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Boosting Lean Production via TPM

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Abstract

This paper aims to have a brief study on the literature related to the application of TPM in the manufacturing industry. The study focuses on the main role of TPM in supporting the established quality improvement initiative such as lean production. Effort was made to discuss the published research related to TPM and lean production. This literature review-based research revealed an important research gap, i.e. the need of a comprehensive integration between these two methodologies. The significance role of TPM as an important complementary to lean production is observed has not been well addressed in the available literature. Most of the researches available investigate these initiatives separately, rather than addressing on the significant role of TPM as one of the main thrust. The beneficial outcome from TPM methodology is quite hindered and unexposed in some literatures related to lean production. The outcomes from this review is hope justify the needs of further research in the area of TPM integration with lean production, aimed at strengthening its philosophy towards more realistic applications.

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1. Introduction

The process of maintaining the machines and processes to ensure its efficiency, availability and reliability, nowadays becomes increasing importance for organizations, as its directly impact on the quality, cost and delivery of the products or services (Ahuja and Khamba, 2008 ; Ahmed *et al.*, 2004; Blanchard,1997). Products have three properties in the eyes of a customer, which is (Q) Quality, (C) Costs and (D) delivery lead time. With the growing dependence of technologies for most business operation, it is vital to develop an appropriate maintainability and reliability strategies to ensure that these organizations are able to deliver high quality and dependable services to their customer (Madu, 2000). Total Productive Maintenance (TPM) methodology is a proven and successful procedure for introducing maintenance considerations into organizational activities (Graisa and Al-Habaibeh,2010; Ahuja and Khamba, 2008 ; Ahmed *et al.*, 2004; Blanchard,1997 ; Hartman, 1992).It involves operational and maintenance staff working together as a team to reduce wastage, minimize downtime and improve end-product quality (Eti *et al.*, 2004).

This paper aims to briefly study the literature related to the application of TPM in the manufacturing industry. The main focus is on the role of TPM in the established quality improvement initiative such as lean production. Effort was made to critically discuss the published research related to TPM, and lean production.

2. Literature review

2.1 Total Productive Maintenance (TPM)

Nakajima (1988), had given the original approach of TPM, defined it as the productive maintenance carried out by all employees through small group activities and can be viewed as equipment maintenance performed on a company-wide basis. A broad definition of TPM methodology available in the literatures (Konecny *et al.*, 2011; Graisa and Al-Habaibeh, 2010 ; Ahuja and Khamba, 2008 ; Ahmed *et al.*, 2004 ; Eti *et al.*, 2004; Chua *et al.*, 2001 ; Ireland and Dale, 2001 ; McKone *et al.*, 1999 ; Bamber *et al.*, 1999 ; Blanchard, 1997 ; Jostes and Helms, 1994 ; Willmott, 1994 ; Hartmann, 1992 ; Nakajima, 1988) . The ultimate goals of TPM is zero breakdowns, zero defects, zero accidents and zero waste (Nakajima, 1988; Ahuja 2008; Hartmann,1992). As a consequence from the elimination of breakdowns and defects, the equipment operation rates improve, costs are reduced, inventory can be minimized and labor productivity increases (Nakajima, 1988). TPM brings maintenance into focus as a necessary and vitally important part of the business. TPM seeks engagement from intra and inter-department in an organization to maximize the overall effectiveness of production equipment. It involves production and maintenance staff working together as a team to reduce wastage, minimize downtime toward improving the end-product quality (Eti *et al.*,2004).

2.2 Lean production

The lean production philosophy aims at reducing the operating costs through the elimination of waste .Waste is everything that does not add value to the product or services (Womack and Jones,1996 ; Monden,1983) and by eliminating the waste, ultimately its will enhance value to the production systems to produce a good quality products aimed at customers satisfaction (Moayed and Shell,2009 ; Sanchez

and Perez,2001).Lean production initially developed by Toyota that focus on the elimination of waste in all forms, including defects requiring rework, unnecessary processing steps, unnecessary movement of materials or people, waiting time, excess inventory, and overproduction (Evans and Lindsay, 2005 ; Womack, *et al.*, 1990 ; Monden, 1983 ;). It has a widespread application cover all aspects of the manufacturing functions from product development, procurement and manufacturing over to distribution (Womack, *et al.*, 1990). The concept of lean production has become dominant in most organization (Karlsson and Ahlstrom, 1996) and many organizations are adopting it in order to keep their competitive edge in both domestic and international market.

Lean production can be also considered as an extended JIT that includes participation of all parties involved in supply chain, intra and inter-organization (Enkawa and Schvaneveldt, 2001). The JIT primary goal is to continuously reduce and ultimately eliminate all forms of waste (Ahmed *et al.*, 2004 ; Cua *et al.*, 2001) It is a philosophy focuses on concept of doing, maintaining and producing what is value adding or what is just needed, be it raw materials, components, parts, WIP, employees, or finished products (Ahmed *et al.*, 2004 ; Cua *et al.*, 2001 ; Wilmott , 1994). With this philosophy, it is possible to produce a variety of products with a minimum of inventory and the lowest level of quality defects. In this paper, the JIT is been considered as the subset of lean production (Enkawa and Schvaneveldt, 2001; Sanchez and Perez,2001)

3. Methodology

This paper reviews the literature related to TPM and lean production. The review surveyed a range of journals related to TPM and lean production, from 1995 up to 2012. The main databases used were Scopus and Emerald, while the main keywords used were “TPM methodology”, “TPM integration”, “TPM implementation”, ‘Lean production’, “Lean methodology” and “ Just-in’time”. Related papers were also found by studying the list of reference in the literature reviewed. A total of 44 papers were studied, in which 25 papers were specifically related to TPM. The review process starts by studying the TPM papers and identifying the TPM operational strategy. Next step was on the cross checking with papers related to lean production in order to identify how the TPM methodology been addressed.

4. The role of TPM in lean production

In the competitive edge today's, the element of Q (quality), C (cost) and (D) delivery is becoming a vital business strategy leading to success and growth in most organizations (Madu, 2000; Ollila, 1999 ;Ben-Daya and Duffua, 1995 ; Jostes and Helms, 1994). Lean production leads to many operational benefits to support the Q, C, D element in organization by focusing on wastes elimination such as (1) waste of rework, (2) waste of overproduction, (3) waste of wait time (4) waste in delivery (production lead time), (5) waste in processing, (6) waste of inventory and (7) waste of motion (Enkawa and Schvaneveldt, 2001; Karlsson and Ahlstrom, 1996).

The wastes generated in production have a strong relationship with the availability of production equipment. The malfunction and breakdown of equipment would results in poor quality products and as a consequence delay deliveries (Sanchez and Perez,2001; Bamber *et al.*, 1999; Blanchard, 1997; Al-Najjar,1996). Thus, a systematic and strategic maintenance management, such as TPM, in maintaining the production's equipment is really significance to support the successful of lean production. Conversely, a review on the available literatures observed that the role of TPM in lean production is quite hindered and unexposed. A typical example of applying TPM methodology to support the lean production is on

poorly maintained machines or equipment. Through a strategic maintenance management, the defects and variations could be eliminated at their source (Ahmed *et al.*, 2004; Madu, 2000; Cua *et al.*, 2001; Finlow-Bates *et al.*, 2000 ; Ben-Daya and Duffua, 1995)

TPM philosophy focuses on the optimization of equipment and process productivity while lean production covers a bigger perspective, addresses on the elimination of waste (labor, time, cost, inventory, etc.) while establishing customer-driven (Thomas *et al.*, 2008 ; McKone *et al.*, 1999). TPM methodology has been recognized as proven procedure for maintaining plant and equipment to its optimum level of operational effectiveness (Ahuja and Khamba, 2008; Ireland and Dale, 2001; Bamber *et al.*, 1999) . It has a high significant impact in improving the operational cost, high levels of quality and reliable delivery performance (Ahmed *et al.*, 2004 ; Cua *et al.*, 2001; Ben-Daya and Duffua, 1995).

Many companies pursue either TPM or lean production to improve their business strategy. However, it is observed that most of the implementation of these initiatives been done separately .The separate implementation will require large scale of resources as well the associated problems of running contending project in the company (Salah *et al.*, 2010). The integration of TPM with lean production will form a comprehensive and consistent set of manufacturing practices directed towards improved performance. Without having a TPM as complementary, the lean production initiative cannot be accomplished (Ahmed *et al.*, 2004 ; Cua *et al.*, 2001) .Managing the plant will also be more effective if those initiatives been integrated into one set of manufacturing practice (Madu, 2000 ; Al-Najjar, 1996 ; Ben-Daya and Duffua, 1995). Either TPM or Lean manufacturing initiative has their own strength and has a significant impact to support others (Pham *et al.*, 2008). There is a need for a further research to comprehensively integrate these two initiatives.

The significance role of TPM element as an important complementary to support the success of lean production was not been comprehensively defined in quite a number of researches related to lean production (see Hedelind and Jackson , 2011 ;Hofer *et al.*, 2011; Singh *et al.*, 2010; Pham *et al.*, 2008; Koh *et al.*, 2004; Cooney, 2002 ; Spithoven, 2001; Sanchez and Perez, 2001). The quite extensive literature examines the role of TPM in lean production was done by Moayed and Shell (2009). Based on the comparative study between the non-lean versus the lean companies, they highlighted that the maintenance function, particularly TPM has a vital role in converting the non-lean to lean companies. Thus, it is one of the key approaches in leading success to lean production implementation. Other literatures relate the TPM contribution to lean production, at moderate level, satisfy to highlight the significance of TPM (Taj and Morosan ,2011; Ahmed *et al.*, 2004 ; Cua *et al.*, 2001 ; McKone *et al.*, 1999).

5. Conclusion

The available literature investigates the relation of TPM and lean production quite in a broad scope. To the author's knowledge, there is a lack of comprehensive research available to integrate the TPM element into lean production. A comprehensive integration is suggested to be further studied between these two methodologies, rather than just focus on the certain methodology only as per current trend. Based on the highlight from this short review, the authors seek for further clarification on the gaps identified as an opportunity for future research.

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