

MAN_32

A COMPARATIVE STUDY OF QUALITY MANAGEMENT PRACTICES AND IMPLEMENTATION FOR AUTOMOTIVE INDUSTRY BETWEEN MALAYSIA AND THAILAND: A CONCEPTUAL MODEL

Zakuan, N.M.¹ and Yusof, S.M.²

¹Department of Manufacturing & Industrial Engineering, Faculty of Mechanical Engineering, Universiti Tun Hussein Onn Malaysia (UTHM), Parit Raja, Batu Pahat, Johor, Malaysia.

²Department of Manufacturing & Industrial Engineering, Faculty of Mechanical Engineering, Universiti Teknologi Malaysia (UTM), Skudai, Johor, Malaysia.

Email: hayatiz@uthm.edu.my

ABSTRACT

This paper discusses the relationship between Quality Management (QM) practices and organizational performance. Based on comprehensive literature review, eight constructs had been identified for QM practices. To examine this relationship, a conceptual model from previous study on QM practices that is successfully applied in different countries is adapted with some changes. As a result, a proposed conceptual model using Structural Equation Modelling (SEM) approach is established. A SEM technique is used because it can provide researchers with a comprehensive means assessing and modifying theoretical models. The same model will be used to study the relationship between QM practices and organizational performance for Malaysia and Thailand automotive industries.

Keywords: *Quality Management (QM) Practices, Organizational Performance, Structural Equation Modelling (SEM), and Automotive Industries.*

INTRODUCTION

In a competitive market, the demand for quality is emerging as the single most critical factor for companies to survive in the ever-expanding global market place. Quality is vital in determining the economic success of manufacturing companies [1, 2]. World-class manufacturing companies gain competitive edge and greater market share through extraordinary levels of performance by providing a quality product with a competitive price as required by demanding customers.

The concept of Quality Management (QM) practices developed as a result on intense global competition. Companies with international trade and global competition have paid considerable attention to QM practices such as procedures, philosophies, tools and techniques. A growing number of companies use QM practices as strategic foundation for generating a competitive advantage [3] and improving organizational performance [4, 5, 6]. Nilsson *et al.* [7] investigated how internal quality practices implemented by the organizations influence customer satisfaction and organizational performance. Their findings show that internal quality practices influence customer satisfaction and organizational performance primarily through better organization's customer orientation. The research also support the claim that organizations with quality foundation are in a better position to adopt a customer orientation.

Recent study by Hoang *et al.* [8] found that quality practices have a positive impact on the organizational innovativeness, which can enhance organizational performance. However, they discover that not all quality practices enhance organizational innovativeness. Only leadership and people management, process and strategic management, and open organization showed a positive impact on the organization's innovation performance. Demirbag *et al.* [9] tried to determine the impact of market

orientation (MO) and implementation quality practices on organizational performance of SMEs. They noted that quality practices implementation strengthens market orientation's, which impacts on organizational performance, and quality practices implementation acts as inter-functional co-ordination mechanism. This reinforces that SMEs should not use marketing strategies only, but also strengthens their strategy by introducing quality practices.

In Malaysia automotive industries, previous research done by Deros *et al.* [10]; Noviyarsi and Yusof, [11]; Zadry and Yusof [12] have shown that there are several critical success factors relating to successful implementation of QM practices. One of main reasons why many Malaysian automotive manufacturers and suppliers have not used advanced tools and techniques was a lack of knowledge and understanding [11]. These tools are viewed as difficult, not applicable and impractical. Aziz *et al.* [13] had surveyed 540 Malaysia manufacturing companies. They reported that Malaysia manufacturing companies are relatively low in use of sophisticated statistical methods for quality improvement. They also stated that the types of quality practices used by Malaysian's manufacturing companies are related to the types of quality practices promoted by the governments. The recent study by Zakuan and Yusof [14], as shown in Table 1 indicates the gap of study on QM practices implementation among ASEAN countries especially in automotive industries from year 2000 to 2007. The questions of which and to what extent QM practices are common to and are different between ASEAN countries and to what extent quality practices implementation will be affected organizational performance are yet to be answered.

Table 1: The gap of study

Year	Author	Focus area	Sector	Single country	Multiple countries
2000	Aziz et al.	Quality practices	Manufacturing	X	UK, Malaysia
2001	Benito and Dale	Quality practices	Automotive	Spain	X
2003	Johnson and Khan	Quality practices	Automotive	UK	X
2003	Sohail et al.	ISO 9000	Automotive	Malaysia	X
2004	Lee et al.	Quality practices	Manufacturing	China	X
2004	Lin et al.	Quality practices	Manufacturing	Taiwan	X
2004	Deros et al.	Benchmarking	Automotive	Malaysia	X
2005	Noviyarsi and Yusof	Quality practices	Automotive	Malaysia	X
2006	Iwaarden et al.	Quality practices	Automotive	X	European
2006	Yoo et al.	Quality practices	Manufacturing	X	Korea, USA, Mexico, Taiwan
2006	Parast et al.	Quality practices	Manufacturing	X	USA, Mexico
2007	Bayazit and Karpak	TQM	Manufacturing	Turkey	X
2007	Prajogo	TQM	Manufacturing	Australia	X

Referring to the above table, it is believed that the need of comparative study among ASEAN countries especially comparing to Thailand which is known as an automotive regional hub in this region [14]. This paper is attempted to propose a conceptual model of relationship between QM practices implementation and the organizational performance for Malaysia and Thailand automotive manufacturer. The proposed conceptual model is based on Structural Equation Modelling (SEM) approach.

QUALITY MANAGEMENT CONSTRUCTS

Based on an extensive review of the quality management practices, the following constructs are identified as critical success factors in quality management practices:

- i. Quality leadership
- ii. Supplier quality management
- iii. Strategic planning
- iv. Human resource development
- v. Customer focus and satisfaction
- vi. Quality information and analysis
- vii. Quality results
- viii. Quality assurance
- ix. General matters

There have been numerous studies examining what constitutes quality management, what the common barriers to quality management implementation are, and what factors are critical for the success of quality management [15]. Although these studies have provided different results, they have identified a common set of practices considered essential to the success of a quality management implementation.

Based on that, Table 2 shows the proposed quality management constructs that will be used in this study.

i. Quality leadership

Quality leadership addresses the critical role of management in driving company wide quality management efforts [16, 17]. Leadership has proved to be the key in the continuous quality improvement process and the driver of the quality management practices [18, 19, 20, 21, 22, 23]. Leaders play an important role in how quality values are projected in a consistent manner, and how adoption of the values through the company is determined and enforced.

ii. Supplier quality management

Supplier management acknowledges the important of suppliers in achieving higher levels of quality in an organization [16]. Continuous improvement also depends on the control of procured materials, parts and services. Vendors' participation during the initial design of new products and in the solutions of problem is important to achieve high quality and faster response to market needs [18, 19, 20, 23, 24, 25,].

iii. Strategic planning management

Strategic planning of quality management is the extent to which the company has a clear vision, long term plan and quality policy [26]. It also incorporates the integration of quality and customer satisfaction issues into strategic and operational plans, which allow firms to set clear priorities, establish clear target goals, and allocate resources for the most important things [27].

iv. Human resource development

Striving to maintain high levels of quality depends on the best use of the talents and abilities of a company's entire workforce [18, 19, 20, 23, 28]. Support for human resources development emphasizes the essential role of employee training and their involvement in quality-related decisions in the company [29]. Companies must develop and realize the full potential of the work force and maintain an environment conducive to full participations, quality leadership, and personal and organizational growth.

v. Customer focus and satisfaction

Well-satisfied customers are the ultimate aim. Develop and manage strong customer relationships for the longer term. The company actively seeks way to improve the product or service in order to achieve greater customer satisfaction [18, 19, 20]. Companies must be knowledgeable in customer requirements and responsiveness to customers' need, maintain high levels of service and measure customer satisfaction through a variety of indicators like commitment to customers, determining customers' requirements and expectations and determining customer satisfaction.

vi. Quality information and analysis

Quality information and analysis refers to the availability of information systems in the company, and the procedures and systems in the company, and the procedures and systems that provide accurate and timely information for the managers to make quality decisions [16]. Analysis of this information allows management to make effective decisions in managing quality. This construct considers scope, availability and use of quality data that underlie the company's overall quality management system.

vii. Quality results

The goal of all quality management practices is to improve quality measurably. The effort of the quality improvement process must be reflected in improved quality levels based on objective measures derived from analysis of customer requirements and expectations, from analysis of business operation, and comparing the company's current quality levels benchmarked against competing firms [19, 20, 23]. Quality result also indicates how much internal operations, customer satisfaction, and market and financial performance in the company have been improved by quality management practices.

viii. Quality assurance

Quality assurance of products and service refers to the systematic approach used by organizations for maintaining and improving the quality of their products and services [29]. Quality assurance requires that adequate and appropriate measures be taken from product design through manufacture and

delivery to customer. The use of scientific monitoring and measuring techniques is one of the principal ways employees are empowered to contribute to the quality improvement process [18, 19, 22].

The above eight constructs were derived from the comparison of quality management practices across different studies and also by combining the constructs in the Malcolm Baldrige Award Criteria, and the ISO 9000 certification requirements. Furthermore, those constructs also,

- constitute practices that represent the hard and soft aspects of quality management.
- cover the most prestigious quality award criteria that are widely accepted by quality management scholars and practitioners.
- have been considered as critical practices in quality management [26].
- correspond to the Malaysia National Quality Award (MNQA) and Thailand Quality Award (TQA) criteria, therefore suitable to testing in the Malaysia and Thailand industry context.

STRUCTURAL EQUATION MODELLING: A REVIEW

Substantive use of Structural Equation Modelling (SEM) has been growing in business and technology. One reason for this is that these confirmatory methods [33] provide researchers with a comprehensive means assessing and modifying theoretical models. Its functions have been found better than other multivariate techniques such as multiple regression, path analysis and factor analysis. SEM is a method that can examine a series of both dependence and independence relationships simultaneously [34].

Prajogo and Sohal [35] had used SEM approach to examine the multidimensionality of TQM in association with organizational performance as shown in Figure 1. Using empirical data gathered from 194 Australian firms, the findings support the proposition in pairing the mechanistic elements of TQM with quality performance and the organic elements with innovation performance. However, Singh and Smith [36] argued that there is insufficient evidence to suggest TQM is related to innovation.

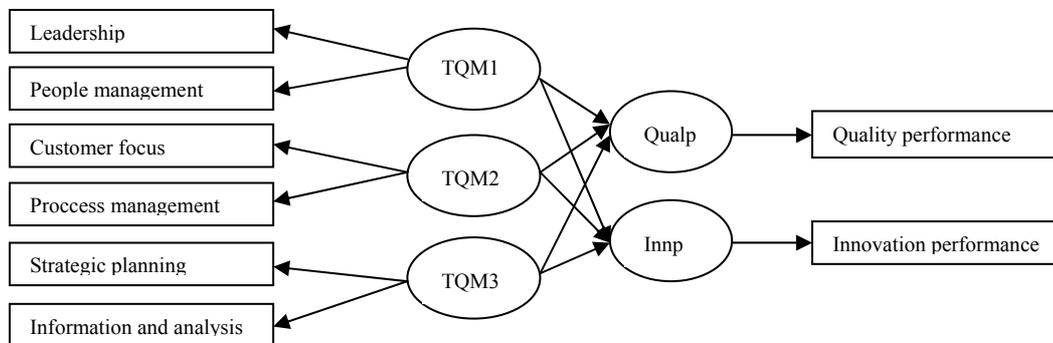


Figure 1: The model of the structural relationship between TQM and two organizational performances

Table 2: Comparison of quality management constructs across different studies

No.	Saraph et al., 1989 [15]	Flynn et al., 1994 [16]	Ahire et al., 1996 [30]	Rao et al., 1999 [29]	Yusof and Aspinwall, 2000 [45]	Parast et al., 2006 [31]	Sila, 2007 [32]	Proposed constructs
1	The role of top management leadership	Top management support	Top management commitment	Top management commitment Quality citizenship	Management leadership	Quality leadership	Leadership	Quality leadership
2	The role of the quality department	Customer involvement	Customer focus	Customer orientation	-	Customer focus and satisfaction	Customer focus	Customer focus and satisfaction
3	Quality data and reporting	Quality information	Internal quality information usage Benchmarking	Quality information availability	Measurement and feedback	Quality information and analysis	Information and analysis	Quality information and analysis
4	Training	Workforce management	Employee training	Employee training	Education and training Human resource development	Support for human resource development	Human resource management	Human resource development
5	Employee relations	-	Employee empowerment Employee involvement	Employee involvement	Resources	-	-	-
6	Product/service design Process management	Product design Process management	Design quality management Statistical process control usage	Product/process design	System and process Improvement tools and techniques	Strategic planning process of quality management	Process management	Strategic planning management
7	Supplier quality management	Supplier involvement	Supplier quality management	Supplier quality	-	Supplier quality	Supplier management	Supplier quality management
8	-	-	Product quality	Internal quality results	-	Quality results	Organizational effectiveness	Quality results
9	-	-	-	-	Supplier quality assurance	Quality assurance of products and services	-	Quality assurance
10	-	-	Supplier performance	External quality results	Continuous improvement process	-	Financial and market results	-

Lin et al. [37] had conducted a comparison study between Taiwan and Hong Kong manufacturing companies to investigate supply chain quality management and organizational performance using SEM as shown in Figure 2. The data showed that Quality Management (QM) practices are significantly correlated with the supplier participation strategy and this influences tangible business result, and customer satisfaction. The same model has been used to analyze the data collected from Taiwan and Hong Kong manufacturing companies.

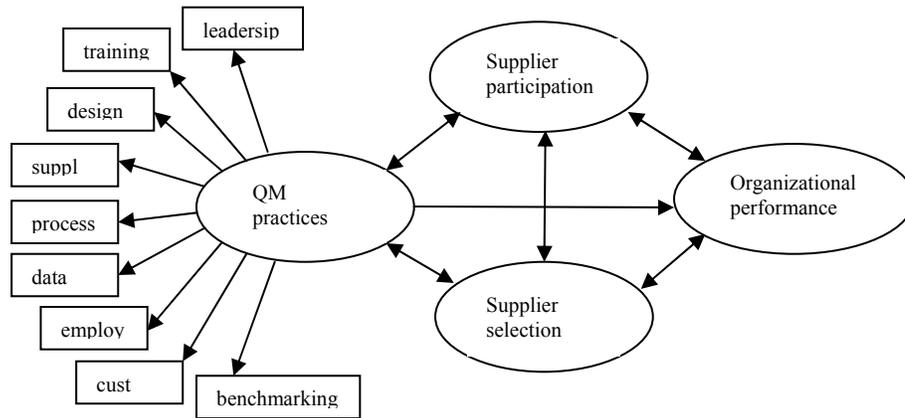


Figure 2: Conceptual SEM for Taiwan and Hong Kong data

Another recent study by Sanchez-Rodriguez et al. [38] had used SEM approach to provide insights into current IT and total quality management (TQM) theory and practice on operational and quality performance. The results indicate that the sampled firms make considerable use of IT to support their TQM initiatives and that overall such efforts generate significant positive gains on operational and quality performance. The model proposed is shown in Figure 3.

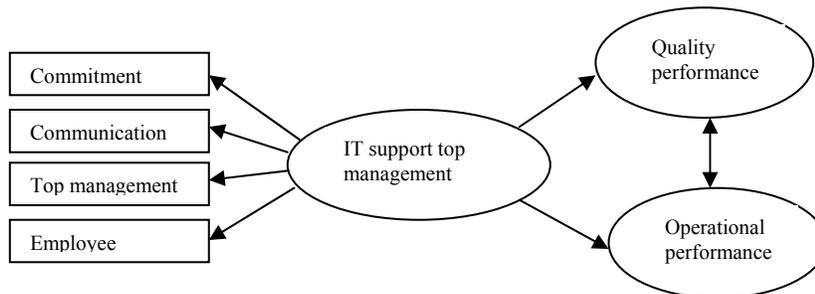


Figure 3: A proposed theoretical structural equation model

It is observed that the number of research using SEM has been growing, Table 3 shows the summary of the past related research across the studies. Based on the review, it can be clearly seen that SEM approach can be used in determining those QM practices implementation and the relation to organizational performance.

Table 3: Summary of past-related research using SEM approach

Author	Factor	Findings	Focus area
Liker <i>et al.</i> , 1998 [39]	<ul style="list-style-type: none"> ● component characteristic ● supplier technical ● buyer-supplier relationship ● use of CAD 	Involving supplier at early design stage is associated with greater contributions of cost reduction and higher quality	Automotive design
Ahire and Dreyfus, 2000 [40]	<ul style="list-style-type: none"> ● design management ● quality training ● product design ● process quality ● external, internal quality 	Design and process management have positive impact on TQM	TQM
Narasimhan and Nair, 2005 [41]	<ul style="list-style-type: none"> ● quality expectations from supplier ● information sharing and trust with supplier 	Quality expectations and information sharing and trust between buyer-suppliers have a positive influence on supply chain.	Supply chain
Author	Factor	Findings	Focus area
Hemsworth <i>et al.</i> , 2005 [42]	<ul style="list-style-type: none"> ● supplier quality ● personnel management ● cross-functional coordination ● management commitment ● benchmarking 	Quality management has a direct impact on information system and purchasing performance	Information system in purchasing
Rohani <i>et al.</i> , 2006 [34]	<ul style="list-style-type: none"> ● commitment management ● system and procedure ● culture ● training ● deployment ● recognition ● team 	Propose theoretical model between SPC and improvement in quality performance	Statistical Process Control (SPC)
Grobler and Grubner, 2006 [43]	<ul style="list-style-type: none"> ● quality ● delivery ● flexibility ● cost 	Finds mostly cumulative effects between the manufacturing capabilities	Manufacturing strategy
Suradi <i>et al.</i> , 2007 [44]	<ul style="list-style-type: none"> ● commitment from top ● customer focus ● campus facility ● communication ● course delivery ● learning environment ● continual assessment 	There is a direct effect between some of education services in quality technical education	Quality in education

DISCUSSIONS

Based on the comprehensive review of previous studies, this paper has proposed the Structural Equation Modelling (SEM) to model the relationship between Quality Management (QM) practices and organizational performance as presented in Figure 4. This proposed model has adapted the conceptual model proposed by Lin *et al.* [37], as their successful model in conducting comparison between two countries. However, some amendments especially on Quality Management (QM) practices constructs have been made.

In this proposed conceptual model, QM practice is represented by eight constructs namely, quality leadership, supplier quality management, strategic planning management, human resource development, customer focus and satisfaction, quality information analysis, quality results and quality assurance. SEM can provide a basis for making meaningful inferences about the theoretical constructs and their interrelations. This research will study the relationship between specific Quality Management (QM) practices and organizational performance for Malaysia and Thailand automotive industries. Lin *et al.* [37] suggested that the international comparative studies on QM practices could provide an insight into organizational performance in global scale.

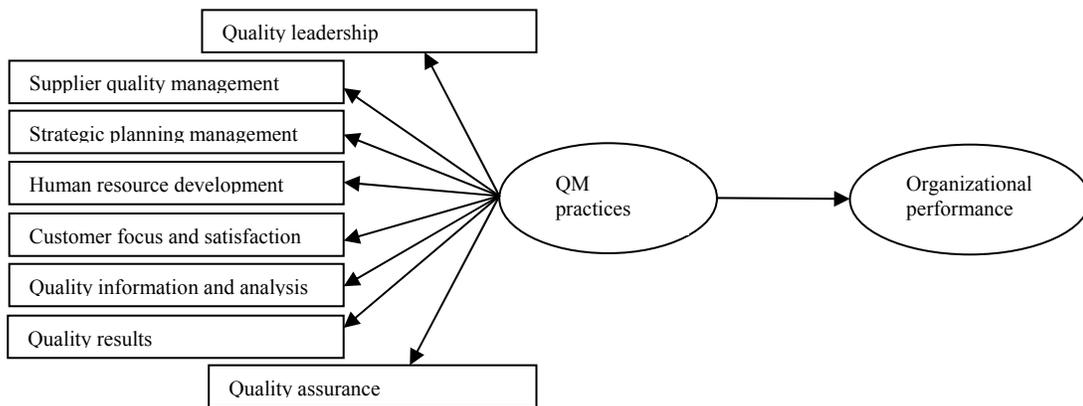


Figure 4: A proposed conceptual model on Quality Management (QM) practices for Malaysian and Thailand automotive industries.

CONCLUSIONS

There are a numbers of studies have been conducted to identify critical success factors for implementation of QM practices, however, no previous studies had tried to investigate the relationship between QM practices and organizational performance especially among ASEAN countries. Based on extensive literature review, eight constructs had been identified and a conceptual model had been proposed which is relevant to Malaysian and Thailand automotive industries. Concerning TQM theory aspects, this study will contribute to clarify the relationship between QM practices and the organizational performance in international context.

ACKNOWLEDGEMENT

The authors would like to thank the Ministry of Higher Education (MOHE) Fundamental Research Grant Vot 78101 and Universiti Teknologi Malaysia for their support in this project.

REFERENCES

- [1] Garvin, D.A. (1988). *Managing Quality: The Strategic and Competitive Edge*. New York: The Free Press.
- [2] Curkovic, S., S. Melnyk, R. Calantone, and R. Handfield. (2000). Validating the Malcolm Baldrige national quality award framework through structural equation modeling, *International Journal of Production Research* 38(4). 765-791.
- [3] Reed, R., Lemak, D.J., and Mero, N.P. (2000). Total quality management and sustainable competitive advantage. *Journal of Quality Management*, 5, 5-26.
- [4] Hendricks, K. B., and Singhal, V.R. (1997). Does implementing an effective TQM program actually improve operating performance? Empirical evidence from firms that have won quality awards. *Management Science*, 43, 1258-1274.
- [5] Lemak, D.J., and Reed, R. (1997). Commitment total quality management: Is there a relationship with firm performance? *Journal of Quality Management*, 2, 67-86.
- [6] Samson, D., and Terziovski, M. (1999). The relationship between total quality management practices and operational performance. *Journal of Operations Management*, 17, 393-409.
- [7] Nilsson, L., Johnson, M.D., and Gustafsson, A. (2001). The impact of quality practices on customer satisfaction and business results: product versus service organizations. *Journal of Quality Management*, 6, 5-27.

- [8] Hoang, D.T., Igel, B., and Laosirihongthong, T. (2006). The impact of total quality management on innovation: Findings from a developing country. *International Journal of Quality & Reliability Management*, 23(9) 1092-1117.
- [9] Demirbag, M., Koh, S.C.L., Tatoglu, E., and Zaim, S. (2006). TQM and market orientation's impact on SMEs' performance. *Industrial Management & Data Systems*, 106(8) 1206-1228.
- [10] Deros, B.M., Yusof, S.M. and Salleh, A.M. (2004). Development of A Benchmarking Implementation Framework for Small and Medium Enterprises. University of Technology Malaysia. PhD Thesis.
- [11] Noviyarsi and Yusof, S.M. (2005). Development of A Proposed Quality Engineering (QE) Implementation Framework for Malaysian Automotive Suppliers. University of Technology Malaysia. Masters Thesis.
- [12] Zadry, H.R., and Yusof, S.M. (2005). Survey results on Total Quality Management (TQM) and Theory of Constraints (TOC) implementation in Malaysia Automotive Suppliers, in *Proceeding of the 35th International Conference on Computers and Industrial Engineering 2005 (ICCIE2005)*, 19th-22nd June 2005, Istanbul, Turkey pp 2239-2244.
- [13] Aziz, Z.A., Chan, J.F.L. and Metcalfe, A.V. (2000). Quality Practices in The Manufacturing Industry in the UK and Malaysia. *Journal of Total Quality Management*. 11(8). 1053-1064.
- [14] Zakuan, N., and Yusof, S.M. (2007). A comparative study of quality practices and implementation for Malaysian automotive manufacturer: A review, in *Proceeding of the 2nd International Engineering Convention (INTEC2007)*, 10th-14th March 2007 Jeddah, Saudi Arabia, pp 51-58.
- [15] Saraph, J.V., Benson, P.G. and Schroeder, R.G. (1989). An instrument for measuring the critical factors of quality management. *Decision Science*. Vol 20 pp 810-829.
- [16] Flynn, B.B., Schroeder, R.G. and Sakakibara, S. (1994). A framework for quality management research and an associated measurement instrument. *Journal of Operations Management*, Vol. 11, pp 339-366.
- [17] Puffer, S.M., and McCarthy, D.J. (1996). A framework for leadership in a TQM context. *Journal of Quality Management*, Vol 1, pp 109-130.
- [18] Crosby, P.B. (1979). *Quality is free – the Art of Making Quality certain*, McGraw-Hill, New York. NY.
- [19] Deming, W.E. (1982). *Quality, productivity and competition position*, MIT Institute for Advanced Engineering Study, Cambridge.
- [20] Garvin, D.A. (1983). Quality on the line. *Harvard Business Review*, September–October. pp65-75.
- [21] Gilbert, R.J. (1990). Are you committed ?, *Quality progress*, May, pp45-48.
- [22] Gryna, F.M. (1991). The quality director of the 90s. *Quality Progress*, May, pp51-54.
- [23] Steeples, M.M. (1992). *The corporate guide to the Malcolm Baldrige National Quality Award*, Business One Irwin, Homewood.
- [24] Ishikawa, K. (1985). *What is Total Quality Control? The Japanese Way*, Prentice Hall, New York.
- [25] Lascelles, D.M. and Dale, B.G. (1989). A review of the issues involved in quality improvement. *International Journal of Quality & Reliability Management*, 5(5) pp76-94.
- [26] Sila, I. and Ebrahimpour, M., (2002). An investigation of the total quality management survey based research published between 1989 and 2000: A literature review. *International Journal of Quality & Reliability Management*. 19(7). 902-970.
- [27] Godfrey, A.B. (1993). Ten areas for future research in total quality management. *Quality Management Journal*. Vol 1, pp47-70.
- [28] Choppin, J. (1991). *Quality through people – A blueprint for proactive Total Quality Management*, Pfeiffer & Company, San Diego.
- [29] Rao, S.S., L.E. Solis, and Raghu-Nathan. (1999). A framework for international quality management research: Development and validation of a measurement. *Total Quality Management* 10(7). 1047-1075.
- [30] Ahire, S.L., Golhar, D.Y., Waller, M.A., (1996). Development and validation of TQM implementation constructs. *Decision Science*. 27 (1) pp 23-56.
- [31] Parast, M.M., Adams, S.G., Jones, E.C., Rao, S.S. and Raghu-Nathan, T.S. (2006). Comparing Quality Management Practices between the United States and Mexico. *Quality Management Journal*. 13(4). 36-49.

- [32] Sila, I. (2007). Examining the effects of contextual factors on TQM and performance through the lens of organizational theories: An empirical study. *Journal of Operations Management*. Vol 25 pp 83-109.
- [33] Anderson, J.C. and Gerbing, D.W. (1998). Structural Equation Modelling in practice: A review and recommended two-step approach. *Psychological Bulletin*. 103 (3) pp 411-423.
- [34] Rohani, J.M., Yusof, S.M. and Mohamad, I. (2006). A relationship between statistical process control practices and improving quality performance: A theoretical framework/model, in *Proceedings of the International Conference on Manufacturing Science and Technology (ICOMAST)*, 28th 30th August. Melaka, Malaysia. Pp 557-560.
- [35] Projogo, D.I. and Sohal, A.S. (2004). The multidimensionality of TQM practices in determining quality and innovation performance: An empirical examination. *Technovation*. 24 pp 443-453.
- [36] Singh, P.J. and Smith, A.J.R. (2004). Relationship between TQM and innovation: An empirical study. *Journal of Manufacturing Technology Management* 15 (5) pp 394-401.
- [37] Lin, C., Chow, W.S., Madu, C.N., Kuei, C.H., and Yu, P.P. (2005). A structural equation model of supply chain quality management and organizational performance. *International Journal of Production Economics*. Vol 96, pp 355-365.
- [38] Sanchez-Rodriguez, C., Dewhurst, F.W. and Martinez-Lorente, A.R. (2006). IT use in supporting TQM initiatives: an empirical investigation. *International Journal of Operations & Production Management*. 26(5) pp 486-504.
- [39] Liker, J.K., Kamath, R.R. and Wasti, S.N. (1998). Supplier involvement in design: a comparative survey of automotive suppliers in the USA, UK and Japan. *International Journal of Quality*. 3(3) pp 214-238.
- [40] Ahire, S.L. and Dreyfus, P. (2000). The impact of design management and process management on quality: an empirical investigations. *Journal of Operations Management*. Vol 18, pp 549-575.
- [41] Narasimhan, R. and Nair, A. (2005). The antecedent role of quality, information sharing and supply chain proximity on strategic alliance formation and performance. *International Journal of Production Economics*. Vol 96, pp 301-313.
- [42] Hemsworth, D., Sanchez-Rodriguez, C. and Bidgood, B. (2005). Determining the impact of quality management practices and purchasing-related information system on purchasing performance. *The Journal of Enterprise Information management*. 18(2) pp 169-194.
- [43] Grobler, A. and Grubner, A. (2006). An empirical model of the relationships between manufacturing capabilities. *International Journal of Operations & Production Management*. 26(5) pp 458-485.
- [44] Suradi, N.R.M., Wan, N.N. and Mohamed, W.N. (2007). Modeling of quality technical education using path analysis, in *Proceeding of the 2nd International Engineering Convention (INTEC2007)*, 10th-14th March 2007 Jeddah, Saudi Arabia, pp 298-303.
- [45] Yusof, S.M. and Aspinwall, E., (2000). Critical success factors for total quality management implementation in small and medium enterprises, *Total Quality Management*, 10 (4, 5) pp. 803-809.