Middle-East Journal of Scientific Research 10 (4): 489-495, 2011
ISSN 1990-9233
© IDOSI Publications, 2011

A Framework for Applying ERP in Effective Implementation of TQM

M.M. Movahedi and M. Nouri Koupaei

Department of Management, Firoozkooh Branch,
Islamic Azad University, Firoozkooh, Iran

Abstract: ERP (Enterprise Resource Planning) is an integrated system that gathers whole decision making information from all the departments of a company into one single place and plays an important role to integrate organization's information, functions and results in successful operation in global markets. On the other hand, TQM (Total Quality Management) is a management system for a customer focused organization that involves all employees in continual improvement of all aspects of the organization. Nowadays, the effective implementation of TQM, for word-class performance and leadership, is a necessity. In this paper, we expect to create business process automation and interaction between environment and technology by applying ERP. The answer to the question ”how can we use ERP as an enabler for the implementation of effective TQM?” is very important. The aim of this study is to introduce a framework for applying ERP in effective implementation of TQM. Finally, a model is developed to represent the relationship between ERP and the implementation of TQM.

Key words: Enterprise Resource Planning (ERP) · Total Quality Management (TQM) · Competitive Management

INTRODUCTION

In underdeveloped countries most companies have been forced to join global markets. The emergence of Total Quality Management (TQM) has been one of the major developments in management practice. TQM is a widely recognized management philosophy and has become the key slogan as organizations strive for competitive advantage in markets [1]. TQM is a continuous process to strive for the improvement involving everyone in an organization. This improved performance is directed toward satisfying such cross-functional goals as quality, cost, schedule and suitability. The effort is “ultimately” focused on increased customer satisfaction. Enterprise Resource Planning (ERP) is a software system to manage business which supports all of operational areas such as planning, production, selling, marketing, distribution, accounting, human resource, inventory management, quality control, maintenance, transportation and e-business. The most important feature of ERP is its ability to integrate and automate the process of businesses, share information in the whole company and provide and access to well-timed information. Finally, its result in successful operation of a company in global market can be guaranteed [2].

TQM began to be introduced in the US around 1980, primarily in response to severe competitive challenges of Japanese companies. The recognition of TQM, as a competitive advantage, is widespread around the world, especially in Western countries and today very few (especially manufacturing) companies can afford to ignore the term TQM [3]. According to another definition, TQM is a management philosophy that seeks to integrate all organizational functions (marketing, finance, design, engineering and production, customer service, etc.) to focus on meeting customer needs and organizational objectives [4].

On the other hand, an ERP is a set of highly integrated applications consisting of applications modules which can be used to manage most of the business functions within an organization. An ERP is designed in such a way that will fit to a variety of different types of business. This is achieved through the extensive use of multi-level parameters which, when set properly, can adapt the ERP for the specific needs of the organization implementing it [5]. ERP uses an integrated database to consolidate data and provide local and global information for effective decision-making. These systems can be fast accessed to critical data and configured to grant users selective access to information depending on

Correspondent Author: M. Mehdi Movahedi, Department of Management, Firoozkooh Branch, Islamic Azad University, Firoozkooh, Iran.

their work roles [6-8]. These systems support information along with a company value chain and help to achieve operating efficiency [9]. So, ERP creates islands of information in the organization [10].

Despite the advantages of TQM, it is clear that TQM is not a solution for solving all problems and removing faced with the challenge of liberalization across borders. So, Mukherjee provided a model for organization's world-class performance [11]. Based on the benefits of ERP and the relationship between TQM and ERP, in this paper, we are going to discuss the effect of ERP to improve Mukherjee's Model.

This research was carried out to answer to the needs to TQM with ERP. The rest of this paper is organized as follows: Section 2 consists of a brief literature review of ERP and TQM. In section 3, we discuss three stages of Mukherjee's theory of holistic management system for world-class performance [11] and leadership and advantages of using ERP. Section 4 describes the proposed model, hypothesis and other information about statistical community. Section 5 proposes the analysis of information. The final section summarizes the conclusions and suggestions.

Literature Review: This study tries to validate the causal effects of TQM and ERP implementation. Many recent studies have focused on the application of ERP in TQM. These studies emphasized the relationship between ERP and TQM. Despite the differences between these researches, almost all of these researches provide a model for the relationship between ERP and TQM.

It has been found that the readiness of some Iranian company for ERP is low, therefore, the company should make suitable plans about all factors identified in the research framework and should use the related experts and consultants to enhance the company's readiness for a successful ERP implementation in future. They have assessed the value of the main factors which are essential for ERP implementation in a company [12]. It has been suggested that changing the culture and policy of training plan, data acquisition method and distribution of responsibilities in these companies as key factors to the success of TQM implementation in construction companies [13].

Li *et al.,* examined the relationship between TQM, ERP implementation, operations management, customer satisfaction and a firm's performance as a result of implementing TQM and ERP [14]. They identified 12 factors leading to five constructs; three factors measure TQM focus, two measure ERP implementation, two evaluate customer satisfaction, three evaluate operations management and two assess performance. Since more and more service organizations are now implementing ERP, this study is a starting point for future research. Jha and Joshi emphasized the relevance of TQM or Business Excellence Strategy implementation for the facilitation of ERP implementation [15]. They believed that ERP plays an important role in high-level management and the coordination of procedural quality functions. They provided a model based on the philosophy of TQM, CSFs and Business Excellence Models for TQM and ERP implementation. Shahrabi develop a model that can be used in creating an effective relationship with suppliers, timely response to customer demands and to achieve manufacturing agility [16]. Varzandeh and Farahbod studied the role of ERP among selected industries to get "Six Sigma" quality [17]. Since, the new "Six Sigma" is data-driven and needs to a reliable source of information and then ERP would guide the organizations and provides them with road map to better meet customers' needs with virtually zero dissatisfaction. They called it 'new Six Sigma quality'. It has been suggested that a comparative study among more than two management philosophies (e.g. LM, TQM, TPM, CWQC, 6Sigma….) considering new approaches can be done in future research [18]. Vuksic and Spremic discused the impacts of ERP in business process renovation such as quality Assurance [19]. Irfan, S. M., *et al*, show that effective HRM and quality practices in the organization create a healthy culture in the organization [20]. Galandere-Zile identified the ERP solutions and technologies could be used in quality management oriented knowledge management system [21]. Laframboise and Reyes believed that a successful implementation of these ERP and TQM resources potentially provides a complementary resource leading to the competitive advantage [22]. Based on the literature review, ERP can be used as an enabler of TQM.

Although the studies mentioned review different dimensions of ERP, but none of them have represented the effect of ERP in organizations to attain the global level. This is the innovation of the paper. We want to develop a framework for applying ERP in effective implementation of TQM. This paper is based on scientific issues and developed on Mukherjee' studies.

Background: Since the frame of this paper is based on the theory of Mukherjee and ERP, in this section, we are going to explain the Mukherjee's theory and the advantages of using ERP.

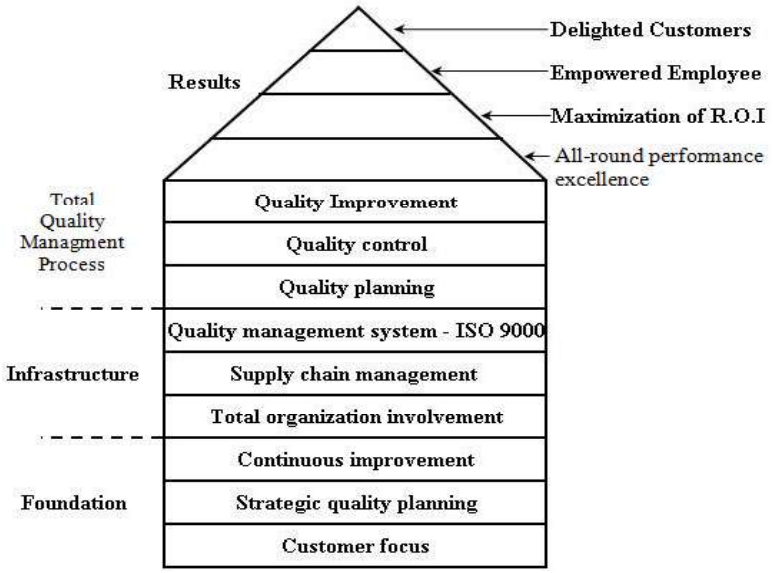

Fig. 1: Dr. P.N. Mukherjee's theory of Holistic Management System for world-class performance and leadership [11]

Mukherjee's Theory: Although there are many successful cases of TQM, but it is not an all-embracing solution for eliminating all deficiencies and meeting current challenges of the globalization and liberalization. So, Mukherjee presented a model for the organization's world-class performance of Indian organizations [11]. This model has a three-step module of Foundation, Infrastructure and Total Quality Management (figure 1). Each consists of further three sub-divisions as below:

Foundation: Customer focus, Continuous improvement and Strategic quality planning.

Infrastructure: Total organization involvement, Logistics and Supply chain management and Quality management system

Total Quality Management: Quality planning, Quality control and Quality improvement.

According to this theory, if this model is implemented step by step, it will enable the organization to achieve its end, i.e., the vision or the long term strategic position that the organization is aiming to practice. This model will ensure the organization to attain 'total quality' in every sphere of its working, i.e., to attain the ultimate in its performance which is the best of its class in the world [11].

As ERP creates the business process automation and interaction between environment and technology, the answer to this question "how can use this system as an enabler for the implementation of effective TQM until the third stage are improved to global level?" is important.

Advantages of Using ERP: ERP is a kind of organizational information system generated for the completion and optimization of business process and transactions of companies. This system is an industrial approach and generally used by industries as a useful solution to access the integrated organizational information systems. During 1990s, ERP was suitable alternative for traditional systems of big and multinational organizations. Nowadays, ERP is, effectively, the peak and completion of information systems. Installing an ERP has many advantages. Some of these advantages are as follow [23-25]:

- Automated ordering and payment, lowering payment processing and paper costs and bureaucratic documentations
- Rapid access to detailed account histories and improved efficiency information integration for decision-making, providing more abundant information and improved planning and analysis
- Updating IT and communication infrastructures and improving competitive advantages
- Improvement of different plans and programs of an organization and facilitate the strategic planning
- Improving the time accountability and response to customers
- Receiving information based on a regular and uniform reporting due to global standards

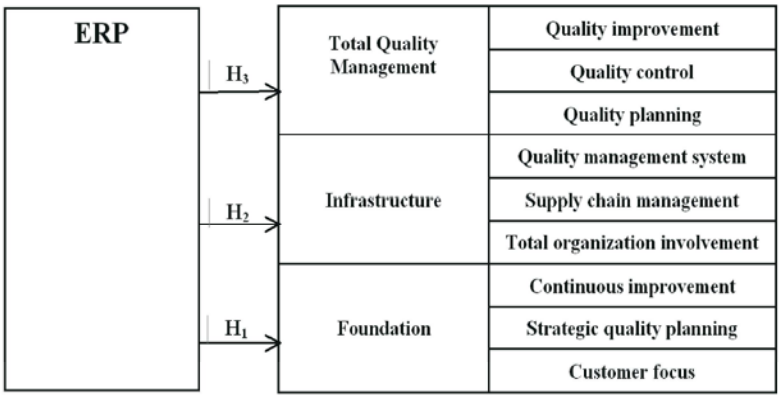

Fig. 2: The conceptual model: The effects of ERP on the three steps of Mukherjee' Model

Conceptual Model and Hypotheses: This section discusses the research construction and derives the hypotheses. Figure 2 depicts the research model and summarizes the hypotheses derived. As was mentioned, TQM is a management philosophy that seeks to integrate all organizational functions (marketing, finance, design, engineering and production, customer service, etc.) to meet the customer needs and organizational objectives [4]. On the other hand, an ERP is a set of highly integrated applications consisting of applications modules which can be used to manage most of the business functions within any organization. So, the sentence "ERP can be used as an enabler for the implementation of effective TQM" is the hypothesis of this study. To get the main hypothesis, in three hypotheses are examined.

Hypothesis: In this study we are going to measure the role of ERP in effective implementation of these steps. Based on Mukherjee's theory and quality control managers opinion, proposed model and the hypothesis of performance are stated as followings (figure 2):

- Hypothesis H1. ERP is effective for the implementation of Total Quality Management foundation.
- Hypothesis H2. ERP is effective for the implementation of Total Quality Management infrastructure.
- Hypothesis H3. ERP is effective for the implementation of Total Quality Management process.

Statistical Community: Statistical community of this study include the experts in the field of quality management and ERP, such as quality control managers of organizations that have been implemented ERP, book authors, researchers, professors and masters and university faculty members, having expertise in this area and the data collection method will use the questionnaires.

The First Hypothesis Is Consisted of Three Parts: Customer focus, Strategic quality planning and Continuous improvement. To test this hypothesis, 12 questions, in the questionnaire, are provided in which 4 questions are related to the first part, 5 questions related to the second part and 3 questions related to the third part.

The Second Hypothesis Is Divided to Three Parts: Total organization involvement, Supply chain management and Quality management system. To test this hypothesis, 8 questions, in the questionnaire, are provided in which 2 questions are related to the first part, 3 questions related to the second part and 3 questions related to the third part.

The Third Hypothesis Is Consisted of Three Parts: Quality planning, Quality control and Quality improvement. To test this hypothesis, 10 questions, in the questionnaire, are provided which 3 questions are related to the first part, 3 questions related to the second part and 4 questions related to the third part.

Also, one sample t-test is used to test the hypothesis.

Validity and Reliability: According to experts and professors and Masters Opinions, the validity has been reviewed and approved. Questions extracted for the questionnaire are based on the Mukherjee's theory and are largely related to the research topic. We use the Cronbach's Alpha to calculate the reliability. The value of this factor has 0.866. The findings indicate a high correlation between the results of questionnaire survey.

Sample Size: The sample size formulas and procedures used for categorical data are very similar, but some variations do exist. Since the data are qualitative and the number of statistical community is unlimited, so the calculation formula of the sample size is as follows [26]:

$$n = \frac{z_{\alpha/2}{}^2 p_\circ (1 - p_\circ)}{\varepsilon^2} \quad (1)$$

In this study, researcher has set the alpha level a priori at. 05, plans to use a proportional variable, has set the level of acceptable error at 5% and has estimated the standard deviation of the scale as 5. Cochran's sample size formula for categorical data and an example of its use is presented here along with explanations as to how these decisions were made.

$$n = \frac{1.96^2 \times 0.5 \times 0.5}{0.1^2} = 96.04 \quad (2)$$

Where $Z_{a/2}$ = value for selected alpha level of 0.025 in each tail = 1.96.

(The alpha level of 0.05 indicates the level of risk the researcher is willing to take that true margin of error may exceed the acceptable margin of error).

Where (p)(q) = estimate of variance = 0.25.

(Maximum possible proportion (0.5) *1-Maximum possible proportion (0.5) produces maximum possible sample size).

Where $\in$ = acceptable margin of error for proportion being estimated = 0.1

(Error researcher is willing to except).

According to the formula at least 97 samples are needed. Therefore, 100 questionnaires were sent to the experts and collected.

Analysis of Information: Questionnaires were distributed to the experts, quality managers, book authors, researchers, professors and masters and university faculty members, who skilled in this area. Results of the descriptive tests indicate that, in Iran, applying ERP has good effect to achieve a successful implementation of all three steps of Mukherjee model in this study. 47% of these experts have a master degree, 34% have Ph.D. and 19% have a bachelor. 81% of these experts are male and 19% female. Also, academic field of these experts are Industrial Engineering, Management, IT, Computer Engineering and few experts in other academic fields.

We used SPSS 19.0 to analyze the data. In following, the results of testing hypothesis are developed:

Testing Hypothesis H1: ERP is effective for implementation total quality management foundation.

$\mu \geq 5$ ERP is effective for implementation total quality management foundation.

$\mu < 5$ Otherwise.

The results of SPSS are shown below:

Testing Hypothesis H2: ERP is effective for implementation of the total quality management infrastructure.

Table 1: One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
H1	100	6.6058	1.02867	0.10287

Table 2: One-Sample Test

	Test Value = 5					
					95% Confidence Interval of the Difference	
	T	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
H1	15.611	99	.000	1.60580	1.4017	1.8099

Table 3: One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
H2	100	6.8078	1.09900	0.10990

Table 4: One-Sample Test

	Test Value = 5					
					95% Confidence Interval of the Difference	
	T	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
H2	16.449	99	0.000	1.80780	1.5897	2.0259

Table 5: One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
H3	100	6.2250	1.01915	0.10191

Table 6: One-Sample Test

	Test Value = 5					
					95% Confidence Interval of the Difference	
	T	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
H3	12.020	99	0.000	1.22500	1.0228	1.4272

$\mu \geq 5$ ERP is effective for implementation total quality management infrastructure.

$\mu < 5$ Otherwise.

The results of SPSS are shown below:

Testing Hypothesis H3: ERP is effective for implementation total quality management process.

$\mu \geq 5$ ERP is effective for implementation total quality management process.

$\mu < 5$ Otherwise.

The results of SPSS are shown below:

CONCLUSIONS

An attempt has been made by this exploratory research to emphasize the relevance of TQM for the facilitation of Mukherjee' theory implementation. The organizations can realize the full benefits of ERP successful integration of several departments and facilitate strategic planning improvement and responsiveness to customers, each of which are key element, of the Mukherjee' theory. According to this theory, three steps including: Foundation, infrastructure and total quality management, are necessary to get the global level.

This paper examined the effects of ERP on during three steps of Mukherjee' Model. This study has three hypotheses and based on research finding, all hypothesis were confirmed. The results of the study indicated a conceptual model representing ERP can be used as an enabler for the implementation of effective TQM until 3 steps are done to reach the global level.

REFERENCES

1. Wang, C.H., K.Y. Chen and S.C. Chen, 2012. Total Quality Management, market orientation and hotel performance: The moderating effects of external environmental factors, International Journal of Hospitality Management, 31: 119-129.
2. Fui-Hoon, F., H. Nah and J. Lee-shang Lau, 2001. Critical factors for successful implementation of enterprise resource planning systems. Business Process Management Journal, 7(3): 289-295.
3. Prajogo, D.I. and A.S. Sohal, 2001. TQM and innovation: a literature review and research framework, Technovation, 21: 539-558.
4. Talib, F., Z. Rahman and M.N. Qureshi, 2010. Integrating Total Quality Management and Supply Chain Management: Similarities and Benefits, Journal of Information Technology and Economic Development, 1(1): 53-85.
5. Macris, A.M., 2011. Enhancing Enterprise Resource Planning users' understanding through ontology-based training, Computers in human behavior, 27: 1450-1459.

6. Clemmons, S. and S.J. Simon, 2001. Control and coordination in global ERP configurations, Business Process Management Journal, 7(3): 205-215.
7. Koch, C., 2001. Enterprise resource planning: Information technology as a steamroller for management politics. Journal of Organizational Change Management, 14(1): 64-78.
8. Markus, M.L., C. Tanis and P.C. Fenema, 2000. Multisite ERP implementations, Communications of the ACM., 43(4): 42-46.
9. Law, C.C.H. and E.W.T. Ngai, 2007. ERP adoption: An exploratory study of the organizational factors and impacts of ERP success, Information and Management, 44: 418-432.
10. Chang, M.K., W. Cheung, C.H. Cheng and J.H.Y. Yeung, 2008. Understanding ERP system adoption from the user's perspective, Int. J. Production Economics, 113: 928-942.
11. Mukherjee, P.N., 2006. Total Quality Management, Prentice Hall of India, New Delhi.
12. Hydeh Mottaghi, H. and H. Akhtardanesh, 2010. Applying Fuzzy Logic in Assessing the Readiness of the Company for Implementing ERP, World Applied Sciences Journal, 8(3): 354-363.
13. Bin Abu Bakar, A.H., Khalid Bin Ali and Eziaku Onyeizu, 2011. Total Quality Management Practices in Large Construction Companies: A Case of Oman, World Applied Sciences Journal, 15(2): 285-296.
14. Li, L., C. Markowski, L. Xu and E. Markowski, 2008. TQM-A predecessor of ERP implementation, Int. J. production economics, 115: 569-580.
15. Jha, V.S. and H. Joshi, 2007. Relevance of Total Quality Management (TQM) or business excellence strategy implementation for Enterprise Resource Planning (ERP)-A conceptual study, proceedings of the 12th international conference on information quality, ICIQ-2007 at MIT, Cambridge, MA.
16. Shahrabi, B., 2011. The Agility Assessment Using Fuzzy Logic, World Applied Sciences Journal, 13(5): 1112-1119.
17. Varzandeh, J. and K. Farahbod, 2010. Comparative and Strategic Role of ERP in Six Sigma Quality, ASBBS Annual Conference: Las Vegas, 17(1): 511-516.
18. Anvari, A., Y. Ismail and S.M.H. Hojjati, 2011. A Study on Total Quality Management and Lean Manufacturing: Through Lean Thinking Approach, World Applied Sciences Journal, 12(9): 1585-1596.
19. Vuksic, V.B. and M. Spremic, 2005. ERP System Implementation and Business Process Change: Case Study of a Pharmaceutical Company, Journal of Computing and Information Technology, Department of Business Computing, Graduate School of Economics and Business, University of Zagreb, Croatia, 13(1): 11-24.
20. Irfan, S.M., M. Mohsin and I. Yousaf, 2009. Achieving Service Quality Through its Valuable Human Resources: An Empirical Study of Banking Sector of Pakistan, World Applied Sciences Journal, 7(10): 1222-1230.
21. Galandere-Zile, I., 2004. Applicability of ERP for Knowledge Management in the Context of Quality Management, CAiSE 2004, LNCS 3084, pp: 276-289.
22. Laframboise, K. and F. Reyes, 2005. Gaining competitive advantage from integrating enterprise resource planning and total quality management, Journal of Supply Chain Management, 41(3): 49-64.
23. Nouri Koupaei, M. and S. Rouhani, 2011. Integrated Framework for Promotion of Quality Management by Utilizing Business Intelligence, International Conference on Business Intelligence and Financial Engineering, Hong Kong, China.
24. Eshlaghi, A.T., A. Asadollahi and A. Poorebrahimi, 2011. The Role of Enterprise Resources Planning (ERP) in the Contribution and Integration of the Information in the Supply Chain, European Journal of Social Sciences, 20(1): 16-27.
25. Rasoulian, M., F. Bagheri, A. Moghaddam and B. Shariflu, 2011. Implementation of Enterprise Resource Planning Systems and Management Accountants' Roles, American Journal of Scientific Research, ISSN 1450-223X, 31: 32-41.
26. Cochran, W.G., 1977. Sampling techniques (3rd ed.), New York: John Wiley and Sons.