practices and business performance. On the other hand, study lead by Fullerton & Wempe (2009) initiated that utilization of manufacturing performance measures mediates the relationship between lean manufacturing and financial performance. Besides, the mediation finding may give a clear view on the consistent result of prior studies that examine the associations between financial performance and lean practices. Consequently, on the part of manufacturing executives, tends to strengthen the relationships between the selected model of business, targeted competitive strategy and the manufacturing performance need to sustain the competitive market (Gomes, Yasin, & Lisboa, 2011). Henceforward, it shows that manufacturing performance plays the important role as a mediating effect. Likewise, according to Leachman, Pegels, & Shin (2005), the greater manufacturing performance leads to the higher competitive advantage. For that reason, in order

to sustain manufacturing strength, the particular companies need to understand the critical manufacturing practices. The present study hypothesizes that:

H_2: LMP positively relates to the Manufacturing Performance

H_3: Relationship between LMP and Sustainability mediates by Manufacturing Performance.

Underpinning Theory

The word "from Friedman to Freeman" is frequently used to show the shift in the discussion on the role of business in society. This word normally refers to the challenge of the broadly acknowledged and applied "shareholder model" or "profit-centred model" of corporate governance. This model operates on the premise that businesses are ultimately if not uniquely accountable to their owners. The proponents of a "stakeholder model" is explain that businesses are accountable to everyone who has a stake in their activity (Kakabadse & Rozuel, 2006). The roots of stakeholder theory attract on four main academic fields for example sociology, economics, politics and ethics. Stakeholder theory draw the literature on corporate planning, systems theory, corporate social responsibility and organizational theory (Wagner et al., 2011). The book entitled Strategic Management: a Stakeholder Approach by Freeman (1984) commonly recognized as launching the stakeholder theory concepts it also describes how stakeholders with alike interests or rights form a group. He was seeking to describe the association between the company and its external environment and its behavior within this environment. The author set out his model as if a chart in which the company is located at the center and is involved with stakeholders associated with the company. The conception of stakeholder management was developed so that organizations could identify, evaluate and examine the characteristics of individuals or groups influencing or being influenced by organizational behavior (Wagner et al., 2011). The main query related to this study is the connection between organization and stakeholder interests, especially regarding sustainability, and in what way this connection affects the way company conducts business. For the common of stakeholders (clients, suppliers, governments, employees, etc.), the drive for sustainability continues to be tough to reconcile with their interests, and this places a burden on the company to reconcile them all (Bulgacov et al., 2015). Hence, based on the literature from the previous studies, the stakeholder theory is suitable to use in this study and will be used to explain the research theoretical framework.

Proposed Framework

The research framework will be framed to examine the role of Manufacturing Performance as a mediating effect on the relationship between LMP and sustainability that to be tested in Manufacturing Organization in Malaysia. Stakeholder theory highlighted that the common of stakeholders (clients, suppliers, governments, employees, etc.) are drive for sustainability (Bulgacov et al., 2015). Based on the above stated justification the researcher intended to employ LMP as Independent variables and Sustainability as Dependant Variable whereas the MP as the mediating variable as depicted in Figure 1.

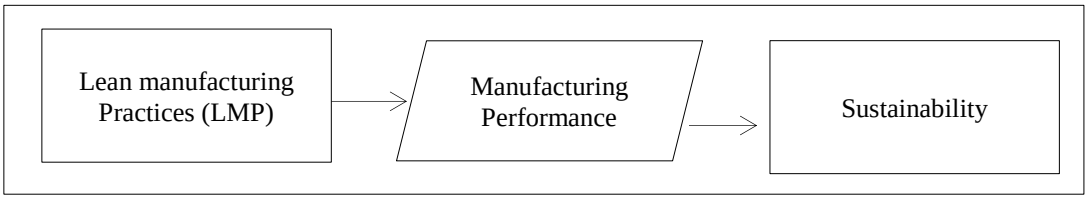

Figure 1: Proposed Framework

Proposed Methodology

The identification of the population is the starting point of sampling process. According to Sekaran (2003), a group of people or organization who are interest to the researcher is known as population. The manufacturing organizations in Malaysia will be the target population of this study. The target sample frame was selected from the sources of Malaysia Federation of Manufacturing in Malaysia (FMM2017). The population size for this study is 2475. Therefore, the sample size required is 331 based on the table produced by Krejcie & Morgan (1970) extracted from Sekaran (2003). Thus, 331 respondents are randomly selected from the list to take part in this study. The present paper intends to use quantitative method which is a primary data will be collected using questionnaire. Therefore, the collected data from the surveyed questionnaires will be analyzed and the hypotheses were tested through statistical software such as SPSS and and structural equation modeling (SEM). Analysis of data will be lead through different stages. First, initial analysis is vital to be conducted at early stage which is data screening and cleaning in order to check any abnormalities. Correspondingly, it will be used to indicate any missing or out layer data. Then, descriptive analysis will be conducted for the determination of the demographical features of the sample of the study such as percentage of firms involved etc. Second, the variables will be measured and the proposed research hypotheses will be tested using factor analysis and structural equation modeling (SEM).

Conclusion

This paper has proposed Manufacturing performance as the role of mediating effect on the relationship between LMP and sustainability as depicted in Figure 1. Finding will provide useful and important input to the Manufacturing organizations, academics and practitioner into the significant direct effect of LMP on sustainability and also the direct effect of Manufacturing Performance on the relationship between LMP and Sustainability in Malaysia.

A review of lean manufacturing practices is reflected to the sustainability. In this study, it is not only focus on lean manufacturing implementation in the organization but it is also prove that the impact of lean manufacturing practices implementation in organization towards sustainability especially in economic, environment and social. Therefore, this research is useful both theoretically and practically. First contribution of theory is examining the mediating effect of manufacturing performance. Second contribution of theory is focusing on lean manufacturing practices and sustainability. This study will investigate each dimensions in lean manufacturing practices have influence on sustainability. This study also may help practitioners, engineers and top management in the manufacturing organizations as it examines the relationship between Lean manufacturing practices and sustainability. In addition, lean manufacturing practices are able to help the organizations to measure the sustainability in a various point of views especially in terms of economic, environmental and social. Subsequently, the top management in the manufacturing organization can plan a strategy in order to improve and enhance productivity so that it reflects in the increase of the company performance.

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