

TOTAL PRODUCTIVE MAINTENANCE: ISSUES AND DIRECTION FOR FUTURE RESEARCH

Adnan Hj. Bakri^{1,a}, Widya Kartini Mohd. Razali^{1,b}, Mohd. Zul-Waqar Mohd. Tohid^{1,c}, Shaiful Anwar Ismail^{1,d}

¹Universiti Kuala Lumpur, Malaysian Institute of Industrial Technology, Masai, Johor Darul Takzim.
^aadnanb@unikl.edu.my, ^bwidyakartini@unikl.edu.my, ^cmzulwaqar@unikl.edu.my, ^dsanwar@unikl.edu.my

ABSTRACT: This paper aims to review the recurrent of research design employed to investigate the various issues in TPM implementation. Concurrently, it is also aimed to analyze the contribution from Malaysian –based researchers towards increasing the literature of TPM. Attempt was made to discuss the available literature related to TPM published from year 1992 until 2012. The outcomes from this review would serve as useful guideline for future research in TPM particularly for Malaysian researcher.

Keywords: Total productive maintenance; case study, automotive industry,

1. INTRODUCTION

The nascent growth in the manufacturing industry has boosted the utilization of automation and mechanization of equipment. As an impact, the control on the production processes is becoming more complex either for equipment or human. Towards competitiveness in the globalization economy, the manufacturing industry must be supported by effective and efficient quality control system and maintenance (Bamber *et al.*,1999 ; Ahmed *et al.*,2004 ; Graisa and Al-Habaibeh,2011). A superb quality system must be supported by well maintained or reliable manufacturing equipment (Madu, 2000; Kutucuoglu *et al.*, 2001 ; Lazim and Ramayah,2010). The process of maintaining the equipment and processes for its efficiency and reliability, becomes the main priority for the organization, as it has direct impact on quality, cost and delivery of the services or product produced. Reliable equipment and processes are parts of the key business success in any organization (Jostes and Helms,1994 ; Kutucuoglu *et al.*, 2001).

The manufacturing industries in the Western countries adopted the total productive maintenance (TPM) alongside with other techniques such as total quality management (TQM), just in time (JIT) and lean production as part of their strategy for the world class performance. The careful adoption of TPM methodology in those industries has proven to make significant contribution to company profitability through increased production efficiency, improved product quality, lowering operating cost, timely delivery to customers, ensured safety of the workplace and improved morale of the employees (Cigolini and Turco,1997 ; Bamber *et al.*,1999 ; Labib,1999 ;Konecny and Thun,2011).

Such impressive highlights in the west have motivated the authors to further investigate the phenomenon of TPM implementation within the domestic manufacturing industry. Subsequently, the following questions aroused: What is the common design used in TPM research? How is the contributions from Malaysian –based research towards increasing the literature in TPM? This paper aims to review the common research design employed in order to investigate the various issues in TPM implementation. Concurrently, it is also aimed to analyse the contribution from Malaysian–based researchers towards increasing the literature of TPM.

2. LITERATURE REVIEW

2.1 Total Productive Maintenance

Total Productive Maintenance (TPM) is an innovative approach employs to maximize equipment effectiveness by establishing a comprehensive productive-maintenance system covering the entire life-span of the equipment (Nakajima, 1988). TPM brings maintenance as a vital part of the business. It involves a synergistic relationship among all of operational hierarchy in the organization towards maximizing the effectiveness of the equipment and processes (Jostes and Helms,1994 ; Eti *et al.*, 2004). A more comprehensive definitions could be referred to paper wrote by Bamber *et al.* (1999) and Ahuja and Khamba (2008).

The ultimate goals of TPM are zero breakdowns, zero defects, zero accidents and zero waste (Nakajima, 1988). In a more wider scope, it strives to maximize the manufacturing priorities namely productivity (P), quality of products (Q), competitive operational and products cost (C), timely delivery to customers (D), safety of operations (S) and improve employee morale (M) The basic practices of TPM are called the pillars of TPM, specifically : autonomous maintenance ; focused improvement; quality maintenance ; planned maintenance; development management; education and training; office TPM, and safety, health and environment (Nakajima,1988 ; Cooke,2000 ; Hansson and Backlund,2003 ; Bamber *et al.*,2004 ; Ahmed *et al.*,2005 ; Ahuja and Khamba,2008).

3. RESEARCH METHODOLOGY

This paper briefly reviews a range of literature related to TPM published from 1994 to 2012. The main databases used were Scopus and Emerald, while the main keywords used were “TPM implementation”, “TPM issues”, and “research design in TPM”. Some related papers were also obtained by studying the references listed in the literature. A total of 75 papers were studied. The review process starts by studying and identifying the common research design in TPM. Concurrently, the Malaysian –based

researches were noted. The graph and table were used as part of tools for review process.

4. REVIEW RESULTS AND DISCUSSION

4.1 Research Design TPM

The issues discussed in TPM literature are varied and diverse, generally evolves on various activities related to TPM development, implementation, evaluation critical success factors, integration of TPM with other quality initiatives and continuous improvement activities (Yamashina,1995 ; Ben-Daya and Duffuaa,1995 ;Blanchard,1997 ; Ollila and Malmipuro,1999; McKone *et al.*,1999 ; Tsang and Chan,2000 ; Ireland and Dale, 2001 ; Ferrari *et al.*,2002 ; Sun *et al.*,2003 ; Konecny and Thun,2011; Graisa and Al-Habaibeh, 2011) The summary of the research method applied by previous researchers were tabulated in the Appendix.

An extent review on the literature revealed that case study is the most widely used research methodology to investigate the various issues in TPM implementation. A case study research represents a portion of 56.3 percent from overall research activities in TPM. A review paper activity, in which classified as historical research and survey research represent a portion of 23.9 percent and 19.7 percent respectively. Figure 1 shows the breakdown of research method applied by previous researchers and Figure 2 shows the focused industry in the previous case study. This figure exposes that the automotive industry is the most popular industry focuses in the case study.

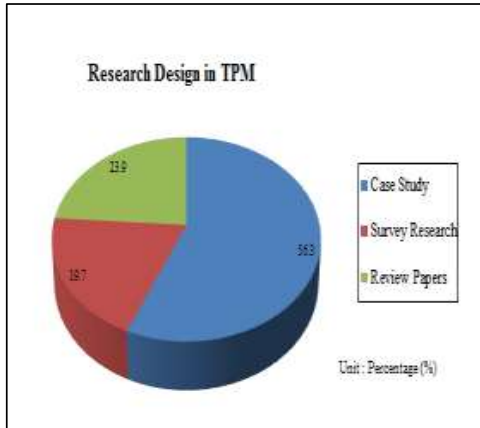


Figure 1: Research design employs in TPM

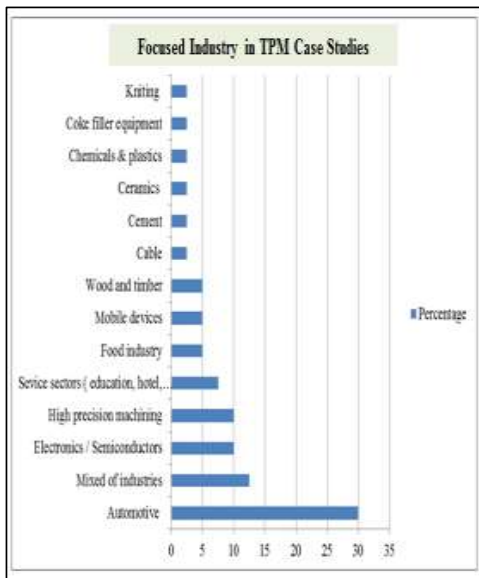


Figure 2: Focused industry in TPM case studies.

4.2 Contribution from Malaysian-based Researchers

A review of literatures revealed that there was little research done to address the TPM implementation issue in Malaysia. The TPM research in Malaysia is still in its infancy and relatively unsaturated (Chong *et al.*, 2012). The first publication on TPM issued by the Malaysian-based researcher was started in year 2002 (Ramayah *et al.*, 2002). Since then, numerous of Malaysian researchers have engaged in studying the TPM .The available TPM research in Malaysia are mostly using survey and quite broad in addressing the issue of TPM implementation (Ramayah *et al.*, 2002 ; Ahmed *et al.*, 2004; Seng *et al.*, 2006; Batumalay and Santhapparaj, 2009 ; Lazim and Ramayah, 2010).

The survey study was aimed at obtaining the baseline data for the status of TPM implementation as well as obtaining empirical evidence for the effect of independent variables towards success of TPM implementation. The common independent variables identified were the role of management, the role of training and education, the effect of employee participation, team work management, formation of autonomous maintenance (AM) and structured planned maintenance (Ramayah *et al.*, 2002 ; Seng *et al.*, 2006 ; Lazim and Ramayah, 2010). The empirical evidences provided by the previous studies are useful as a starting point for further exploration in TPM research. Each of the independent variables identified could be further investigated by applying a case study method for an in-depth information (Yin, 2009). Only a few Malaysian researchers employ the case study method in their research (Ahmed *et al.*, 2005 ; Lazim *et al.*, 2008 and Chong *et al.*, 2012).

Authors	Research focus	Method of study	Focused Industry
Ramayah <i>et al.</i> , 2002	Investigation on the impact of company-wide factors on the extent of TPM implementation	Survey study to 200 companies	General
Ahmed <i>et al.</i> , 2004	Study on the status of TPM Implementation	Survey to 65 SMEs companies	General
Ahmed <i>et al.</i> , 2005	Development of integrated model of TPM with 3S and EBM	Case study - Single case (one company)	Semiconductors
Seng <i>et al.</i> , 2006	Examine the effect of operational strategy to the extent of TPM implementation	General survey -no. of companies involved was not identified	General
Lazim <i>et al.</i> , 2008	Study on the TPM implementation focusing on autonomous maintenance (AM) and planned maintenance (PM)	Case study - single case (one company)	Automotive
Batumalay and Santhapparaj, 2009	Study on the factors contributed to improvement in overall equipment effectiveness (OEE)	General survey to 70 companies	General
Lazim and Ramayah, 2010	Study on the relationship of TPM practices towards manufacturing performance	General survey to 100 companies	General
Chong <i>et al.</i> , 2012	Study on the possibility of transferring the TPM practices to supply chain	Case study - Multiple cases (7 companies)	Automotive

Figure 3: Malaysian-based research in TPM

About 62.5 percent from Malaysian based research were conducted in non-specific industry (Ramayah *et al.*, 2002; Ahmed *et al.*, 2004; Seng *et al.*, 2006 ; Batumalay and Santhapparaj, 2009 ; Lazim and Ramayah, 2010). The number of researchers focused on a specific industry, relatively still small (37.5 percent). Lazim *et al.*, (2008) and Chong *et al.*, (2012) focused their study on automotive companies whereas Ahmed *et al.*, (2005) focused on semiconductors company.

Malaysian automotive industry has grasped attention for this research activity since it is considered one of the vital industries to support the vision of Malaysian government to be a developed nation by 2020. Automotive industries are known to be very competitive since the companies have to meet both internal and external pressures like stringent customer requirements, competitive pricing, lead time, zero defects and new advance manufacturing technology adaptation etc. Moreover, the companies have to follow strict government regulations and policies on health, safety and environmental issue (Lazim *et al.*, 2008). Nonetheless

there is a lack of study relating to TPM implementation in Malaysian automotive industry.

Chong *et al.*, (2012) conducted a case study in the automotive supply chain by examining on how the automotive manufacturer transferring the TPM practices to its vendors. It was reported that the manufacturer obtained a predictable impacts from those vendors performing TPM. Vendors on the other side enjoyed the improvement benefits mainly on their machine availabilities, product qualities, safety requirements, and plant cost effectiveness levels, thus, they are able to satisfy and fulfill the requirement from manufacturer. However, the study by Chong *et al.*, (2012) only analyzed the TPM implementation at the vendor's site. The information on how successful the manufacturer in implementing TPM before transferring their experience and knowledge to the vendors was not presented.

Another study focused on the automotive industry was the one by Lazim *et al.*, (2008) who conducted a study on TPM implementation in one of the leading suppliers of various automotive components. Their study only focused mainly on two out of main pillars of TPM, namely autonomous Maintenance (AM) and planned maintenance (PM). Other vital pillars such as training and education, focused improvement, quality maintenance, early management, safety, health and environment were not addressed.

5. CONCLUSION

TPM methodology promised to yield efficient support to the organization for competitiveness, in terms of quality product, reasonable operational cost as well as timely delivery to the customers. (Ben-Daya and Duffuaa, 1995 ; Blanchard, 1997 ; Bamber *et al.*, 1999 ; Ollila and Malmipuro, 1999 ; Kutucuoglu *et al.*, 2001 ; Williamson,2006).

This short review uncovered that the case study approach is the most preferred research design for investigating a various issues in TPM. On the other hand, the contribution from Malaysian researcher towards

increasing the TPM literature is relatively low. It is clear that, there are a lot of opportunities for Malaysian researcher to further investigate the actual phenomenon in TPM implementation. By the lively research activity, the Malaysian researchers could further contribute to the overall worldwide research in TPM.

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