



Cairo University

MODELING TOTAL QUALITY MANAGEMENT AND LEARNING ORGANIZATION IN CONSTRUCTION DESIGN ORGANIZATIONS USING SYSTEM DYNAMICS

By

Dalia Abdel Aal Ibrahim Abdel Rahman

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements for the Degree of
MASTER OF SCIENCE
in
STRUCTURAL ENGINEERING

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Summary:

Organizational performance improvement is a strategic goal for any organization. Design organizations adopt popularity effective management concepts like total quality management (TQM) depend on basic management principals to achieve the objectives of all involved stakeholders. Recently, learning organization (LO) concept has been emerged as a new management concept to improve organization's performance. This research aims at developing a model that represents the relationship between total quality management's principals and learning organization's dimensions through causality links using system dynamics approach. The model helps construction design organizations to improve its overall performance by moving towards being a learning organization through developing existing quality system policies and procedures. The model is implemented using Vensim PLE[®] software package, and it is validated through structured interviews with quality professionals, key management employees and system users. Frequency analysis technique is used to discover the level of influence of the model's variables on each other. Sensitivity analysis is conducted to determine the most sensitive variable on performance that affect the overall total quality management maturity level and progress of learning level. A case study of construction design organization is presented to demonstrate the use of the proposed dynamic models. The findings of the case analysis reveal that more leadership involvement with different means, investing in the organization's human capital and embracing a strategy based on shared vision between management and employees together with a system of policies and procedures supporting these targets. These actions supports improving the learning environment and leads to improvement in the quality maturity level which improves organization's overall performance at the end.

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LIST OF ABBREVIATIONS

ABBREVIATION	DESCRIPTION
TQM	Total Quality Management
TQL	Total Quality Learning
TQC	Total Quality Control
LO	Learning Organization
OL	Organizational Learning
ISO	International Standards Organization
TQMI	Total Quality Management Index
SD	System Dynamic
CLD	Causal Loop Diagram
MBNQA	Malcolm Baldrige National Quality Award Model
EFQM	European Foundation for Quality Management)

ABSTRACT

Organizational performance improvement is a strategic goal for any organization. Construction design organizations adopt popularity effective management concepts like total quality management (TQM) to achieve involved stakeholders' objectives. Recently, learning organization (LO) concept has been emerged as a new management concept applied to improve organization's performance. This research aims at developing a model that represents the relationship between total quality management's principals and learning organization's dimensions through causality links using system dynamics approach. The model helps construction design organizations to improve its overall performance by moving towards being a learning organization through developing existing quality system policies and procedures. The model is implemented using Vensim PLE[®] software package, and it is validated through structured interviews with quality professionals, key management employees and system users. Frequency analysis technique is used to discover the level of influence of the model's variables on each other. Sensitivity analysis is conducted to determine the most sensitive variable on performance that affect the overall total quality management maturity level and progress of learning level. A case study of construction design organization is presented to demonstrate the use of the proposed dynamic models. The findings of the case analysis reveal that more leadership involvement with different means, investing in the organization's human capital and embracing a strategy based on shared vision between management and employees together with a system of policies and procedures supporting these targets. This leads to improvement in the quality maturity level which improves organization's overall performance.

CHAPTER 1

INTRODUCTION

1.1 General

Many Organizations apply management strategies and concepts to improve competitiveness and performance. The Quality has become one of the main dimensions on which manufacturing as well as service organizations may compete. Therefore, total quality management as a well-known management concept gained popularity during the past decades as a positive influencer in organizations' performance. Also applying the learning organization concept and implementing organizational learning mechanisms effectively increases organizations' management capabilities and utilizing their knowledge effectively, consolidates the learning organization pillars and overcomes learning disabilities, which reinforces general organizational development. Total Quality Management (TQM) mainly is based on continuous improvement "one of its eight principals" that requires a commitment to learning, which means that TQM could essentially considered a mean to build learning organization.

The quality movement passed through three waves of development. The first wave was total quality management (TQM), the second wave was about embedding flexibility and flux within organizations to achieve wide dynamic performance, and the third wave was about learning institutionalization. Senge (1994)[1]. With time, the quality movement came to be acknowledged as the forerunner in creating learning organizations (Elkjaer 1999)[2] and organizational learning has been considered a necessary outcome of a TQM initiative (Ferguson et.al.2005)[3]. A similar conclusion was drawn using the structured equation modelling technique in a study of small and medium-sized enterprises (Martinez & Jimenez 2009)[4] in the service sector (Moreno et.al.2005) [5] ;(Ang et.al.2011)[6] and in a cross-national study of manufacturing organizations (Sun et.al. 2008)[7] and in high-tech organizations (Hung et.al.2010)[8].

Researchers like Sitkin et.al. (1994)[9] discussed that total quality management (TQM) consists of both total quality control (TQC) and total quality learning (TQL). Accordingly, under conditions of high uncertainty and task complexity, taking a TQL improvement results in higher performance than a TQC approach (Linderman et.al.2004)[10]. Looking at TQM implementation from the angle of quality awards, Leonard and McAdam (2003)[11] supported this linkage between TQC and TQL. They argued that quality awards assessment process like the Business Excellence Model and the Malcolm Baldrige National Quality Award (MBNQA) should be appreciated not just in terms of institutionalization of superior quality levels (a process akin to TQC) but also in terms of the institutionalization of the benefits emanating from organizational learning (a process akin to TQL). Therefore, it is possible to conclude that TQM affects the way in which organizations learn (Martinez & Jimenez 2009)[4].

1.2 Problem Statement

To improve the organization's performance and competitiveness, many organizations during the past decades adapted total quality management concept (TQM). Sila (2007)[12] concluded that effective implementation of TQM can be reached by applying quality systems conforming to international standards organization ISO 9000/2000 series quality accreditation system. And that it is expected as a result of their orientation towards ISO9000 that ISO-registered organizations implement TQM practices more effectively compared with non-ISO-registered organizations.

Previous studies stressed the role of TQM in maintaining a sustainable competitive advantage by facilitating intangible resources such as knowledge (Thigarajan and Zairi 1997)[13]; (Zakuan et al. 2010)[14]. Also, Aydin and Ceylan (2009)[15] concluded that the organization's ability to apply preserve and retrieve new knowledge plays a critical role in organizational learning. That is defined as developing and implementing new knowledge to change employees' culture and behavior to enable organization growth through innovation. Kofoed et.al.(2002)[16] argued the effect of continuous improvement (main principal of TQM) on organizational learning and change oriented aspects that inherent in the TQM definition. Researchers Ruiz-Moreno et.al.(2005)[17] and Crossan et.al.(1999)[18] reached that learning in TQM practices enables organizations to create new markets and enhance their competitive advantage. Love et.al.(2000)[19]; Moreno et.al. (2005)[20]; and Martinez & Jimenez (2009)[4] concluded that Total quality management (TQM) practices can be used to promote learning in business settings. In TQM practices, organizational learning enables firms to create a unique resources, and turn resources into sustainable competitive advantage for above average returns (Mosakowski (1993)[21]; Barney (1991)[22]; and Barney (2001)[23]. Moreover, Marshall et.al.(2009)[24]; and Schein (1996)[25] considered organizational learning a main resource for organizations to achieve and maintain efficiency, competitive advantage and growth.

Although the above mentioned conceptual link between TQM and organizational learning, Sun et.al.(2009)[7] has reported the need for more cases to illustrate the dynamics and mechanism of how TQM and organizational learning can be integrated. This points to a gap that has largely remained unaddressed in some literature. Similarly, Mitki et.al.(1997)[26]while recognizing the link between TQM and organizational learning also acknowledge this gap when they argued that the learning process mechanisms are guided through the spiral of active experimentation, generalization, reflection, and corrective action are needed so an organization can improve continually. The literature on organizational learning calls these mechanisms and defined them as procedural arrangements and institutionalized structural that allow organizations to collect, store, analyze, and systematically use information that is relevant to their and their members' performance. (Popper and Lipshitz 1998)[27]. Organizational learning mechanisms enable analyzing and sharing organization's individual members' experiences by other members. They stated that "the experience becomes the organization's property through the distribution of lessons learned ". (Lipshitz and Popper 2000)[28].

Garvin (1993)[29] argued that if the learning from organizational experiences is a critical enabler for TQM, a formal method that can integrate a learning mechanism into TQM implementation has largely missed the TQM literature. Therefore, while it has been recognized since the early 1990s that the learning organization which adapts TQM committed to continuous improvement, the question remains unanswered is what are the most TQM variables that affect the learning process during the continuous improvement process? And what kind of learning mechanisms are the most supportive of continuous improvement process? (Saivolenen and Haikonen 2007)[30].

1.3 Research Objectives

The objective of this research is to demonstrate the relationship between total quality management concept (TQM) and learning organization concept (LO). To prove the relation, a simulation model using system dynamics approach is developed to represent this relation in construction design organizations. This aids organizations that apply quality systems in understanding the relation between total quality management and learning organization. The proposed model aids in improving the performance of organizations applying TQM principals/quality management systems through learning.

Modeling this relation enables assessing the most effective variables in the relation and reinforce it to overcome the learning disabilities. It assists managers to understand the dynamic feedback nature of work and closes open gaps between quality system policies and procedures and organizational learning techniques to reach a complete integration. Which result in improving the whole organization performance.

1.4 Research Methodology

To achieve the above mentioned objectives, the following research methodology is followed:

- Review the pertinent literature and available documents that studied this issue before.
- Develop a mental qualitative model “Causal loop diagram “in order to understand the dynamics of total quality management principles (achieved by applying quality management system) and the dynamics of a learning organization firm as well as the causal relation between each variable and the other. The model variables and relationships are extracted from relevant literature plus suggested variables by researcher.
- Translating the developed causal loop into a stock and flow diagram. This was done through defining each variable in the causal loop either as stock, flow, or auxiliary based on the understanding of the system.
- Develop a systematic analysis model using system dynamics with the aid of the available software package Vensim PLE®.
- Simulate the system dynamics model using Vensim software by encoding the prepared stock and flow diagram to understand the behavior of all the variables in the studied relation.
- Check the results then validate the causality relationships and variables’ dynamic behavior between the model’s variables using structured interviews with different category of employees in the targeted organizations.
- Modify the model accordingly and conduct sensitivity analysis to show the modifications impact on variables assumptions, and on the model results.
- Present and describe the model outcomes through visual graphical representation to show the dynamic behavior pattern of the models variables.
- Provide recommendations for future research.

1.5 Thesis Organization

Following this introductory chapter, the thesis is organized as follows:

Chapter 2 presents an overview for the previous researches that studied the relation between total quality management (TQM) and learning organization (LO) from different aspects. Also, it explains total quality management (TQM) is and its relation with ISO standards, learning organization and organizational learning, and the relation between TQM and LO from literature. And explains the system dynamics as a tool that helps in system thinking and its contribution in solving strategic problems. It also highlighted the use of system dynamics in quality management as it provides insight into behavior and evolution of complex systems.

Chapter 3 presents a description for the designed model. It explains the dynamic hypothesis on which the model is constructed, the designed causal loop diagram and the causal relationships between the variables, as well as the transformation to stock and flow diagram. In addition, this chapter includes the model boundary diagram, model assumptions and simplifications and