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Development and Validation of TQM Implementation Constructs

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ABSTRACT

The contemporary quality management (QM) literature prescribes various quality improvement strategies. However, it lacks scientifically developed and tested constructs that represent an integrative QM philosophy. Moreover, an impact of the prescribed QM strategies on a firm's product quality has not been analyzed. Through a detailed analysis of the literature, this research identifies 12 constructs of integrated QM strategies. Using a survey of 371 manufacturing firms, the constructs are then empirically tested and validated. LISREL 7 is used for this purpose. Finally, a framework to examine the effects of integrated QM strategies on a firm's product quality is suggested. Comparisons between this and two other comprehensive scales of TQM are made.

Subject Areas: Quality Management, Scale Development, and TQM Theory.

INTRODUCTION

Over the last two decades, U.S. firms have been challenged by competitors from overseas, notably, Germany and Japan, to produce better quality products at lower prices. In response, these firms initially sought to emulate the Japanese productivity achievements by focusing on shop floor efficiencies through techniques such as quality circles [12] [49] [107]. However, a closer look at the genesis of Japanese manufacturing excellence in the early 1980s revealed that a holistic approach to Quality Management (QM) was instrumental in improving the efficiency and quality of products and processes [34] [42] [43] [71]. These findings, along with the successes of pioneering companies such as Ford and Motorola, led to a widespread QM awareness among the U.S. manufacturers. The inception of the Malcolm Baldrige National Quality Award in 1987 led to an even stronger interest among organizations from all sectors in holistic quality management. As a result, the number of U.S.

firms implementing comprehensive quality improvement strategies increased significantly over the last six years [32].

While many Western firms have adopted integrated QM strategies, their implementation has not been equally successful [105]. The implementation failure has been attributed to a shift in emphasis from improving product quality to unfocused improvement efforts, such as installing a piecemeal SPC system, or starting training programs without understanding their impact on quality [23] [90]. Although the QM literature does not examine linkages among the various strategies (such as top management commitment and customer focus) and their impact on product quality, several elements of the QM strategies have emerged from reported case studies, conceptual papers and empirical research. For example, benchmarking, statistical process control, employee training, and involvement programs are among the most commonly implemented QM strategies [33] [76] [93]. However, due to a paucity of insights into the interactions among these strategies, organizations employ them in isolation. Such an unfocused effort may lead to a failed QM program. Hence, it is important to develop the QM theory, investigate linkages among the QM strategies, and identify the ones that are critical for improving product quality.

The QM theory is far from being fully developed. Anderson, Rungtunsanatham, and Schroeder [4] make the only known effort of synthesizing a theory of quality management. They assess the impact of Deming's management method on a firm's organizational behavior and practice of quality management. However, as will be discussed in the next section, this work suffers from a lack of systematic scale development, content validity, and empirical validation. Hence, it falls short on overall generalizability of results. A more general approach to developing a sound theory could consist of five phases: (1) exploration, (2) construct development, (3) hypothesis generation, (4) hypothesis testing for internal validity, and (5) testing for external validity [91]. The main purpose of this empirical research is to contribute to the first three phases of QM theory building. In particular, the major objectives of this research are to:

1. identify constructs of QM strategies and develop scales for measuring these constructs,
2. empirically validate the scales, and
3. conduct a preliminary investigation of the relationships among the QM strategies.

Two other studies have published empirically validated scales for integrated quality management [39] [89]. Our work differs from these studies in many significant ways and, we believe, is more comprehensive. We also delineate the specific contributions of this research vis-a-vis the other two studies.

The remainder of this paper is organized as follows. First, a review of relevant quality literature is presented. This is followed by identification of QM constructs and development of related scales. Empirical validation of the constructs is presented next. Based on the exploratory analysis of the statistical relationships among various QM constructs, managerial implications are offered. The next section compares and contrasts this research with scales for quality management developed by Saraph, Benson, and Schroeder [89] and Flynn, Schroeder, and Sakakibara [39]. The paper concludes with recommendations for future extension of this research.

LITERATURE REVIEW

Over the last fifteen years, many researchers have discussed the reasons for the inferior quality of U.S. products and have recommended quality improvement prescriptions such as management leadership, product quality planning, customer focus, and shop floor quality control [11] [13] [21] [22] [51] [57] [58] [83] [97]. Some conceptual base was also developed to better explain the superior operational performance of firms that incorporated quality into their operations [42] [43] [87] [101]. In addition, the literature is replete with case studies of successful TQM implementation. These studies span various industries such as automotive [1], textile [2], chemical [18], and banking [27]. Unfortunately, conceptual papers and case studies, while providing insights into key elements of QM strategies, cannot generalize the prescriptions.

Early empirical studies provide general comparisons of quality management practices between the U.S. and Japanese organizations [33] [42] [43]. These studies concluded that the Japanese give a very high priority to elements such as top management commitment, product quality planning, and shop floor quality control, while the U.S. firms focus on inspecting quality. Various aspects of the QM strategies were also presented in more recent empirical articles. For example, Lascalles and Dale [68] studied the impact of buyer-supplier relationship on suppliers' QM implementation. Modarress and Ansari [76] surveyed the use of various quality control techniques in U.S. firms. Ebrahimpour and Withers [34] compared the involvement of shop floor employees in QM implementation in the Japanese firms operating in the U.S., and U.S. firms. Empirical research has also focused on the relationship between various quality management elements and performance. For example, Schroeder, Sakakibara, Flynn, and Flynn [93] compared the QM strategies of Japanese transplants in the U.S. with the U.S. manufacturing plants. Roth and Miller [88] discussed success factors in manufacturing firms. Benson, Saraph, and Schroeder [8] reported one of the first empirical efforts to analyze the effect of an organization's quality background on its actual quality performance. However, these empirical studies did not identify and validate the QM constructs, nor did they analyze relationships among the constructs.

As mentioned earlier, Anderson et al. [4] have made the only known effort to develop the theoretical foundations of quality management practice. They examined Deming's 14 points and deciphered seven major concepts through a Delphi study. With the help of literature from organizational behavior and scientific management theory, they proposed various relationships among the identified concepts. While this approach is valuable in rationalizing the prescriptions laid out in Deming's method, it may not lead to a generic theory of quality management. Individual participants in the Delphi study may have different perceptions of a specific quality approach (such as Deming's philosophy). These perceptions may translate into respondents' personal views of important dimensions of quality management. A very small group of respondents (despite the level of their professional expertise) responding within the framework of only one quality philosophy may yield a set of biased constructs. Such a study may lack content validity. Furthermore, Anderson et al. [4] do not provide specific scale development and validation for quality management.

A more general approach to developing a sound theory could consist of five phases: (1) exploration, (2) construct development, (3) hypothesis generation,

(4) hypothesis testing for internal validity, and (5) testing for external validity [91]. For a theory of quality management, this will require a forward outlook in which (a) based upon literature in quality management, organizational behavior, and general management theories, theoretical constructs of quality management are developed; (b) these theoretical constructs are empirically validated; and (c) theories about the interactive effects of these validated constructs on outcome measures of quality management are tested [91]. Our research followed this approach. Through a detailed analysis of the literature, we identified 12 constructs of integrated QM strategies. Using a survey of 371 manufacturing firms, the constructs were then empirically tested and validated. Thus, our research contributes to the first three phases of TQM theory development in a different way than Anderson et al. [4]. It spans the TQM concepts beyond a particular approach and encompasses the more generic core values of TQM that drive the various elements of TQM philosophy. These elements are developed from the conceptual literature and actual practices of organizations as evidenced through various cases studies and empirical research. They are also rooted in the literature on quality management, general operations management, and organizational behavior. Thus, the scales developed here are broader in scope and possess better content validity [14]. Furthermore, the scales are refined and validated to ensure unidimensionality, convergent and discriminant validity [84].

Only two other published studies have developed and empirically validated instruments for integrated QM. Based on a review of QM literature, Saraph et al. [89] developed an instrument to measure critical constructs of quality management. Using a sample of 162 managers, they validated scales for the identified constructs. Flynn et al. [39] developed dimensions of quality management from literature. A study of 42 manufacturing plants from three industries, which sought multiple responses from managers and workers from various functions, formed the basis for empirical validation and refinement of these constructs. While both of these studies are useful, our work differs significantly from them in terms of the overall approach to scale development and validation. As will be evident in the section on Empirical Validation of Constructs, we draw upon more current and comprehensive scale validation techniques used in the marketing and social sciences literature to yield more reliable and valid scales. Yet, overall, all three studies (Saraph et al. [89], Flynn et al. [39] and ours) complement one another in many aspects. Together, they should provide a very strong composite set of constructs and associated scales for further theory development. The commonalities and differences between the three studies are discussed in detail towards the end of our paper.

RESEARCH CONSTRUCTS

This section deals with defining constructs identified from the literature and generating items that represent manifestations of these constructs. Constructs are latent variables, which means they cannot be measured directly. For example, top management commitment to quality is a construct that cannot be measured directly. However, when top management is committed to quality, adequate resources will be allocated to quality improvement efforts. Thus, allocation of adequate resources to quality improvement efforts can be one of the manifestations of Top Management Commitment to quality. For a field study, each manifestation is measured with an item in a scale.

When the items in a scale sufficiently span the scope of the construct, the scale is said to have content validity [14] [70]. To assure content validity, the constructs and the representative items were identified through a thorough literature review. A detailed discussion of these constructs and the corresponding scales follows.

Top Management Commitment

Top management commitment has been identified as one of the major determinants of successful QM implementation [26] [33] [58]. The critical role of top management in providing leadership has been illustrated in the literature for several diverse organizations, such as Asahi Breweries Ltd., Japan [78], Xerox, Inc., U.S.A. [60], Dunlop, Ltd., Malaysia [36], and Dow-Corning Pvt. Ltd., Australia [18]. Top management acts as a driver of QM implementation, creating values, goals, and systems to satisfy customer expectations and to improve an organization's performance. The clarity of quality goals for an organization determines the effectiveness of the quality efforts [94] [98]. Top management committed to quality must convey the philosophy that quality will receive a higher priority over cost or schedule, and that in the long-run, superior and consistent quality will lead to improvements in cost and delivery performance [37] [42] [64]. The top management should not only give high priority to quality, but should also demonstrate its quality commitment by providing adequate resources to the implementation of QM efforts, particularly, considerable investment in human and financial resources [18] [50]. Performance assessment for plant managers and corporate top executives should also include a critical component: their performance on quality dimension [19] [89]. Accordingly, we developed the following six-item scale to represent Top Management Commitment to quality:

1. clarity of quality goals for the organization,
2. relative importance given by top management to quality as a strategic issue,
3. relative importance given by top management to quality versus cost,
4. relative importance given by top management to quality versus production schedule,
5. allocation of adequate resources to quality improvement efforts, and
6. performance evaluation of managers based on quality.

Customer Focus

All activities of an organization must be planned and executed to improve processes that lead to manufacturing quality products. However, quality must be incorporated into these activities with a clear customer focus. Despite the use of the latest process improvement techniques and capable management, a firm's neglect of its customers may lead to a disaster [63]. In fact, the pressure to revitalize manufacturing over the last decade has been rooted in customers' demand for a greater variety of reliable products with short lead times [30]. The importance of customer focus is also evident from the fact that it is assigned the highest weight among the Malcolm Baldrige Award criteria [73].

Customer expectations are dynamic in nature [95]. Hence, an organization needs to assess them regularly and adjust its operations accordingly [101]. Voss [103]

suggests that an organization's long-term success is tied to customer retention efforts. Organizations may outperform their competition by being able to: (1) respond quickly to customers' demands with new ideas and technologies, (2) produce products that satisfy or exceed customers' expectations, and (3) anticipate and respond to customers' evolving needs and wants [98]. Therefore, customer focus must be reflected in the overall planning and execution of quality efforts.

Customer focus of an organization is usually assessed by the frequency and rigor of customer satisfaction surveys. However, mere execution of such surveys is not useful unless the results are made available to functional areas such as manufacturing, design and planning. Further, these results should be used in improving the product quality [53] [57] [58]. Hence, we measured the Customer Focus of the organization's quality management with the following four-item scale:

1. extent of customer satisfaction survey feedback given to managers,
2. availability of customer complaint information to managers,
3. extent of the use of the customer feedback to improve product quality, and
4. overall customer focus in quality management.

Supplier Quality Management

An organization must ensure quality at all stages of manufacturing. As such, an effective supplier quality management approach should form the basis for procuring quality parts. The suppliers' role is critical in many ways. First, the quality of incoming parts from suppliers determines the level of inspection efforts of a buyer organization. Second, the quality of the supplied material, to an extent, determines the final product quality. Third, supplier's capability to react to a buyer firm's needs, in turn, can determine the buyer's flexibility in responding to the customers' needs. The purchasing literature is replete with the role of suppliers in quality management initiatives [99]. For example, Newman [79] [80] provides guidelines to ensure suppliers' quality and develops a framework for single-source qualification. Giunipero and Brewer [48] present a performance-based supplier evaluation procedure. Juran [57] [58] recommends extensive, long-term partnership with suppliers. With the objectives of minimizing incoming material inspection and receiving reliable, frequent deliveries through long-term relationships, quality-oriented firms like Xerox and Ford have developed extensive supplier evaluation systems. Often, such organizations offer technical assistance to suppliers to ensure consistent superior quality of products [29]. Accordingly, the following six-item scale represented the profile of an effective Supplier Quality Management strategy:

1. relative importance placed by the organization on quality of purchased parts versus price,
2. consideration of supplier's technical capability,
3. consideration of supplier's financial capability,
4. consideration of supplier's delivery performance,
5. extent of technical assistance to suppliers, and
6. emphasis on long-term supplier relationships.

Design Quality Management

A comprehensive approach to designing quality into products reflects an organization's strategic quality planning capabilities [53]. Juran strongly recommends investment of time and resources in designing quality into products [57] [58]. Approaches such as quality function deployment (QFD) help an organization translate customer needs into actions by various functions (design, manufacturing, purchasing, etc.). Taguchi's design of experiments [100] and Shingo's error-proofing techniques are very useful quality design tools [87] [100]. Today's complex products cannot be designed by the design engineers alone. An interdisciplinary approach to designs (wherein other functions such as production, materials planning and engineering get involved in the early stages of product design) is essential [109]. Such a team approach results in a faster response to customer needs and superior product quality [13] [33] [57] [58] [69] [95]. Also, manufacturing and marketing experiences of the design team members enhance their ability to design quality products [57] [58]. These considerations led us to the following six-item scale to evaluate organization's Design Quality Management:

1. emphasis on shop floor experience for the design team,
2. emphasis on marketing experience for the design team,
3. use of Taguchi's design techniques,
4. use of Shingo's error-proofing techniques,
5. use of Quality Function Deployment techniques, and
6. interdisciplinary approach to product design.

Benchmarking

Effective management of quality of products and internal processes without losing perspective of the external factors, such as competition, requires judicious use of benchmarking. Benchmarking consists of analyzing the best products and processes of leading competitors in the same industry, or leading organizations in other industries, using similar processes. An organization should, then, use this knowledge to improve its own products and processes. The importance of adequate, accurate and timely information on best practices of various processes is acknowledged by leading organizations like Xerox [59]. Even with the best operating and communication devices, two airplanes can and have crashed into each other in broad daylight [63]. In order to avoid a similar disaster, organizations implementing QM strategies also should look out the window frequently.

The purpose and guidelines for effective benchmarking have been extensively discussed in the QM literature. Benchmarking entails product as well as process benchmarking. Benchmarking must be done with a clear focus on the goal of improving product quality and reducing cost. Appropriate planning and execution of benchmarking goes a long way in improving processes. To take advantage of the benchmarking technique, an organization should benchmark its products as well as processes. Accordingly, the following five-item scale was developed to measure extent of use of Benchmarking by organizations:

1. emphasis on benchmarking competitors' products and processes,
2. emphasis on benchmarking noncompetitors' products and processes,
3. effectiveness of benchmarking in product quality improvement,
4. effectiveness of benchmarking in product cost reduction, and
5. willingness of the organization to benchmark in the future.

SPC Usage

To minimize in-production quality problems, Juran [56] and Taguchi [100] argue for a sound design quality planning. However, when products are being produced on the shop floor, variations in the manufacturing process variables (such as raw material quality, machine conditions, worker skills, etc.) contribute to a variation in product quality. Hence, the role of quality control in manufacturing is as critical as the design quality of products and processes. Statistical process control (SPC) techniques are often used to detect assignable causes contributing to the variation in manufacturing quality, to provide useful information for product design, and to determine process capability. Although some limitations of SPC in quality improvement have been recognized [10] [87], it helps quality-oriented firms, beginners in particular, to monitor quality variations and to investigate critical areas where improvements are needed [28]. A wide range of SPC tools such as scatter diagrams, Pareto charts, cause-effect diagrams, and control charts are used to monitor quality [76]. To use the SPC tools effectively, production workers should have an adequate knowledge regarding their usage [34]. Hence, the following four-item scale was developed to assess the extent of SPC Usage in organizations:

1. extent of use of SPC in manufacturing,
2. knowledge of production employees in SPC tools,
3. effectiveness of SPC in improving product quality, and
4. willingness of the organization to use SPC in the future.

Internal Quality Information Usage

While benchmarking allows an organization to look out the window, SPC tools allow it to monitor the quality of internal processes. However, both strategies will be rendered ineffective if there is inferior dissemination of the generated information. To maintain a true customer focus, an organization must ensure prompt feedback of customer survey results to appropriate functional areas for effective actions [95]. One of the indicators of the extent to which the quality information is shared is the frequency of quality performance data relayed back to the concerned work stations, cells, and departments [62]. Juran [57] [58] advocates the determination of cost of quality for all process components and wide dissemination of this information within the organization. The Baldrige Award recognizes the importance of making timely, adequate, and relevant quality data available to concerned departments and employees [73]. These observations led to the following six-item scale for evaluating the effectiveness of Internal Quality Information Usage:

1. availability of the cost of quality data to managers,
2. visual display of quality information at work stations,
3. visual display of quality performance versus goals,
4. transmittal of defects information to specific work stations,
5. availability of scrap data, and
6. availability of rework data.

Employee Empowerment

Employee empowerment is used as an effective strategy by companies like Toyota and Ford. In fact, Johnson and Johnson's major recall of millions of Tylenol tablets in the 1980s was initiated by a middle-level manager who used his own judgment and interpretation of the company's values statement [74]. The focus on quality at the source requires empowering production workers to inspect their own work and to stop production if the process is out of control [33] [34]. Employee empowerment is essential to improve in-process quality control. Due to increased awareness of responsibility and equity among subordinates, empowerment also leads to increased employee participation [35]. Empowerment does not mean only shifting the responsibility for quality decisions to workers, it also entails providing supporting framework, such as the necessary resources and technical support, to assist them in such decision making. These essential aspects of Employee Empowerment were captured in the following five-item scale:

1. workers authorized to inspect their own work,
2. workers encouraged to find and fix problems,
3. workers given resources to fix problems,
4. technical assistance given to workers for solving problems, and
5. supporting infrastructure for problem solving.

Employee Involvement

Employee empowerment alone is not adequate to ensure employees' full participation. It has been found that four contextual factors affect employee commitment to participation: explicitness of performance target, revocability of one's actions, consequent publicity, and volition (ownership) of actions [83]. Employee involvement groups have been found to positively impact employee commitment to quality [83]. However, organizations must develop formal systems to encourage, track, and reward employee involvement. Otherwise, the extent and quality of participation declines, leading to a dissatisfied work force [20] [49]. The use of cross-functional quality improvement teams [67] [75] [85] and quality circles [57] [93], along with a framework of appropriate evaluation and reward systems for quality improvement projects, have been shown to improve quality significantly [65]. Recently, it has been noted that the level of employee participation depends on individual or group rewards [16] [104]. Many QM firms implement such reward systems and also offer profit-sharing