

A Theoretical Model for Implementing Quality Management in an Automated Environment

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Abstract

This paper will present the results of a study which included the development of a quality management model, based on an extensive literature survey, and the empirical validation of the model. The study was designed to address two major research questions:

1. What is a plausible model of the quality management process?

Specifically, the study aimed to determine which quality management constructs or practices should be included in a model of quality management. Additionally, the study identified or hypothesized a set of relationships among the underlying constructs, and

2. Which of the hypothesized relationships included in the model were supported empirically by real world data?

A review of the literature provided the basis for the answers to both parts of question one. A model consisting of eight quality management practices, and five performance measures was developed. The literature review provided support for a proposed set of relationships among the thirteen constructs included in the quality management model. The proposed relationships formed the basis of a set of nine hypotheses tested in the study.

A survey instrument was developed, from published indicators, to collect perceptual data about the utilization of quality management practices in companies and the perceived impact of these practices on performance measures.

Structural equation modelling was employed to analyze the data collected from two hundred and ninety five respondents at organizations throughout the United States.

The resulting model has utility for quality practitioners and researchers since it serves as an organizing framework for understanding the quality management process.

Keywords: Quality Management, Automated Environment

1. Introduction

Total quality management (TQM), also referred to as quality management, is generally acknowledged as an approach to organizational management, which brings about enhanced performance. Over the past three decades, organisations throughout the developed world have been aggressively pursuing quality management since there is a commonly held view that high quality products and services results in improved financial performance [8]. However, as in the case with the definition of quality management, there is no agreement on a single theory or model of quality management which explains how the different quality management practices interact or work in concert to ultimately effect improvements in performance measures [13]. The lack of a definitive theory, which explains and substantiates the manner in which the quality management practices or dimensions are related in order to bring about improved organization performance, has resulted in claims and counter-claims by advocates and opponents of quality management as

to its ability to deliver stellar economic returns [8].

Contributions by practitioners, such as Deming, Juran, Crosby, and Ishikawa, served to project the practices of quality management ahead of the theoretical development and understanding of models by which the quality management process can be explained [10, 13, 15]. Furthermore, quality management was not developed by academics, nor was it program tested prior to adoption by the business community.

Research aimed at identifying the dimensions or constructs underlying quality management has flourished in recent years [11]. A review of quality management literature, however, reveals a paucity of research related to the development of theoretical models which account for quality management's influence on measures of organizational performance. It is precisely this void (i.e. the lack of a credible and valid theoretical model), in the quality management body of knowledge, which this paper will address.

2. Background and Purpose of the Study

Research findings on the development of a general model of quality management are by no means in agreement. Various studies [1, 2, 16] have shed light on the building blocks or constructs underlying quality management. However, the findings of these studies have been diverse. Resultantly there is lack of consensus among researchers and practitioners in some important areas. First, there is limited agreement as to which constructs should be included in a general model of quality management.

Second, there is dearth of empirical research findings to support a theoretical model which is capable of explaining the pattern of relationships among the quality management constructs i.e., the manner in which the quality management practices interact to finally effect enhancement in organizational performance measures such as customer satisfaction and financial results.

A number of studies have attempted to identify those quality management practices, which maximally contribute to organization performance. While these studies have unquestionably made a contribution to the body of quality management knowledge, they have generally fallen short of offering a comprehensive explanation of how the quality management practices interact and influence each other to culminate in superior organizational performance. Previous research has not fully developed and validated a generalizable theory which adequately explains the quality management process [17].

Therefore, to contribution to an advanced understanding and development of a comprehensive model of quality management, the purpose of this study was to:

1. Formulate, on the basis of existent literature, a comprehensive theory of quality management. Such a theoretical framework of quality management will comprise a set of unobserved factors or constructs, along with a proposed pattern of relationships among the constructs. The framework will include quality management constructs, such as leadership, supplier focus, and process management, as well as constructs of performances measures, such as customer satisfaction and product or service quality. This theoretical framework will assist quality practitioners in a number of ways such as: optimizing performance through effective resource allocation, and determining those management practices which should be emphasized or promoted in order to improve business results;
2. Develop a structural or statistical model, on the basis of the above theory, by specifying a set of linear stochastic equations for both the measurement model and the structural model. Structural equation modeling was employed to test the significance and strength of the postulated relationships.
3. Develop and refine measurement scales for each of the model's constructs since such scales are a prerequisite for successful model testing and estimation. The literature

review served to firstly, identify the gap in the existing body of quality management literature, and secondly, to suggest the appropriate research questions addressed by this study.

3. Research Questions

The questions, which drove this research, may be succinctly stated as follow:

1. What is a plausible model of the quality management process? i.e., which constructs should be included in a model of quality management? and (ii) what is an appropriate set of relationships among the constructs? and
2. Which of the proposed relationships are supported by the data?

4. Literature Review

4.1 Concept and Definitions of Quality

The concept of Quality can be viewed from different perspectives. For example, using the definition of Quality being “free of deficiencies” requires the measurement of number of defects, while quality defined as “satisfying the customer” requires a determination of the number of satisfied customers.

Hardie [13] identifies the following five categories into which Quality definitions could be placed: conformance to requirement, fitness for purpose, meeting customer perceptions, exceeding customer expectations and superior to competitor.

Furthermore Garvin’s [12] seminal work identified eight critical dimensions of quality to include: performance, features, reliability, conformance, durability, serviceability, aesthetics and perceived quality.

4.2 Review of Quality Management Models, Theories and Frameworks

The study reviewed contributions by quality gurus such as Deming, Juran, Crosby, in addition to the work of Spencer [17], Hardie [13] Flynn *et al* [11], Saraph *et al.* [16], Black and Porter [5], Ahire *et al* [1], and Tammi and Nabil [18]. Specific quality management frameworks reviewed included the Malcolm Baldrige Quality award Framework and the European Business Excellence Model.

5. The Conceptual Model and Hypotheses

The model of quality management developed and tested in this study included a number of theoretical constructs or practices of quality management as well as measures of organizational performance. A set of eight quality management constructs was identified from the literature including: leadership, supplier focus, teamwork, customer focus, learning, process management, continuous improvement, and employee fulfillment.

In order to model the effects of the aforementioned quality management practices on organizational performance, an assessment of the organization’s performance on critical outcomes must be done. Literature informed the selection of the following five performance measures: product or service quality, operational quality, customer satisfaction, employee satisfaction and financial quality.

5.1 Operationalization of the Constructs

An empirical examination of the proposed model of quality management depicted in Figure 1 below requires the operationalization of the theoretical constructs included in the model [9]. Indicators or measurement statements for each construct were identified from previous studies [6,11,17]. The scales for measuring respondent perception on each of the constructs was refined and found to be both reliable and valid for the purpose of the study.

5.2. A Diagrammatic View of the Model and Hypotheses

The model below includes the quality management practices; performance measures and proposes a set of relationships amongst these constructs.

6. Research Methodology

This study was designed to achieve two objectives. The first objective, to develop and articulate a theoretical model of quality management, was accomplished through a detailed analysis and interpretation of the published literature. The resulting model of quality management comprises a set of thirteen constructs with a proposed pattern of relationships amongst them.

The second objective of this study, to empirically test the plausibility of the proposed theory of quality management, was accomplished by fitting the model to the data gathered from quality executives in industry and commerce. The use of survey data gathered from quality practitioners is well established in quality management and organisational research [11, 16].

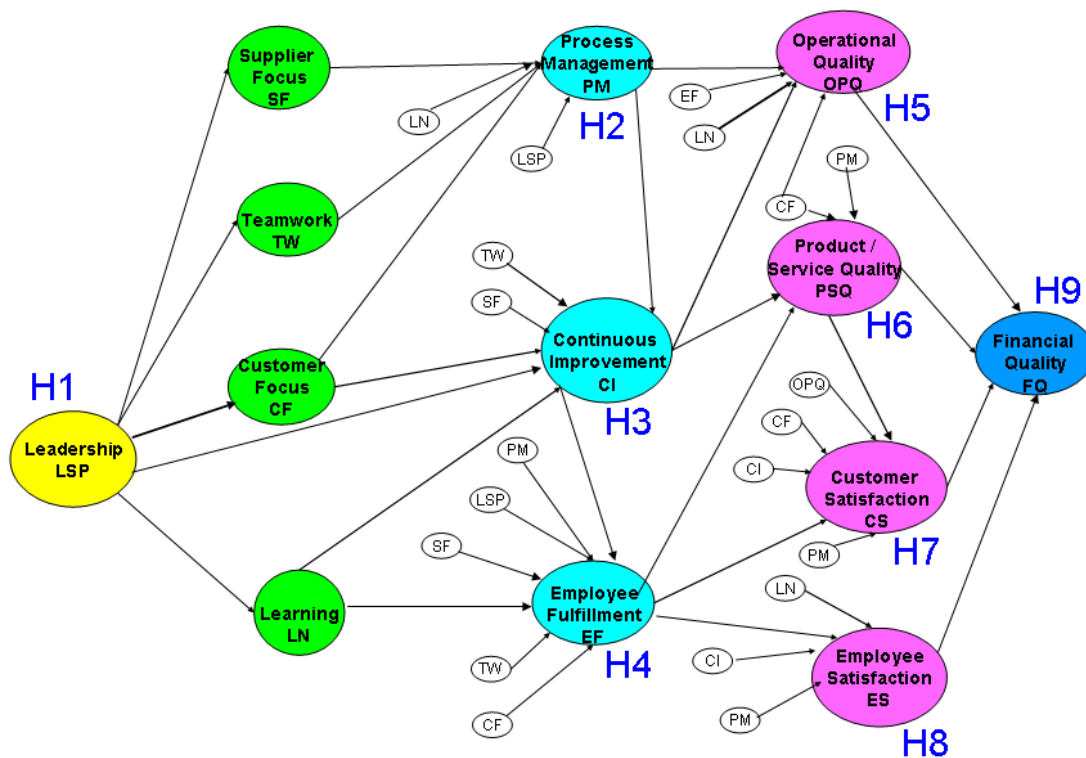


Figure 1. Constructs and relationships included in the model

A sample of 3 250 organisations and quality executives were surveyed. A total of 312 (9%) responses were received from the bulk mail out within a two week period.

The statistical procedure used to test the hypotheses proposed in this study is structural equation modelling (SEM). SEM examines several multiple regression models simultaneously and estimates the parameter coefficients. The basic steps involved in SEM include: 1) model specification, 2) identification, 3) estimations of the parameters, 4) testing model fit to the data, and 5) re-specification of the model [7, 9]

6.1. Results of the study

The study gathered data from quality practitioners in about 30 industry sectors with just on 50% of the data emanating from four sectors i.e., aeronautical, automotive, electronic, and medical devices.

About 76 % of the responses were based on manufacturing organizations while the remaining 24 % of the responses were related to service organizations.

The statistical analysis i.e., structural equation modelling indicated that the data supported the relationships indicated in figure 2. below.

The results lend support for the positive relationship between leadership and supplier focus, team work, learning. This finding has major implications for management. Learning needs to be embedded at all levels in the organization and in all aspects for the organization operations and planning. Furthermore, the model suggests that the ultimate measure of organization performance i.e., Financial quality is directly influenced by both Operational and Product/Service quality.

Process management could be viewed as a dependant quality management practice which is influenced by the quality levers of supplier focus, team work, and learning. The results furthermore, endorse the linkage between process management, continuous improvement and employee fulfilment.

Interestingly, none of the quality management ‘levers’, such as Teamwork, Supplier Focus and Learning was found to significantly influence continuous improvement. Equally surprising, the link between learning and continuous improvement was not supported by the data. This link is well established in the literature [13, 16].

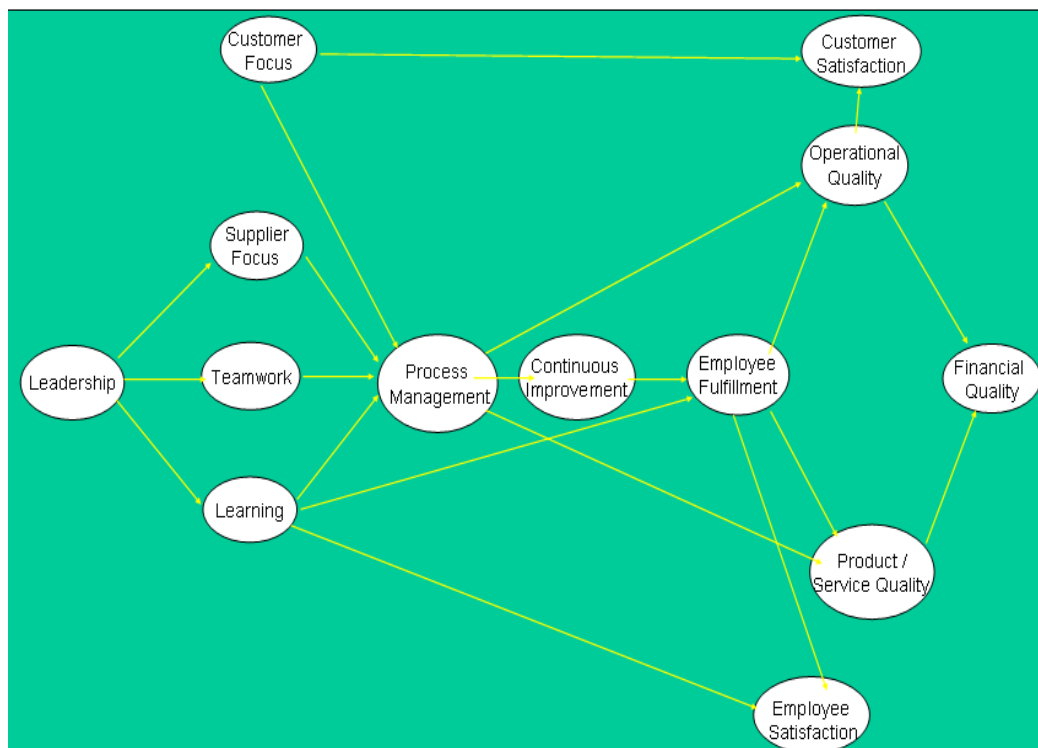


Figure 2. Relationships supported by the data

The lack of support for the relationship between customer focus and product/service quality is contrary to the extensive literature support [11,16,17].

It was surprising that the relationship between customer satisfaction and financial

performance was not supported by the data. This result is contrary to the empirical validation provided by Saraph *et al* [16] for the link between customer satisfaction and financial performance.

Interestingly, the data did not support the link between financial quality and either of employee satisfaction or employee fulfilment.

8. Conclusion and Recommendations

The analysis indicates that the data supports twenty significant relationships postulated in the study's hypotheses. These results shed light on the precise nature of the inter relationships among the quality management practices and manner in which these practices influence measures of organizational performance. While the limitations of the study such as respondent bias, organizations on which the data was collected, and the appropriateness of the selected respondents, it the view of the researcher that the findings of the study contributes to a more comprehensive understanding of the intricate relationships between quality management practices and organizational performance measures.

Additionally, the study contributed to the further refinement and validation of the measurement scales used to assess each of the constructs included in the model.

The study has implications for management of all types of organizations in so far as it provides an alternative quality management framework for practitioners. The framework serves to inform the implementation of a quality management programme in any type of organization including an automated environment. A final application of the framework is its diagnostic and training potential.

The model could be used as a diagnostic tool to determine area within an existing quality management system which may be considered good practice or specific areas which may require improvement. Finally, the model serves a valuable instrument to provide training to management and employees as to the non linear nature of the quality management process and the intricate inter connected nature of the models variable or constructs.

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Dr Oswald Franks is a registered professional engineer with just on thirty years experience, which spans both industry and academia. Dr Franks holds a number of post graduate qualifications including a doctorate (PhD) in Engineering Science, a Government Certificate of Competency (Mines & Works), and an Honours degree in Business Administration.

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Oswald has a global perspective having studied abroad in the United States of America and the United Kingdom. Additionally, he has delivered conference presentations on Quality Management and Continuous Improvement in a number of countries including Germany, China, India, Singapore, Malaysia, England, USA, Canada, and Israel.

Oswald commenced his career with a stint as a Contracts Engineer with Consani Engineering in Cape Town and was responsible for the engineering design and project management of a number of multi million rand contracts for the armaments and petrochemical industries.

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