The Impact of Total Productive Maintenance (TPM) as Mediator between Total Quality Management (TQM) and Business Performance

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***Abstract*— Total quality management (TQM) is importance management tool for every industry to compete in global market. However, based on previous TQM literature reported that ambiguous or mixed relationship between TQM and business performance and lack of examining moderator and mediator in previous work. Furthermore, there lack of study of Total preventive maintenance (TPM) as mediator. Therefore, it is important to obtain successful TQM paradigm. TPM acted as a prominent paradigm to improve the manufacturing performance to gain further competitive advantage. TPM focused on trying to on-going and minimize the error of production; Maintenance emphasize on maintain autonomously, equipment by production workers, in good condition. Hence, the purpose of this study is to mediator effect of TPM between TQM and business performance. Based on Federation of Malaysian Manufacturers (FMM) and the foreign companies' directory list in Malaysia, 1500 companies have been selected for final survey. Of the 1500 surveys, 327 surveys, which were equivalent to 21.8% response rate, were returned. The result shows that TPM has been proved as partial mediator between TQM and business performance with indirect effect 0.25. The result will help manufacturing companies in improving TQM practices through TPM as mediator to compete in global market.**

***Keywords*—** *Total Quality Management, Total Productive Maintenance and Business Performance*

1. Introduction

In this fast growing industrial era, organization required to produce high quality product with competitive prices through minimize manufacturing expenses, which can achieved by business performance improvement. Besides that, manufacturer also faced the challenges to make the process of technical in centralization and automation of the plant, which require many manual workers to constantly maintenance the automation system. The increased competition forced organization to optimize and improve their productivity to sustain in competitive market. The factor of complementary to achieve customer needs is to costs reduction. Thus, TQM practices is introduced to improve quality and reduce cost [1] Nevertheless, there are lacks of exploring and examine the mediator effect in previous research. Based on previous studies, researchers had provided inconsistent results in the relationship

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of TQM practices and business performance. Due to mediator effects is less emphasized in previous work for improvement. Hence, this study tend to identify the mediator effect of TPM to strengthen the relationship between TQM and business performance. Both TQM and TPM approaches can aid firms to create strategies to improve productivities. The integration of TQM and TPM able to fulfil quality requirement, and lead to higher accomplishment in business performance.

TQM acted as a management practices tools, which assist organizations that face with challenges to obtain high performance through improvement of products or services quality [2]. However, the implementation of TQM concept is complicated since the firms are required to transform their management system [3]. It is believe that focus on quality improvement not enough to exceed customer expectation. Therefore, organizations are needed to explore and identify particular of quality of customer needs consequence [4]. Organizations that implement TQM are needed to constantly focused on their customers' satisfaction and business processes control. TQM practices emphasized on continuously improvement in all operations within the firm to produce and deliver high quality of products and services to fulfil the changing of customers' preference continuously [5].

The terms "Total Productive Maintenance" which consisted of three words: Total is referring to the involvement of employees from different level within the organization; Productive focused on trying to on-going and minimize the error of production; Maintenance emphasize on maintain autonomously, equipment by production workers, in good condition – keep clean, repair, grease and willing to spend required time on it [6]. TPM as one of the method that improve the quality and it also act as a supplementary method to assist others quality techniques [7]. However, the implementation of TPM is time consuming and it needed to base on standardization to implement its full range [8]. Conversely, many researchers are still suggested that implementation of TPM in different organization of varying environment enables to boots up the competent performance in term of accomplishing organizational objective and goals [9] [1].

The Relationship between TQM and Business Performance

TQM practices can lead to higher business performance. Thus, firms are able to gain a sustainable competitive advantage compared to firms that do not adopt TQM (Valmohammadi & Roshanzamir, 2015). Most of the research focused on examining the TQM impact on business performance, and analyze the mechanisms that lead to management improvement. Based on the previous study, TQM implementation have a significant relationship with business performance which lead to better results in financial performance [11], customer satisfaction [12], [13], productivity [14], [15], quality [16], [17], innovation [15], employee satisfaction [18], [19]. Therefore, firms that emphasize on quality and customers requirement are tended to achieve through employees' participation, motivation and continuous improvement compared to non-TQM firms [20].

H_1: TQM practices is positively correlated with business performance

The Relationship between TQM and TPM

TQM is significantly supporting TPM to improve business performance [21]. The implementation of TQM and TPM is correlated to each other's. The common goals of TQM and TPM are continuous improvement, process focus, top management commitment, employee empowerment and information gather & analysis [22]. Both concepts indicated similarity in quality, time and cost flexibility to improve the business performance [23]. Hence, the transfusion of TQM and TPM is able to enhance the quality, equipment, reliability and productivity [24]. Besides that, it also require participation of employees in all levels and aims for long term success by customer satisfaction with benefits to all workers of the manufacturing and for society [25].

H_{2a}: TQM practices is positively correlated with TPM.

The Relationship between TPM and Business Performance

TPM implementation is significantly related with business performance [26]–[28][26], [27]. TPM is used to improve employees' working efficiency, productivity and equipment effectiveness. There is a growth of TPM implementation by many firms to enhance equipment efficiency and to gain competitiveness in global market through cost and quality [29]. In this competitive environment, manufacturer should focus on maintenance as a potential sources for cost saving and competitive advantage [27]. A part from that, TPM also provided a global strategy for manufacturing firms and ways for TPM practices to increase the product's quality and productivity to accomplish strategic core competencies [30]. Based on the result from K. Singh & Ahuja [31] , found that the initiative of TQM and TPM lead to the quality overhaul and maintenance practices within manufacturing plants to enhanced business

performance. Therefore, business performance of TPM firms is greater than non-TPM firms. Based on the discussion above, the hypothesis of this study at below:-

H_{2b}: TPM practices is positively correlated with business performance.

Therefore; H_2: TPM mediates between relationship between TQM and business performance.

2. Methodology

A seven-point Likert scale have been applied in the instrument for collecting data. The instrument has been validated by the experts in green practices. First, pilot study have been conducted and then revisions have been made for improving the instrument. Based on Federation of Malaysian Manufacturers (FMM) and the foreign companies' directory list in Malaysia, 1500 companies have been selected for final survey. Of the 1500 surveys, 327 surveys, which were equivalent to 21.8% response rate, were returned. Of the 327 surveys, 6 surveys were found to have more than 10 percent of unanswered items and 2 surveys were excluded because respondents provided the same responses to all questions in the survey, resulting in an effective sample of 319 usable completed surveys (21.3 percent usable response rate)

3. Result

TPM as the mediator variable was included into the model, as shown in Figure 1. Table 1 shows that the relationship between TQM and BP was reduced when TPM was included in the model, but the relationship was still significant with rc from 0.81 (CR=13.177, p<0.01) to 0.55 (CR=7.449, p<0.01). The result also showed that TQM had a significant and direct effect on TPM with rc=0.80 (CR=14.346, p<0.01). In addition, TPM had a significant and direct effect on BP with rc=0.31 (CR=4.334, p<0.01). The goodness-of-fit indices for the structural model (χ^2/df=2.220, GFI=0.920, AGFI=0.902, TLI=0.937, CFI=0.952, and RMSEA=0.044) were well within the generally accepted limits, indicating a good fit to the data. Thus, it can be concluded that TPM partially mediated the relationship between TQM and BP. In order to test whether TPM was an important mediator between TQM and BP, the following suggested the indirect effects values [32]: (1) indirect effect (IE)>0.01: low effect; (2) IE>0.09: moderate effect; and (3) IE>0.250: high effect. Table 5.51 shows that the standard indirect effect (IE) of TQM to BP was 0.250, which can be categorised as high effect of mediation [32]. Based on Hair (2010), (1) IE<0.085: non-mediator; (2) IE>0.085 and IE<DE: partial mediator (TQM → BP relationship, p<0.05); and (3) IE>0.085 and IE>>DE: total mediator (TQM → BP relationship, p>0.05).

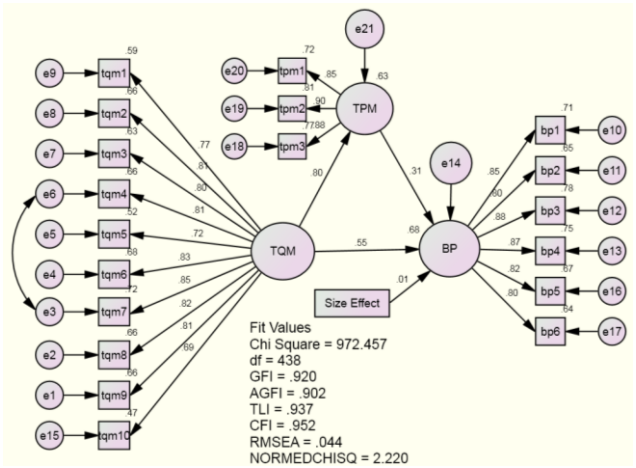

Figure 1 Mediator testing for TPM between TQM and BP

Table 1: Mediator testing for TPM between TQM and BP

	Hypotheses	Links in the model	Standardised Estimate (rc)	CR	Result	Remark
1.	H11	TQM → BP	0.81	13.177**	Supported	Without TPM
2.	H11	TQM → BP	0.55	7.449**	Supported	With TPM
	H12a	TQM → TPM	0.80	14.346**	Supported	With TPM
	H12b	TPM → BP	0.31	4.334**	Supported	With TPM
		H12: TPM partially mediates the relationship between TQM and business performance				

Note: *p<0.05; **p<0.01 (one-tailed test)

Table 2: Direct effect and indirect effect for TPM as mediator

	Effect	Links in the model	Standardised Estimate (rc)	Result	Remark

1	Direct Effect	TQM → BP	0.55	Supported	
2	Indirect Effect	TQM → TPM → BP	**0.25*** **	Supported	**High effect**
	Total effect	TQM → TPM → BP	0.80		

Note: *IE≥0.01 (Low); **IE≥0.09 (Moderate); ***IE≥0.250 (High)

4. Discussion

First, it was expected that TPM was a mediator between TQM and business performance. This finding is supported by Seth & Tripathi [34] and Konecny & Thun [30]. Konecny & Thun [30]prove that TPM is a mediator between TQM and business performance in order to improve quality, flexibility, cost, and time in the context of manufacturing industry in Germany. Seth & Tripathi [35] indicate that TPM has a synergetic effect and is also very successful in improving productivity, quality, delivery, safety and hygiene, and employee motivation.

5. Conclusion

This study proved that TPM are very important as mediator between TQM and business performance. TPM practices will lead to the different level of business performance.

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