TQM

Total Quality Management

ABSTRACT

The objective of our paper is to identify factors and develop constructs that could be used to develop a conceptual Total Quality Management (TQM) model that is applicable to small and medium scale manufacturers in the United States. The data for this study was collected from a mail survey targeted to managers in the manufacturing plants. Responses were analyzed and factor analysis was used to develop measurement instruments.

TQM

In Small And Medium Scale Manufacturers: Development Of Measurement Instruments

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INTRODUCTION

Excellence in manufacturing system has become important to gain the competitive advantage (Womack, Jones and Roos, 1990 and Holweg and Pil, 2004). Manufacturers in their quest to remain competitive started nurturing their core competencies. Large scale manufacturers are outsourcing most of the other activities (Fine, 1998; Friedman, 2006), and have essentially become assemhlers of parts resulting in ever expanding global supply networks (Womack, Jones and Roos, 1990 and Holweg and Pil, 2004; Fine, 1998, Friedman, 2006). Consequently, total quality manufacturing system has become a required miniunum to be a part of (national or global) supply networks of large manufacturers (Rao, Solis and Raghunathan, 1998; Womack et al., 1990) and quality, therefore, has become the most important "qualifier" (Hill, 2000).

Early research in quality was mostly prescriptive in nature. Writings of gurus such as Deming and Jurou are the examples of such studies (Petersen, 1999). It was followed by more descriptive research by Womack, Jones and Roos (1990), Holweg and Pil (2004), and Pande, Neuman and Cavanaugh (2000). They describe the successes of companies like Toyota, Motorola and GE. Researchers have always pointed out the need for empirical studies in manufacturing and quality (Rao, Solis and Raghunathan, 1999). Furthermore, while quality in small and medium scale manufactures is critical to the success of overall quality, current research mostly seem to focus of large and well-known. Although quality in small and medium scale manufactures is critical to the success of any organization, research mostly seems to focus on large and well-known organization. In this paper we attempt to fill this void by focusing on small and medium scale manufacturers in the United States. In this study we develop requisite constructs which are the building blocks of any empirical research. The objective of our paper is to identify factors aud develop constructs that could be used to develop a theoretical Total Quality Management (TQM) model that is applicable to small and medium scale manufacturers in the United States. We have also suggested directions for future research in the area.

TQM is also very much a scientific management system oriented towards data collection and analysis. The goal of TQM is to improve efficiency of the production system. To this end TQM ruthlessly focuses on reducing wastes of all kinds (Petersen, 1999; Wruck and Jenson, 1994). Implementation of TQM, therefore, should result in reduction in scrap, rework and also setup time, thus reducing overall production cost (Womack et al., 1990; Fujimoto, 1999). TQM, like any business process, should result in increasing customer satisfaction, profitability and growth for the manufacturer (Wruck and Jenson, 1994). For example, Toyota is one of the companies in the forefront of this revolution. Toyota focused not on quality assurance through inspection and rework, but on developing quality management system where each step of production is executed flawlessly. Furthermore, quality of a product is as good as the lowest quality part inside it. Therefore, many manufacturers who maintain excellence in manufacturing demand a total quality manufacturing system in their suppliers' organizations as well.

Organization of the rest of the paper is as follows. Next section discusses the identification of constructs for small and medium manufacturing companies based upon the existing literature on quality. It is followed by description of data collection through survey and research methodology used in the paper. Based on the constructs a conceptual model on TQM for small and medium manufacturing companies is presented. Finally, the paper concludes with a discussion of results and ideas for future research.

ITERATURE REVIEW

Total quality management (TQM) endeavors to produce flawless outputs, and also continuously improve the manufacturing system. To this end, workers are required to be not only fluent in scientific management systems such as Statistical Process Control (SPC) methods, but also empowered enough to make collective decisions utilizing their skills and experiences as and when required. So, trained and empowered workers are the cornerstone of the total quality management (TQM) method in any organization. Moreover, since total quality management takes systems view, inter-functional coordination inside the organization is also necessary (Wruck and Jenson, 1994; Rao et al., 1999; Petersen, 1999).

In TQM, quality of a product is defined in terms of conformance to the specifications while maintaining flexibility and speed (Hill, 2000). Quality is rightly recognized as the cornerstone on which each of these goals has to be built on (Ferdows and De Meyer, 1990). To be successful, these specifications should reflect customers needs and wants. Customer orientation requires abilities to understand the market and customers (Day, 1994). Therefore "customer orientation" (as known in the marketing literature) is the requisite characteristics of the organization following TQM.

Customer orientation provides context for SPC, empowerment of employees, and also the inter-functional communications. For example, in SPC specifications are required to decide whether or not the process is capable of being changed. Specifications make sense only if they reflect customers need. Similarly, empowerment means bringing decision making authority closer to the field. People who actually interact with customers and work on the plants are given authority, which traditionally is only held by people higher up in the hierarchy. Thus, customer orientation is expected to bring customers' voice to the plant (and vice versa) quickly without distortion (Day, 1994; Petersen, 1999 Wruck and Jenson, 1994). Based upon the available TQM literature, these following six constructs have been identified for small and medium manufacturing companies.

Workers' Training: Training is an essential part of TQM. Deming's framework demands that workers be trained (Petersen, 1999). SPC tool, which is the vital to quality control, requires extensive training (Wruck and Jenson, 1994). Successful practitioners of TQM such as Toyota in manufacturing (Womack et al., 1990; Holweg and Pil, 2004) and Wipro in computer software / hardware (Hamm, 2007) are well known for their commitments to continuously train their employees.

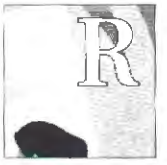
Workers' Empowerment: Deming's framework requires empowerment of workers (Petersen, 1999). Empowerment deals with authority to make decisions. Effective decisions should also take workers' knowledge and experience into account (Wruck and Jenson, 2004). In TQM workers (who are in direct contact with the job) are required to take corrective actions as and when required. Time lapse between errors and the corrective actions is not acceptable. In addition, organizations successful in implementing TQM empower their workers to make decision as a team (Womack et al., 1990; Holweg and Pil, 2004).

Inter-functional Link: TQM takes the process view of organizations. It demands all the functions to cooperate seamlessly towards the agreed goal (Petersen, 1999; Dreyfus, Ahire and Ebrahimpour, 2004). This is achieved by cross functional team works as well as deployment of the computer and communication system across the functions (Ng, Ip and Lee, 1999).

Internal Results: The goal of TQM is to improve efficiency and effectiveness in manufacturing (Petersen, 1998; Wruck and Jenson, 1999). Toyota started many of the practices attributed to TQM based on the work of Deming. When Toyota started it had a very small resource base, and it had to optimize the available resources (Womack et al., 1990; Fujimoto, 1999). Drawing upon the goals of Toyota in its initial stages, the goals of manufacturing in TQM are fewer inventories, less scrap and rework, reduced setup time and lower production cost (Rao et al., 1999).

Customer Orientation: Organizations implementing TQM are required to be customer orientated (Day, 1994). There are two aspects of customer orientation. First, they have to be able to analyze the market to understand the trend of technology and also the competitors move. This ability is captured by the construct "competitor scan" in our study. The second construct represents organization's ability to understand customers' need and demand and incorporate them in their decision-making process. This construct is called "customer link."

External Results: TQM like any business process aims at improving organizations' bottom line (Wruck and Jenson, 1994). The success in TQM is manifested by improvements in customer satisfaction and/ or improvements in financial performance (manifested by profitability and growth). External results can therefore have up to three constructs "customer satisfaction", "profitability" and "growth" (Pande et al., 2000).



ESEARCH METHODOLOGY

Data for this study were collected using a questionnaire survey, based on previous studies. The questions pertaining to internal results and financial performance are adapted from published sources such as Rao et al. (1999) and Solis (1998). The items for training and empowerment constructs are discussed in Holweg and Pil (2004), Rao et al. (1999), Solis (1998). The questions pertaining to customer orientation are from Bruner, James, and Hensel (2001).

The questionnaire was addressed to the plant managers, quality control managers or managers knowledgeable on plant operations. All the questions in the survey were five point Likert scale. They were to be answered by the respondents on the basis of their best judgments. The mailing list was bought from a professional organization. This survey was conducted in January 2008. Around 1500 surveys were mailed to small and

medium scale manufacturers. We received 93 usable responses. This is a low response rate. However this is consistent with recent experience of difficulties in getting responses in surveys.

The data collected was used for extracting factors. The process for factor extraction follows the direction of Hair, Anderson, Tatham, and Black (1998). SPSS was used for this analysis. Factor extraction was done using principal component analysis and varimax or oblimin rotation as required. Each item with factor loading of 0.4 or more was included in the particular factor. However, items with cross loadings were dropped from consideration. Further, Chronbach's alpha was measured for each of the factors. Chronbach's alpha is a measure of the reliability of the factor. A Chronbach's alpha value of 0.7 is considered good and above 0.6 is acceptable. We could extract eight factors mostly in line of conceptual discussion above. A further elaboration of the process is done in the paragraphs below.

Training and Empowerment

Trained and empowered workers are necessity for the success of quality effort. Stinginess in training and empowerment is identified as the indicator showing the extent of success in TQM efforts (Holweg and Pil, 2004). We used nine items related to the theme of training and empowerment to extract functions. Conducting principal component analysis with oblimin rotation, we got two usable factors using total of seven items. The details of the items are shown in Table 1.

Table-1 Factors/ Items Related to Training and Empowerment

Training	**Chronbach's α**	**0.815**
• *Employee rotation* • *Multiple skills* • *Ability to fix problems*		
Empowerment	**Chronbach's α**	**0.839**
• *Sufficiently trained* • *Involved in decision-making* • *Workers accountable for their decisions* • *Participate in quality related decisions*		

Internal Results

These results are the direct outcome and the sole responsibilities of the manufacturing people. Improvements in the manufacturing are shown by the reduction in levels of waste and rework and production cost. Five items were used in the factor extraction. Using principal component analysis and with oblimin rotation we got two factors. However there were only two items in the second factor and one of them was cross loaded with the first factor. So, we decided to retain only one factor as shown in Table 2.

Table-2 Factor/ Items Related to Internal Results

Internal Results	**Chronbach's α**	**0.664**
• *Level of Scrap* • *Level of Rework* • *Cost of Production*		

Customer Orientation

The items for customer orientation were adapted from Bruner et al. (2001). There were nine items. With principal component analysis and oblimin eight items were properly loaded and we extracted three factors- competitor scan, customer link and inter-functional link. Two items were dropped because of cross loading. The final result of this extraction is given in Table 3. (on next page)

Customer Satisfaction

The success of manufacturing operations must lead to tangible and intangible benefits. These benefits are measured in terms of customer satisfaction and other benefits such as lower levels of inventory, less customer complaints, lower warranty cost. We used five items for the factor extraction and got two factors. One factor is customer satisfaction which is detailed below. Other factor, though was loaded with three items (lower levels of inventory, less customer complaints, lower warranty cost) had very low reliability as measured by Chronbach's alpha. So, we ignored this factor. The other factor with two items had satisfactory Chronbach's alpha value, so this is used here to represent Customer Satisfaction Table 4. (on next page)

Financial Performance

Success of quality efforts must lead to improvement in bottom line (Pande, et al., 2000). We used items related to profitability and growth to extract factors for financial performance. We could extract two factors, but they were slightly different than our initial expectations. Of the two, we found one factor that captures plant's contribution to organization's growth and profitability to parsimoniously represent the financial performance. Results are presented in Table 5. (on next page)

Based on theoretical discussions and the constructs extracted above we propose a conceptual model, shown in the Figure 1. (on next page) This theoretical model is applicable to small and medium scale manufacturing firms whose data was used to extract constructs. Workers training, empowerment and inter-functional link has direct and positive impact on the internal results. However, this positive impact is moderated by customer orientation, which has two factors – market analysis and customer link. The internal result should have positive and direct impact on the financial performance and the customer satisfaction.

Table-3 Factors/ Items Related to Customer Orientation

Customer Link	**Chronbach's α**	**0.623**
• *Commit to Customer Satisfaction* • *Create Customer Value* • *Understand Customer Needs* • *Measure Customer Satisfaction*		
Competitor Scan	**Chronbach's α**	**0.675**
• *Respond to competitors' Actions* • *Focus on opportunities to get competitive advantage* • *Evaluate Competitors' strategy*		
Inter-functional Link	**Chronbach's α**	**0.757**
• *Integrate different functions* • *Share information among divisions*		

Table-4 Factor/ Items Related to Customer Satisfaction

Customer Satisfaction	**Chronbach's α**	**0.657**
• *Referrals by customers* • *Customers' loyalty*		

Table-5 Factor/ Items Related to Financial Performance

Customer Satisfaction	**Chronbach's α**	**0.683**
• *Plant's contribution to profitability* • *Plant's contribution to growth*		

Conceptual Model on TQM for Small and Medium Scale Manufacturers

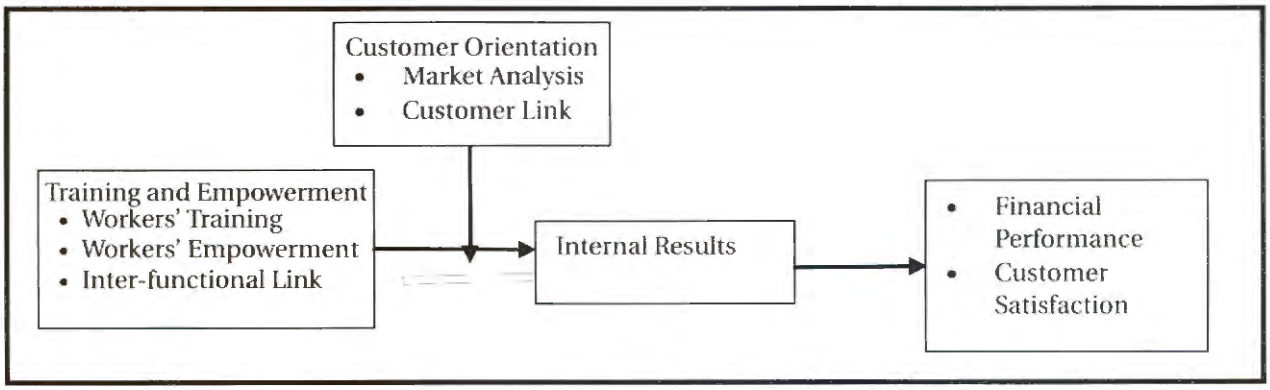


Figure I

ISCUSSIONS AND FUTURE RESEARCH

We received 93 responses in this survey. These were used for the exploratory factor analysis. The result obtained provides enough bases to propose confirmatory factor analysis and a path analysis. Path analysis allows us to test the validity of the hypotheses suggested by model in Figure 1. Further data collection is required for this purpose.

Few researchers have also pointed to the need of validating quality related constructs using data from different countries (Rao et al., 1999). Similarly, others have discussed to the need of testing the argument on "convergence" vs. "national specificity" of TQM theory (Rungtusanatham et al., 2005). Now, since epicenter of manufacturing have moved from United States to countries such as China and India, data collection from manufacturers from these countries for such tests is highly desirable.

Moreover, concepts related quality should also be validated across the industry line (manufacturing and service) (Pande, 2000). In addition it can also be validated across the enterprises of different sizes -small and medium scale and large scale. Scope of future study should be carefully decided before collecting the data.

ONCLUSION

In this article, we collected data from the American (small and medium scale) manufacturers and used them to conduct exploratory factor analysis. The data was collected from the small and medium size manufacturing enterprises in the United States. The factor analysis gave eight constructs, which were mostly in agreement with the expectations of the conceptual discussions. Using these factors and the theoretical discussions, we developed a TQM model pertaining to small and medium scale manufacturing enterprise. We also suggested directions for the expansion of this study.

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