

MEDIATOR EFFECT OF STATISTICAL PROCESS CONTROL BETWEEN TQM AND BUSINESS PERFORMANCE IN MALAYSIA AUTOMOTIVE INDUSTRY

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ABSTRACT

In today's highly competitive market, Total Quality Management (TQM) is vital management tool in ensuring a company can success in their business. In order to survive in the global market with intense competition amongst regions and enterprises, the adoption of tools and techniques are essential in improving business performance. There are consistent results between TQM and business performance. However, only few previous studies have examined the mediator effect namely statistical process control (SPC) between TQM and business performance. A mediator is a third variable that changes the association between an independent variable and an outcome variable. This study present research proposed a TQM performance model with mediator effect of SPC with structural equation modelling, which is a more comprehensive model for developing countries, specifically for Malaysia. A questionnaire was prepared and sent to 1500 companies from automotive industry and the related vendors in Malaysia, giving a 21.8 per cent rate. Attempts were made at findings significant impact of mediator between TQM practices and business performance showed that SPC is important tools and techniques in TQM implementation. The result concludes that SPC is partial correlation between and TQM and BP with indirect effect (IE) is 0.25 which can be categorised as high moderator effect.

Keywords: TQM; SPC; SEM; Automotive.

INTRODUCTION

The concept of total quality management (TQM) has been developed as a result of intense global competition [1]. Firms that manage the international trade in global competition have put emphasis on TQM philosophy, procedures, tools and techniques. Juran [2] defines TQM as philosophy aimed at achieving business excellence through the application of tools and technique, as well as the management of soft aspects, such

as human motivation in work. Furthermore, Demirbag et.al [3] defines TQM as a management philosophy aims to contribute continuous improvement in the organization with the participation of all employees to achieve customer satisfaction by producing better, cheaper, faster and safer than competitors. The role of TQM in improving business performance is broadly agreed in the literature and empirical study [4],[5],[6]. TQM helps to manage the firm to improve the effectiveness and business performance to achieve world class status for the past two decades [7]. However, the study of mediators is neglected and is referred to less frequently in literature review. The fundamental systems-interactive paradigm of organisational analysis features the continual stages of input, throughput (processing), and output, which demonstrate the concept of openness and closeness. Processing is the process of changing from one “look” to another, or one culture to another [8]. In this study, the author defines input as TQM; processing as application tools and techniques namely SPC; and output as business performance. Thus, one of the objectives of this study is to empirically analyse the impact of SPC between TQM and business performance.

LITERATURE REVIEW

Statistical process control (SPC) was pioneered by Walter A. Shewhart in the early 1920's. Then, W. Edwards Deming applied SPC methods in the United States during World War II to improve quality in the military products [9]. Deming also introduced SPC to Japan after the war had ended and he developed the control chart and the concept of statistical control in the production process [9]. SPC is used in order to observe a process to ensure the process conforming the specification with a minimum of recovery [10–12]. In particular, SPC allows sources of variation to be detected and measured, then amenable for correction. SPC emphasises on early detection and prevention of problems rather than the correction of problems after they have occurred. SPC eliminates reject product and identifies bottlenecks, waiting times and other sources of delays within the process [2]. Thus, SPC removes the need for post-manufacture inspection. However, the application of SPC relies not only on the tools with which it is applied, but also on how to do correction [13], [14]. Shewhart notes that every process has variation. Some variation that is controlled and natural to the process is called common sources of variation. In contrast, variation that is not controlled and not present at all times is called assignable sources of variation [11]. The assignable sources of variation can be detected, identified, and removed to ensure the process is stable within a value of limits [12]. In this study, author defines SPC as a method of statistical techniques for monitoring and controlling the variation in a process to produce product which meets specification.. However, only few previous studies have examined the mediators and moderators between TQM and business performance [15]. The inconsistent results between TQM and BP are because the mediators and moderators have been overlooked in research designs [16][17][18]. This present research proposed a TQM performance model with mediator effect of TQM with structural equation modelling, which is a more comprehensive model for developing countries, specifically for Malaysia.

H1: Relationship between TQM and Business Performance

Most previous studies indicate a significant relationship between TQM practices and business performance [19]; [20]; [21]; [22]. In contrast, other studies show that TQM

does not improve business performance [23]; [3]. Other findings show partial correlation between TQM practices and business performance [3]; [24]; [7]. Accordingly, the author proposes that:

H1: TQM practices are positively significant and have direct effects on business performance.

H2a: Relationship among TQM and SPC

The relationship between TQM and SPC will be first reviewed. SPC can assume a stable process, but predictions cannot be made until the process is fully defined and controlled [25]. TQM provides infrastructure such as top management support, employee participation, and improvement to implement tools and techniques; thus, TQM should be implemented before the execution of SPC [2]. Ahmad et al., [10] indicate that TQM practices have impact on SPC. Thus, TQM practices are positively correlated with SPC.

H2a: TQM practices are positively significance and direct effect on SPC.

SPC aims to reduce process variance and significantly impacts performance improvement, cost savings, and customer satisfaction [26]. Morgan & Dewhurst [27] indicate that control charts could be adapted to effectively monitor supplier performance. Rohani et al. [28] conduct a survey on 326 respondents from the Malaysian automotive industry and find a positive relationship between SPC and business performance. Information provided by the SPC system enhances the ability of top management to make decisions, in turn increasing business performance based on SPC data [11], [29], [30]. Thus, SPC increases productivity by reducing waste and improving quality for short- and long-term benefits; this means that SPC practices are positively correlated with business performance. Accordingly, the author proposes that:

H2b: SPC practices are positively significance and direct effect on business performance.

There are lack of empirical evidence of SPC as mediator between TQM and business performance in previous work [15]. In this study, SPC acts as mediator between TQM and business performance. Accordingly, the author proposes that:

H13: SPC is a mediator between TQM and business performance.

RESULT

Response Rate

For the final survey, 1,500 surveys were randomly selected from the sampling frame. 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).

Convergent validity

All AVE values in TQM, BP and SPC constructs were above 0.50 and this evidence supported the convergent validity of the measurement model of TQM [31], as shown in Table 1. The results showed that both Cronbach's alpha and composite reliability for the constructs achieved 0.7, as suggested by Nunally [32] and Hair [31].

Table 1: Convergent validity and composite reliability for second order measurement model

Construct	Item	Loading (L), L>0.6	Cronbach's alpha $\alpha > 0.7$	Composite reliability (CR) CR>0.7	Convergent validity (AVE) AVE>0.5
TQM	TQM1	0.77	0.941	0.938	0.708
	TQM2	0.82			
	TQM3	0.79			
	TQM4	0.82			
	TQM5	0.72			
	TQM6	0.83			
	TQM7	0.83			
	TQM8	0.82			
	TQM9	0.81			
	TQM10	0.69			
SPC	SPC1	0.79	0.872	0.872	0.696
	SPC2	0.89			
	SPC4	0.84			
BP	BP1	0.85	0.934	0.938	0.715
	BP2	0.79			
	BP3	0.88			
	BP4	0.87			
	BP5	0.83			
	BP6	0.81			

Discriminant Validity

The results showed that AVE values were greater than the square of correlation among the constructs, as shown in Table 2. Thus, it can be concluded that discriminant validity was supported.

Table 2: Discriminant validity for second order measurement model

	TQM	SPC	BP
TQM	0.708		
SPC	0.569	0.696	
BP	0.599	0.598	0.715

SEM

Same procedure of testing for mediator was conducted as Hypothesis H12. SPC as the mediator variable was included into the model, as shown in Figure 1. The result showed that the relationship between TQM and BP was reduced from $rc=0.81$ (CR=13.177, $p < 0.01$) to 0.55 (CR=6.531, $p < 0.01$), but still significant, as shown in Table 3. The result also showed that TQM had a significant and direct effect on SPC with $rc=0.81$ (CR=13.967, $p < 0.01$), and SPC also had a significant and direct effect on BP with $rc=0.31$ (CR=3.748, $p < 0.01$). The goodness-of-fit indices for the structural model ($\chi^2/df=2.357$, GFI=0.930, AGFI=0.905, TLI=0.951, CFI=964, and RMSEA=0.065)

were well within the generally accepted limits, indicating a good fit to the data. Thus, it can be concluded that SPC partially mediated the relationship between TQM and BP.

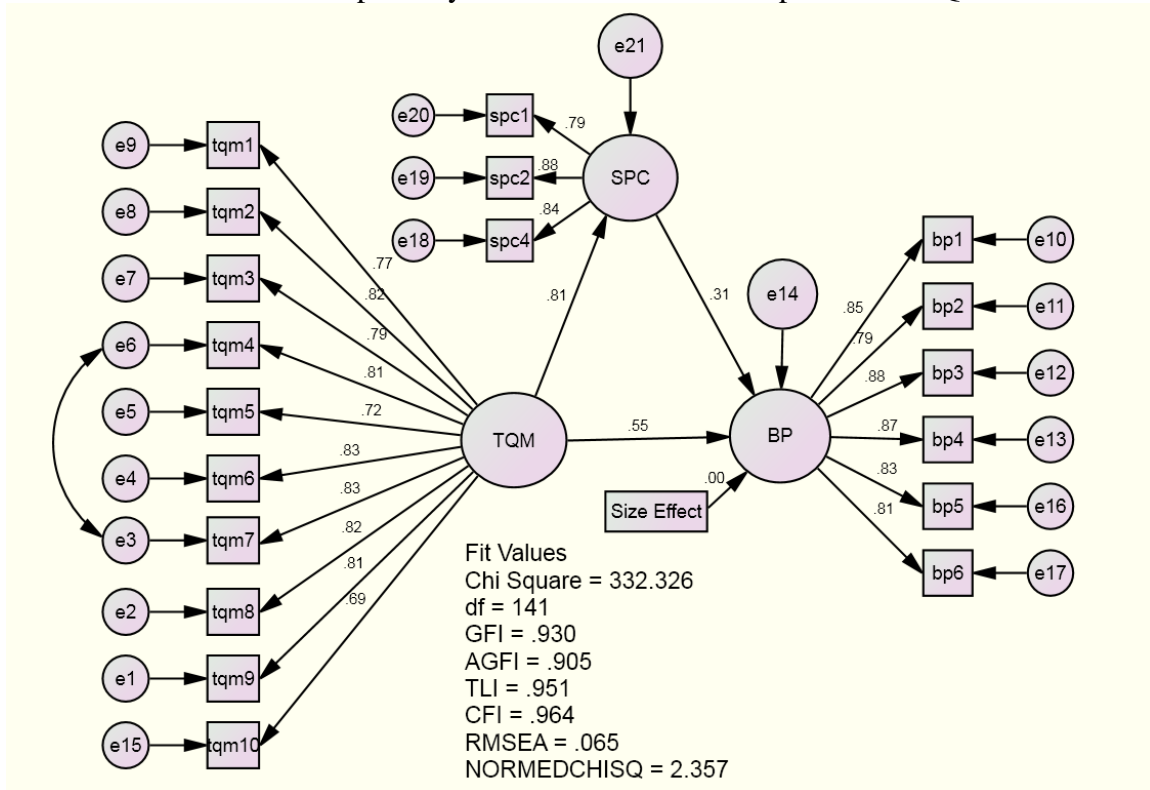


Figure 1 Mediator testing for SPC between TQM and BP

Table 3: Mediators testing result for SPC between TQM and BP

No.	Hypotheses	Links in the model	Standardised Estimate (rc)	CR	p-value	Result	Remark
1.	H11	TQM → BP	0.81	13.177*	0.000	Supported	Without SPC
2.	H11	TQM → BP	0.55	6.531**	0.000	Supported	With SPC
	H13a	TQM → SPC	0.81	13.967*	0.000	Supported	With SPC
	H13b	SPC → BP	0.31	3.748**	0.000	Supported	With SPC
H13: SPC partially mediates the relationship between TQM and business performance.							

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

Table 3 shows that the standard indirect effect (IE) of TQM to BP was 0.254, which can be categorised as a high effect of mediation [33].

Table 4: Direct effect and indirect effect for SPC as mediator

No.	Effect	Links in the model	Standardised Estimate (rc)	Result	Remark
1.	Direct Effect	TQM → BP	0.55	Supported	
2.	Indirect Effect	TQM → SPC → BP	0.25***	Supported	High Effect
	Total effect	TQM → SPC → BP	0.80		

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

DISCUSSION

It was expected that SPC was a mediator between TQM and business performance. According to Baron & Kenny (1986), mediator approach research focuses to identify mechanism as a process between TQM and business performance, besides direct impact of TQM towards performance. Mediator functions to explain “how” or “why” the relationship happened between TQM and business performance [17], [18]. The structural relationships in the structural models were used to test the mediating effect. The results showed that SPC mediated the relationship between TQM and business performance in automotive industries in Malaysia. Thus, SPC can explain the relationship between TQM and business performance, i.e., how to achieve business performance through implementing TQM. However, the mediator test showed partial mediation, explaining that the tool or technique alone did not completely explain the relationship between TQM and business performance [34]. The reason was that there were various tools and techniques that contributed to the business performance.

The results proved that SPC was a mediator between TQM and business performance. This finding is supported by Morgan & Dewhurst [27], Rohani et al., [28], Ahmad et al., [10], Rahman et al., [35], and Taj & Morosan (2011) [26]. According to Rahman et al., [35], SPC is a useful tool to improve quality process, to timely detect abnormality, to check critical parameters, to reduce variations, and to maintain the stability of process. Rohani et al., [28] explored the relationships between SPC and performance from 326 companies in Malaysian automotive industry by using SEM and the result was significant. Many researchers view SPC as a monitoring tool to ensure that the output of a process conforms to the intended design [27], [28]. However, SPC also can be applied in outside production process to effectively improve supplier’s delivery performance to the buyers [27]. The study indicates that SPC approach is effective in monitoring supplier performance through establishing achievable performance targets and meaningful data.

CONCLUSIONS

The main objectives of this study are to examine the impact of SPC between TQM and business performance. The result concludes that SPC is partial correlation between and TQM and BP with indirect effect (IE) is 0.25 which can be categorised as high moderator effect. It has proved that the impact of SPC based on system theory.

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