AN EMPIRICAL INVESTIGATION OF THE RELATIONSHIPS AMONG SUPPLIER-BASED RELATIONSHIPS, QUALITY PRACTICES, AND OUTCOMES

IE Working Paper DO8-124-I 06-10-2004

Luis Solís

Instituto de Empresa
María de Molina, 12 5ª
28006 Madrid
Spain

James A. Pope *, T.S. Ragu-Nathan, S. Subba Rao, Glenn A. Metts & Arthur W. Smith

Department of IOTM
College of Business Administration
The University of Toledo
Toledo, Ohio, USA 43606-3390
419-530-2380
jpope@utoledo.edu

Abstract

This paper investigates the linkage between one aspect of supply chain strategy and TQM principles and outcomes. We empirically test the relationship among strategic quality planning, supplier-based relationships, and some TQM practices such as product design, product innovation, dependable deliveries, and value-to-customer quality and organizational performance. The findings suggest that the success of some TQM practices may be buoyed by over-lapping supply chain principles such as supply chain management strategy. Other positive relationships described in the literature such as that between strategy, TQM principles, and organizational performance, are again confirmed. A LISREL (SEM) model is the vehicle used in the analysis of the relationships.

Keywords

Total Quality Management (TQM), Quality, Operations Strategy, Structural equation models, survey research/design

* Corresponding author

INTRODUCTION

Total quality management (TQM) is a management philosophy aimed at improving the quality of products and processes to achieve competitive advantage. While the implementation varies from one organization to another, there are major characteristics that provide a unifying theme to all programs. Agreement is apparent among the quality movement founders and principal spokesmen (Crosby, 1979; Deming, 1986; Ishikawa, 1985; Juran, 1988) regarding fundamental philosophy, assumptions, and recommended practices (Hackman and Wageman, 1995). Some of the fundamental characteristics of the TQM approach are: 1) prevention rather than detection (Cardy, Dobbins and Carson, 1995; Walton, 1986), 2) understanding that customer satisfaction is the driving force behind work processes (Cardy and Dobbins, 1996), 3) continuous improvement, and 4) the underlying belief that people are naturally motivated to do a good job and improve quality (Hackman and Wageman, 1995). Based on these characteristics and descriptions from prior literature, the definition of TQM that we shall use in this study is by Flynn, *et. al.* (1995): "TQM is an integrated approach to achieving and sustaining high quality output, focusing on the maintenance and continuous improvement of processes and defect prevention at all levels and in all functions of the organization, in order to meet or exceed customer expectations."

The quality management literature exhibits different orientations: overview, conceptual, case study, analytical, simulation and empirical. Overview articles present an integrative approach to managing quality (Aggarwal, 1993; Becker, 1993; Cole, 1992; Drayton, 1991; Easton, 1993; Flynn, 1992; Garvin, 1991; Madu and Kuei, 1993; Tillery, Rutledge, and Inman, 1993; and Zairi, 1993). Overview articles range from insights into the Baldrige criteria (Garvin, 1991; Easton, 1993), comparison of Japanese versus U.S. quality practices (Ebrahimpour, 1985; Handfield, 1989; Flynn, 1992), comparison of the quality approaches proposed by the quality management gurus (Kathawala, 1989), and linkages of TQM to an organization's strategic position (Madu and Kuei, 1993).

Conceptual articles include prescriptive models and methods for implementing TQM and opinions of researchers on various aspects of TQM. Conceptual literature is an important part of the published TQM research (Juran, 1993; Ross, 1991; Sloan, 1992; Suresh and Meredith, 1985; Tillery and Rutledge, 1991; Water and Vries, 1992; Zeithaml, 1988). In addition, case studies present detailed studies of a few organizations (Ciery, Sampson, and Sohal, 1991; Garvin, 1993; Kumar and Gupta, 1993; Lascelles and Dale, 1989; Modarres and Ansari, 1990; Voss, 1992). Conceptual articles and case studies account for much of the quality literature which is consistent with the fact that TQM has been recognized as a powerful competitive strategy (Madu and Kuei, 1993).

Another area, the analytical literature, focuses on the modeling of various aspects of TQM (e.g., cost models) (Karp and Ronen, 1992; Pignatiello, 1988; Tosirisuk, 1990; and Wacker, 1989). Moreover, simulation articles focus on simulated experiments (Knight, Beningfield, and Kizzort, 1987).

Several empirical studies have examined TQM implementation (Rao, Ragu-Nathan, and Solis, 1996; Benson, Saraph and Schroeder, 1991; Ebrahimpour and Lee, 1988; Garvin, 1984; Benson et al., 1991). It is important to note that empirical research requires the availability of broad databases for theory and model testing. Since TQM is a long-term, ongoing program with real payoffs accruing years after implementation (Erickson, 1992), much of the empirical quality literature was developed later (Roth and Miller, 1992; Saraph, Benson, and Schroeder, 1989; Schroeder, Sakakibara, Flynn, and Flynn, 1992; Ferdows and Demeyer, 1990; Rao, Ragu-Nathan, and Solis, 1997; Solis, Rao, Ragu-Nathan, Chen, and Pan, 1998).

In the paper, based in empirical research, we shall identify the effect of supplier-based relationships with TQM practices. This paper studies the relationship between TQM concepts and the role supplier-based relationships have on those concepts and on the eventual performance outcomes.

Supply chain literature contains dozens of references to the importance of supplier relationships and its impact on product design (Hartley, Zirger and Kamath, 1997), product innovation (Bagchi-Sen, 2001) and product delivery (Chamberlain, 1998). In this paper, we shall examine and test the linkage between supplier relationships and product design, product innovation and dependable deliveries to the customer. We shall also analyze the role that product design, product innovation and dependable delivery play in providing value-to-customer quality. To complete the model, we will study the relationship between value-to-customer quality and organization operational performance. The proposed model and the various relationships to be tested are summarized in Figure 1.

Insert Figure 1 about here

If these relationships are shown to be significant, an important implication is the following: If supplier relationships have an impact on the effectiveness of the other constructs, it could change the way in which TQM is implemented in organizations.

LITERATURE REVIEW

The following sections review current literature for each of the constructs in the proposed model. Each section relates the relevant literature leading to propositions to be investigated.

Strategic Quality Planning

Improving quality is a long-term competitive strategy (Barclay, 1993; Lascelles and Dale, 1989; Peters, 1988; Juran, 1986; Deming, 1986; Tillery and Rutledge, 1991). It requires developing a quality culture, which is a lengthy process. Given the time factors, organizations must plan the process for achieving quality and integrating quality improvement planning into the overall business plan. Although organizations often seek immediate benefits from the start of a quality improvement process, a long-term focus is a greater objective. The American Quality Foundation and Ernst and Young (1992) found that in the United States, Canada, Germany and Japan, strategic quality planning had significant effects on

organizational performance measures. A strategic view of quality leads to: 1) the integration of quality management and customer satisfaction in the organizational strategic and operational plans, 2) a long-term quality vision for the organization, and 3) the deployment and understanding of quality goals and policies throughout the entire organization.

The strategic quality planning construct in the proposed model includes three items: 1) strategic plan long-term support of quality improvement, 2) strategic plan synergy with the firm's quality mission and policies, and 3) strategic plan focus on quality as an integral part of the overall strategy.

SUPPLIER RELATIONSHIPS

Supplier-based quality practices provide a means to increase the likelihood of an organization having suppliers who are reliable and willing to work toward the company's goals of achieving quality excellence.

One contribution of quality management is the recognition of suppliers as one of the most important resources organizations can have (Galgano, 1994). Leonard and Sasser (1982) found defective incoming supplies to be a major source of quality product/process problems. The impact of defective supplies on quality performance has raised the importance of quality procured materials, parts, and services, and elevated supplier relationships as a major component of quality management (Ahire, Golhar, and Waller, 1996; Flynn, *et al*., 1995).

Krause, Handfield, and Scannel (1998) studied the importance of supplier development based on reactive and strategic processes and concluded that the strategic approach to these relationships provided significantly greater long-term benefits compared to the reactive approach. Their work suggests that the approach to supplier relationships is a key component of organizational strategy. Trent and Monckza, (1999) investigated the importance of suppliers, particularly in supporting product and service quality requirements. They discussed how purchasing and sourcing decisions contribute to total quality. They also discussed a number of relationships with suppliers such as supplier development, supplier quality performance targets, the involvement of suppliers in design and development, and the certification of suppliers. A study by Wong (2003) provided some insights into the success factors of managing supply partners. They used content analysis to identify seven themes on managing supply chain partners after examining the comments from 59 companies in response to open-ended questions. A carefully crafted strategic plan should support supplier relationship building for quality. Therefore we have our first proposition:
P1: Strategic quality planning has a positive impact on supplier-based relationships.

Impact of Supplier Relationships on Total Quality Practices

The importance of supplier relationships has also been studied in the context of its impact on product design, product innovation, and dependable product delivery capabilities (Teague, Bak, Puttre, Fitzgerald, Minihan and Carbone, 1997; Schmidt and Wood 2000, Hartley et al., 1997).

In a study by Hartley, Zirger, and Lamath (1997), management of the buyer-supplier interface leads to reduced supplier-related delays and over-all project related delays. A generic new product design and development (NPDD) model proposed by Peters, Rooney, Rogerson, McQuarter, Spring, and Dale (1999) supported the importance of common information and information management in the NPDD process. Research by Callahan and Moretton (2001) concluded that supplier involvement in defining product requirements, system design and beta testing reduced development time. Furthermore, effective integration of suppliers into the product value/supply chain has been found to be a key for manufacturers in achieving the improvements necessary to remain competitive (Handfield, Ragatz, Petersen, and Monczka, 1999). This work presented 17 case studies of manufacturing organizations. In 37.2 percent of these organizations, they reported supplier involvement as early as the concept development stage.

Lo and Yeung (2004) propose a practical framework which can be used in the development of a strategic partnerships with critical suppliers. Their research examined the various phases of the development of the strategic alliance which include total quality philosophies, supplier selection, supplier development and supplier integration. They examined constructs associated with these phases and found that continuous improvement, supplier development management and buyer-supplier relation were given the highest mean scores and are therefore the essential elements for strategic alliance.

Brinton (1996) reported supplier involvement as one of the keys to successful product development. The importance of supplier involvement at the concept stage of product development was confirmed by Carbone (1998) in an article on the development of medical technology. Current research supports the importance of suppliers in the product design process and leads us to our second proposition.

P2: Supplier-based relationships have a positive impact on product design.

In the literature we find support for the importance of supplier relationships and supplier involvement in product innovation. Innovation has been defined as "the generation, acceptance and implementation of new ideas, processes, products or services for the first time within an organizational setting" (Pierce and Delbecq, 1977; Thompson, 1965). Other scholars have defined innovation as "the implementation of an internally generated or a borrowed idea whether pertaining to a product, service, system, process, policy, program, or service that is new to the organization at the time of adoption" (Damanpour and Evans, 1984). In a manufacturing context, product innovation may be summarized as the extent to which the manufacturing enterprise is capable of introducing new products and features in the market place (Koufteros, 1995; Clark and Fujimoto, 1991).

The role of innovation in supporting the achievement of significant improvements in the capabilities of an organization were discussed by Schroeder, Scudder, and Elm (1989). Bagchi-Sen (2001) find that small to medium-sized enterprises (SME's) with higher levels of product innovation use external service inputs for problem-solving and business development. Annon (1998) in a study based on an A.T. Kearney survey of 463 of the world's largest corporations, found that better supplier relationships create opportunities for

both sides to innovate which leads to improved performance. In a meeting of the Soap and Detergent Association (SDA) (Schmidt, 2000), the SDA conference reported that association members rely on suppliers for help with innovation. There is therefore strong literature support for the connection between supplier-based relationships and innovation. Based on this, proposition three is:

P3: Supplier-based relationships have a positive impact on product innovation.

The characteristics of dependable delivery tested in our model include the concepts of on-time, accurate quantity, and dependability. Hall (1993) defines dependable delivery as "the extent (to which) a manufacturing enterprise is capable of providing on-time, the type and volume of products required by customer(s)". Dependability is viewed as the consistency of the company in performing at the time scheduled or promised. Hartley, *et. al*., (1997) found that management of the buyer-supplier relationship was effective at reducing supplier related delays. Supplier related delays affect the organizations internal customers by creating design, product introduction and production delays. For the same reasons the end (external) customers are also effected in a similar way. Other research reports that the delivery construct accounts for 21percent of the variance underlying success factors for the JIT-P process (Nassimbeni, 1995). Chamberlain (1998) reports that supplier integration resulted in a 50 percent lead-time reduction with respect to "time to market" over three years in a study at Maytag.

Wagner and Frankel (2000), found that services provided by carriers play an important role in developing new customers and in retaining existing accounts. Increasingly, carriers are tailoring their practices to provide customized services for shippers. They are investing in information collection technologies to support improved routing, scheduling, expediting and tracing. Throughout the supply chain, delivery time is critical and adherence to delivery schedules is highly valued by shippers and receivers.

The strong literature support for the connection between supplier-based-relationships to dependable delivery brings us to proposition four.

P4: Supplier-based relationships have a positive impact on dependable deliveries.

TQM Practices and the relationship to Value-to-Customer Quality

The goal of any organization is to remain viable by providing its customers with products that are competitive in every way with that of its competitors so as to insure survival of the organization. In this context, TQM is often viewed as a rational strategy to assure quality and customer value. Value-to-customer quality, as defined in a manufacturing context includes all of these attributes. As a construct, value-to-customer quality may be defined as "the extent (to which) a manufacturing enterprise is capable of offering product quality and performance that creates higher value for customer(s)." Moreover, it gauges the capability of the firm to produce products that would satisfy customer needs and expectations for quality performance (Gray and Harvey, 1992; Arogyaswamy and Simmons, 1993).

There is considerable literature support for the impact of product design, product innovation, and dependable delivery on value-to-customer quality. See Rahman (1995), Vonderembse and Ragu-Nathan (1997), Tarasewich (1996), and Agus, Krishman, and Kadir (2000).
Many of the constructs in the middle portion of our model are tested in prior literature; the arrangement of the relationships, however, is significantly different. Choi and Eboch (1998) found that TQM practices have a stronger impact on customer satisfaction than they do on plant performance. This work proposed a mediational model for the plant performance effect on customer satisfaction and found the model un-supported by the data. This is explained by the fact that TQM practices are designed for customer satisfaction while activities on the plant floor are designed for plant performance. Based on the above literature support we offer the following propositions:

P5: Product design has a positive impact on value-to-customer quality.
P6: Product innovation has a positive impact on value-to-customer quality.
P7: Dependable delivery has a positive impact on value-to-customer quality.

Organization Operational Performance and Value-to-Customer Quality

The relationship between value-to-customer quality and performance has been investigated mostly indirectly through TQM practices (Samson and Terziovski, 1999). The linkage between TQM practices and performance is supported by the vast majority of prior literature. Agus, *et. al*., (2000) investigated the link between TQM practices, customer satisfaction, and performance. The results offer empirical evidence of the contribution of TQM practices to customer satisfaction. See also Terziozski and Samson (2000).

Romano (2002) studied the impact of the sensitivity to ISO 9000 certification and quality management practices and performance of 100 Italian certified manufacturing companies. He found that companies with the most advanced internal quality systems tended to favor obtaining their supplies from certified suppliers and trusted the quality levels of their deliveries. This sensitivity to certification led to better performance in terms of punctuality, delivery speed and volume flexibility. There were no significant effects on quality and costs.

Romano and Vinelli (2001) described two case studies in which quality in the respective supply chains was controlled using two different approaches. In one case the approach was very traditional. In the other case, the approach was very innovative, in that there was a culture of coordination and frequent contact among the various stages of the supply chain and the customer. It was found that the latter approach led to meeting the quality expectations of the final customer to a greater degree than in the case of the more traditional approach.

We define value-to-customer quality in a manufacturing context as the capability of offering product quality and performance that create greater value for customers and satisfy customer needs and expectations for quality performance (Gray and Harvey, 1992; Arogyaswamy and Simmons, 1993). Value-to-customer quality is a component of customer satisfaction, and as such, we believe value-to-customer quality has a relationship to performance.

Operational performance will be measured in terms of the amount of rejects, rework and defects. This leads us to our final proposition:

P8: Value-to-customer quality has a positive impact on organization operational performance.

DATA COLLECTION AND SAMPLE CHARACTERISTICS

The Quality Management Division of the American Society for Quality (ASQ) sponsored the survey and provided the mailing list. The list consisted of organizations with SIC codes ranging between 2000 and 3900. Five manufacturing sectors accounted for 55.2 percent of the responses: chemicals, rubber and plastics, electronic products, food and kindred products and fabricated metal products. A stratified sample was obtained from the ASQ to properly reflect the membership, which consists of top managers, quality managers, and presidents and owners. The survey was mailed to 2900 potential respondents yielding 300 usable responses for a response rate of 10.4 percent. The majority of responses came from organizations with fewer than 500 employees (70.5%). Only 18 percent of the responses were from firms with more than 1000 employees. While the majority of respondents identified themselves as middle management level quality managers, 30 percent identified themselves as CEO's, owners, presidents and vice-presidents. Some of the demographic information on the respondents is shown in Table 1.

Insert Table 1 about here

Methodology

The items used to measure each of the seven constructs and the data-set for this research were tested previously in prior research by Solis (1998). Since parts of the original data set developed by Solis were utilized for this research, we will summarize the construct validation process applied in his research.

Solis (1999) tested each of the items in a pilot study using structured interviews and Q-sort methodology. The data were analyzed for simplicity of factor structure, purification, reliability, brevity, convergent validity, discriminant validity and predictive validity. Factor analysis was utilized to confirm the set of items for the seven constructs in the proposed model. Following Nunally's (1983) suggestion, eigenvalues greater than 1.0 were utilized as a general guideline for the number of factors to extract. Maximum likelihood was selected as the extraction procedure and the varimax method was utilized for factor rotation. Missing values in the data set were replaced with the mean for the item. Items which did not load at 0.60 or above or with cross-loadings greater than 0.40 were eliminated. Finally, the stability of the factors was analyzed by measuring the ratio of respondents to items; the Tinsley and Tinsley guideline of having a minimal ratio between 5 and 10 was followed.

A five point Likert scale was used with the respondents indicating strong agreement (1) to strong disagreement (5) for each question. Organizational performance was evaluated based

on the respondents perceived performance relative to their industry/competitors on the following scale: 1) much lower, 2) lower, 3) about the same, 4) higher, or 5) much higher. The items used to measure each of the seven constructs are presented in appendix A.

RESULTS

The model in Figure 1 was tested utilizing Structural Equation Modeling (SEM) methodology. All propositions were tested as null hypotheses. SEM is preferred over Factor Analysis because of its ability to account for inter-item error correlations which enhances the robustness and flexibility in establishing construct validity. The software employed was Lisrel 8.3 developed by Jöreskog and Sörbom (1989). Detailed results for the model and all measurement items and constructs are summarized in Table 2. Overall, the results indicated significant relationships among all hypothesized relationships proposed by the model. Figure 2 shows the model with the structural path coefficients (λ) values and the corresponding t-values in parentheses.

Insert Figure 2 and Table 2 about here

Tests for reliability and unidimensionality (convergent validity) are important in establishing construct validity. The reliability of the constructs was measured using Cronbauch's alpha. The values for the model constructs reported are: 0.89 for Strategic Quality Planning, 0.83 for Supplier-based Relationships, 0.85 for Product Design, 0.91 for Product Innovation, 0.92 for Dependable Deliveries, 0.86 for Value-to-customer Quality and 0.76 for Organizational Performance. All alpha values indicate good reliability.

Unidimensionality (convergent validity) requires that there be one single latent variable underlying a set of measurement items. Unidimensionality is measured by the Goodness of Fit Index (GFI) and the Adjusted Goodness of Fit Index (AGFI). The results of the analysis indicate values of 0.89 and 0.87 for GFI and AGFI. Values approximating 0.90 or higher are considered evidence of good fit (Dillon and Goldstein, 1984).

DISCUSSION

The hypothesized relationship between strategic quality planning and supplier-based relationships was strongly supported by the model. We believed that this relationship existed based on the work of Krause, *et. al*., (1998), which suggests that the approach to supplier development is a key component of organizational strategy. We extended this to infer that supplier relationships are a key component of strategic quality planning as well. We also hypothesized that supplier relationships directly affected product design, product innovation and dependable deliveries. These relationships were also confirmed by the results of the analysis with strong support for the linkage from supplier relationships to product design. The support for the linkage to product innovation and dependable deliveries, while significant, were less strong.

The hypothesized linkage between supplier relationships and product innovation, while significant (t=2.45) is only moderately supported by the results. The rather moderate support

may be due to the differences between large organizations which internalize much of the innovation process and small to medium size enterprises (SMEs)
which have been reported in the literature to rely more heavily on external sources of innovation (Bagchi-Sen, 2001).

Slightly stronger support is indicated for the linkage from supplier relationship to dependable delivery (λ=.23, t=3.50). This linkage makes good sense, especially in manufacturing organizations that rely heavily on suppliers for a significant portion of the finished product cost through procurement activities.

The linkages from product design, product innovation and dependable deliveries to value-to-customer quality are supported at similar levels as from supplier-based relationships to these same three constructs. We found strong support for the linkage from product design to value-to-customer quality (λ=.41), weak support for product innovation to value-to-customer quality (λ=.17), and moderate support for dependable delivery to value-to-customer quality (λ=.19).

Support for the linkages from value-to-customer quality to organizational performance was found to be strong (λ=.30) and significant. We postulated this relationship based on prior literature and the operational components of the value-to-customer construct. The majority of prior research has reported significant support for the relationship between TQM practices and organizational performance and the value-to-customer construct used in this study is closely related to the customer satisfaction construct used in TQM.

CONCLUSION

In this study we developed and tested a model in which strategic quality planning was hypothesized to have an impact on supplier-based relationships, which in turn would have an impact on product design, product innovation and dependable deliveries. We found these relationships supported by the model. We also tested the linkages from product design, product innovation, and dependable deliveries to value-to-customer quality. These linkages were also supported. Finally the linkage from value-to-customer quality and organizational performance was supported as well.

Some managerial implications can be drawn from the study. First of all the strategic relevance of supplier relationships and its effect on processes within organizations implies that managers should be actively involved in the supplier selection process. Historically, the supplier selection has been performed by procurement and quality functions, which generally operate independently of internal process managers. This is not to say that internal managers have not been involved in this process but that their involvement has been largely reluctant and generally punitive in nature. Because of the impact that the suppliers have on the success of internal processes, which impact both the customer and the organizational performance, managers should be integrated into the selection and relationship building process. A second inference from this study is that there may be some over-lap between TQM practices and supply chain management principles. The position of the supplier relationship construct between strategic quality planning and performance and internal process constructs which are

charged with carrying out strategy indicate that successful TQM results may partially rely on supply chain management practices that enhance the performance of suppliers in support of internal processes.

Future research should investigate the relationship between successful TQM and supply chain management practices including not only supplier relationships but other possible connections among these constructs as well. Another area for future research is the connection between managers of internal processes (operational level managers) and their role in supplier selection and relationship building. This concept is important to organizational performance, which increasingly relies on the performance of suppliers.

APPENDIX A

Strategic quality planning measurement items include responses to the following questions:

- SP1 Our strategic plan supports long-term (3 years of more) quality improvement efforts.
- SP2 Our strategic plan is supported by our company's quality mission and policies.
- SP3 In our strategic plan quality is an integral part.

Supplier-based relationship items include responses to the following questions:

- SB1 Our primary criteria to select suppliers is quality not price.
- SB2 Our supplier relationships are focused on the long term.
- SB3 Our supplier relationships have achieved high levels of confidence and trust.
- SB4 Our suppliers readily participate in solving quality problems.
- SB5 Our suppliers are involved in our continuous improvement effort.

Product design items include responses to the following questions:

- PD1 Our product design process incorporates manufacturability as an important component.
- PD2 We involve external suppliers early in the product design.
- PD3 Our product design process applies customer-driven techniques (such as quality function deployment).
- PD4 Our product design process is supported by a multidisciplinary approach (marketing, manufacturing, R & D, etc.)
- PD5 Our product design process addresses environmental and legal concerns.

Product Innovation includes responses to the following questions.

- PI1 Our capability of developing a number of "new" product features is
- PI2 Our capability of developing a number of "new" products is
- PI3 Our capability of developing unique features is

Dependable Delivery items include responses to the following questions:

- DD1 Our capability of providing dependable deliveries is
- DD2 Our capability of providing on-time deliveries is
- DD3 Our capability of delivering the correct quantity of products needed on time is

Value-to-customer Quality items include responses to the following questions.

- VCQ1 Our capability of offering products that perform according to customer needs is
- VCQ2 Our capability of offering products that meet customer's safe-to-use needs is
- VCQ3 Our capability of offering products that meet customer's reliability needs is
- VCQ4 Our capability of offering products that meet customer's pre-established standards is

Organization Operational Performance items include responses to the following questions.

- OP1 Our rework levels are
- OP2 Our finished product defect rate is
- OP3 Our scrap levels are

REFERENCES

Agus, A., K. Krishnan, S. Kadir 2000. The structural impact of total quality management on financial performance relative to competitors through customer satisfaction: a study of Malaysian manufacturing companies, Total Quality Management, Vol. 11, Nos 4,5&6.

Aggarwal, S. 1993. A Quick Guide to Total Quality Management, Business Horizons, 36(3), 66-68.

Ahire, S., D. Golhar, & M. Waller 1996. Development and Validation of TQM Implementation Constructs, Decision Sciences, 27(1), Winter, 23-56.

American Quality Foundation and Ernst & Young 1992. International Quality Study: The Definitive Study of the Best International Quality Management Practices. Cleveland: Thought Leadership Series.

Annon. 1998. Strong supply relationships reduce cost, spark innovation, Purchasing, Jan 15.

Arogyaswamy, B. & R. Simmons 1993. Value-Directed Management: Organizations, Customers, and Quality. Quorum Books, Westport, Conn.

Bagchi-Sen, S. 2001. Product innovation and competitive advantage in an area of industrial decline: the Niagara region of Canada, Technovation 21.

Barclay, C. 1993. Quality Strategy and TQM Policies: Empirical Evidence, Management International Review, Special Issue, 33, 87-98.

Becker, S. 1993. TQM Does Work: Ten Reasons Why Misguided Attempts Fail, Management Review, 82(5), 30-33.

Benson, P., J. Saraph, & R. Schroeder 1991. The Effects of Organizational Context on Quality Management: an Empirical Investigation, Management Science, 17(4), 1107-1124.

Brinton, J. 1996. The right approach to development can make a major difference, Electronic Business Today, August.

Callahan, J. & B. Moretton 2001. Reducing software product development time, International Journal of Project Management, 19.

Carbone, J. 1998. The rule for medical buyers: low cost, Purchasing, August 13.

Cardy, R, & G. Dobbins 1996. Human Resource Management in a Total Quality Organizational Environment: Shifting From a Traditional To a TQHRM Approach, Journal of Quality Management, 1(1), 5-20.

Cardy, R., G. Dobbins, & K. Carson 1995. TQM and HRM: Improving Performance Appraisal Research, Theory, and Practice, Canadian Journal of Administration Sciences, 12, 106-115.

Chamberlain, G. 1998. Teamwork gives Maytag a jump on competition, Purchasing, May 7.

Choi, T., & K. Eboch, 1998. The TQM Paradox: Relations among TQM practices, plant performance, and customer satisfaction, Journal of Operations Management 17.

Cieri, D., D. Sampson, & A. Sohal 1991. Implementation of TQM in an Australian Manufacturing Company, International Journal of Quality and Reliability Management, 8(5), 55-65.

Clark, K., & T. Fujimoto 1991. Product Development Performance: Strategy, Organization, and Management in the World Auto Industry. Harvard Business School Press, Boston, MA.

Cole, R. 1992. The Quality Revolution, Production and Operations Management, 1(1), 118-120.

Crosby, P 1979. Quality is Free - The Art of Making Quality Certain. McGraw-Hill, Inc., New York.

Damanpour, F, & W. Evans 1984. Organizational Innovation and Performance: The Problem of Organizational Lag, Administrative Science Quarterly, 29, 392-409.

Deming, W.E. 1986. Out of the Crisis, MIT Center for Advanced Engineering Study, Cambridge, MA.

Dillon, W. R., & M. Goldstien 1984. Multi-variate Analysis Methods and Applications. John Wiley and Sons. New York.

Drayton, K. 1991. Are You Ready to Apply for the Award? Management Review. 80(11), 40-43.

Easton G 1993. The 1993 State of U.S. Total Quality Management: a Baldridge Examiner's Perspective, California Management Review, 35, Spring, 32-54.

Ebrahimpour, M. 1985. An Examination of Quality Management in Japan: Implications for Management in the United States, Journal of Operations Management, 5(4), 419-431.

Ebrahimpour, M., & S. Lee 1988. Quality Management Practices of American and Japanese Electronic Firms in the United States, Production and Inventory Management Journal, 29(4), 28-31.

Erickson, T. 1992. Beyond TQM: Creating the High Performance Business, Management Review, 81(7), 58-61.

Ferdows, K., & A. DeMeyer 1990. A Lasting Improvement in Manufacturing Performance: In Search of a New Theory, The Journal of Operations Management, 9(2), 168-184.

Flynn, B. 1992. Managing for Quality in the U.S. and in Japan, Interfaces, 22, Sept-Oct., 69-80.

Flynn, B., R. Schroeder, & S. Sakakibara 1995. A Framework for Quality Management Research and an Associated Measurement Instrument, Journal of Operations Management, 11, 339-366.

Galgano, A. 1994. Company Wide Quality Management. Productivity Press, Portland, OR.

Garvin, D. 1984. Japanese Quality Management, The Columbia Journal of World Business, 19, 3-12.

Garvin, D. 1991. How the Baldridge Award Really Works, Harvard Business Review, 69(6), 80-95.

Garvin, D. 1993. Building a Learning Organization, Harvard Business Review, 71(4), 78-91.

Gray, J. & T. Harvey 1992. Quality Value Banking: Effective Management Systems that Increase Earnings, Lower Costs, and Provide Competitive Customer Service. Wiley, New York, NY.

Hackman, J., & R. Wageman 1995. Total Quality Management: Empirical, Conceptual, and Practical Issues, Administrative Science Quarterly, 40(2), 309.

Hall, R. 1993. A Framework for Linking Intangible Resources and Capabilities to Sustainable Competitive Advantage, Strategic Management Journal, 14, 607-618.

Handfield, R., G. Ragatz, K. Petersen & R. Monczka 1999 Involving Suppliers in New Product Development, California Management Review, Vol. 42 No 1.

Handfield, R. 1989. Quality Management in Japan versus the United States: An Overview, Production and Inventory Management Journal, 30(2), 79-85.

Hartley, J., B. Zirger, & R. Kamath, 1997. Managing the buyer-supplier interface for on-time performance in product development, Journal of Operations Management, 15, 57-70.

Ishikawa, K. 1985. What is total quality control? The Japanese way. Prentice Hall, New York.

Juran, J. 1986. Quality Trilogy, Quality Progress, August, 14-24.

Juran, J. 1988. On Planning for Quality. Collier Macmillan.

Juran, J. 1993. Why Quality Initiatives Fail, Journal of Business Strategy, 35-38.

Karp, A., & B. Ronen 1992. Improving Shop Floor Control: An Entropy Model Approach, International Journal of Production Research, 30(4), 923-938.

Kathawala, Y. 1989. A Comparative Analysis of Selected Approaches to Quality, International Journal of Quality and Reliability Management, 6(5), 7-17.

Knight, J., H. Benningfield, & B. Kizzort 1987. Quality Circles, IEEE Transactions on Engineering Management, 34(4), 214-222.

Koufteros, X. 1995. Time-Based Competition: Developing a Nomological Network of Constructs and Instrument Development. Doctoral Dissertation, University of Toledo, June.

Krause, D., R. Handfield, & T. Scannell, 1998. An empirical investigation of supplier development: reactive and strategic processes, Journal of Operations Management 17, 39-58.

Kumar, S. & Y. Gupta 1993. Statistical Process Control at Motorola's Austin Assembly Plant, Interfaces, 23(2), 84-92.

Lascelles, D. & B. Dale 1989. A Review of the Issues Involved in Quality Improvement, International Journal of Quality and Reliability Management, 5(5), 76-94.

Leonard, F. & W. Sasser 1982. The Incline of Quality, Harvard Business Review, September-October, 163-171.

Lo, V. H. Y. & A. H. W. Yeung 2004, Practical framework for strategic alliance in Pearl river Delta manufacturing supply chain: A total quality approach, International Journal of Production Economics, Vol. 87, 231-240.

Madu, C. & C. Kuei 1993. Introducing Strategic Quality Planning, Long Range Planning, 26(6), 121-131.

Modarerres, B. & A. Ansari 1990. Two Strategies for Regaining US Manufacturing Dominance, International Journal of Quality and Reliability Management, 7(6), 68-77.

Nassimbeni, G. Factors underlying operational JIT purchasing practices: Results of an empirical research, International Journal of Production Economics 42 1995.

Nunnally, J. 1983. Psychometric Theory. McGraw-Hill, New York, NY.

Peters, A., E. Rooney, J. Rogerson, R. McQuarter, M. Spring, & B. Dale. 1999. New Product Design and Development: a generic model, The TQM Magazine, Vol. 11 No. 3.

Peters, T. 1988. Facing Up to the Need for a Management Revolution, California Management Review, 30, 8-38.

Pierce, J. & A. Delbecq 1977. Organizational Structure, Individual Attitudes, and Innovation, Academy of Management Review, 2, 26-37.

Pignatiello, J, 1988. An Overview of the Strategy and Tactics of Taguchi, IIE Transactions, 20(3), 247-254.

Rahman, S. Product development stages and associated quality management approaches, 1995. The TQM Magazine, Vol. 7 No 6.

Rao, S., T.S. Ragu-Nathan & L. Solis 1996. A Comparative Study of Quality Practices: USA, China, and India, Proceedings of the Decision Sciences Institute Annual Meeting, November, Orlando, FL.

Rao, S., T.S. Ragu-Nathan & L. Solis 1997. Quality Practices and Quality Results in New DevelopingCountries: The Case of India, China, and Mexico, Journal of Quality Management, 1997, 2(2), 235-250.

Romano, P. 2002. Impact of Supply Chain Sensitivity to Quality Certification on Quality Management Practices and Performances, Total Quality Management, Vol. 13, No. 7, 981-1000.

Romano, P. & A. Vinelli 2001, Quality management in a supply chain perspective, International Journal of Operations & Production Management, Vol. 21, No. 4, pp. 446-460.

Ross, D. 1991. Aligning the Organization for World-Class Manufacturing, Production and Inventory Management Journal, 32(2), 22-26.

Roth, A. & J. Miller 1992. Success factors in manufacturing, Business Horizons, July-August, 35(4), 73-79.

Samson, D. & M. Terziovski 1999. The relationship between total quality management practices and operational performance, Journal of Operations Management, 17.

Saraph, J., P. Benson, & R. Schroeder 1989. An Instrument for Measuring the Critical Factors of Quality Management, Decision Sciences, 20, 810-829.

Schmidt, B. & A. Wood 2000. Soapers Lean on Suppliers for Help with Innovation, Chemical Week Feb 23.

Schroeder, R., S. Sakakibara, E. Flynn, & B. Flynn 1992. Japanese Plants in U.S.: How Good Are They? Business Horizons, 35(4), 66-72.

Schroeder, R., G. Scudder, & D. Elm 1989. Innovation in Manufacturing, Journal of Operations Management, 8(1), 1-15.

Sloan, D. 1992. Health Care and Demand for Quality, International Journal of Quality and Reliability Management, 9(3), 60-68.

Solis, L., 1998. Unpublished Dissertation. An Exploratory Study of the Relationship Between Quality Management and Manufacturing Competitive Capabilities, University of Toledo.

Solis, L., S. Rao, T.S. Ragu-Nathan, C. Chen, & S. Pan 1998. Quality Management Practices and Quality Results: A Comparison of Manufacturing and Service Sectors in Taiwan, Managing Service Quality, 8(1), 46-54.

Suresh, N., & J. Meredith 1985. Quality Assurance Information Systems for Factory Automation, International Journal of Production Research, 23(3), 479-488.

Tarasewich, P. 1996. Design for Success, Competitiveness, 29 / IM March/April.

Teague, P., D. Bak, M. Puttre, K. Fitzgerald, T. Minahan & J. Carbone 1997. Suppliers, the competitive edge in Design, Purchasing, May 1.

Terziovski, M, & D. Samson 2000. The effect of company size on the relationship between TQM strategy and organizational performance, The TQM magazine, Vol. 12, no. 2.

Thompson, V. 1965. Bureaucracy and Innovation, Administrative Science Quarterly, 10, 1-20.

Tillery, K., & A. Rutledge 1991. Quality-Strategy and Quality-Management Connections, International Journal of Quality and Reliability Management, 8(1), 71-77.

Tillery, K., A. Rutledge, & R. Inman 1993. Quality Management and POM Textbooks: A Review and Assessment, International Journal of Quality and Reliability Management, 10(1), 8-16.

Tosirisuk, P. 1990. Economic Design of Process Parameter Control Limits and Process Adjustment Intervals for Continuous Production Processes, Computers and Industrial Engineering, 19(1-4), 263-266.

Trent, R. J. & R. M. Monckaz 1999. Achieving world-class supplier quality, Total Quality Management, Vol. 10, No. 6, 927-938.

Vonderembse, M. & T.S. Ragu-Nathan T.S. 1997. Quality function deployment's impact on product development, International Journal of Quality Science, Vol. 2, No 4.

Voss, C. 1992. Applying Service Concepts in Manufacturing, International Journal of Operations and Production Management, 12(4), 93-99.

Wacker, J. 1989. Integrative Theory of Strategic Quality Management: A Cost Benefit Framework for Evaluating Quality Improvement Programs, International Journal of Production Research, 27(1), 53-71.

Wagner, W.B. & R. Frankel 2000. Quality Carriers; Critical Link in Supply Chain Relationship Development, International Journal of Logistics: Research and Applications, Vol. 3, No. 3, 245-257.

Walton, M. 1986. The Deming Management Method. Putnam, New York.

Ward, P., G. Leong & K. Boyer 1994. Manufacturing Proactiveness and Performance, Decision Sciences, 25(3), 337-358.

Water, H., & J. Vries 1992. The Organization of Quality Management from Abstract Model to Real Example, International Journal of Quality and Reliability Management, 9(2), 10-17.

Wong, A. 2003. Achieving Supply Chain Excellence, Total Quality Management, Vol. 14, No. 2, 151-159.

Zairi, M. 1993. Competitive Manufacturing Combining Total Quality with Advanced Technology, Long Range Planning, 26(3), 123-132.

Zeithami, V. 1988. Consumer Perception of Price, Quality, and Value: A Means-End Model and Synthesis of Evidence, Journal of Marketing, 52(3), 2-22.

Figure 1

Model and Associated Hypotheses

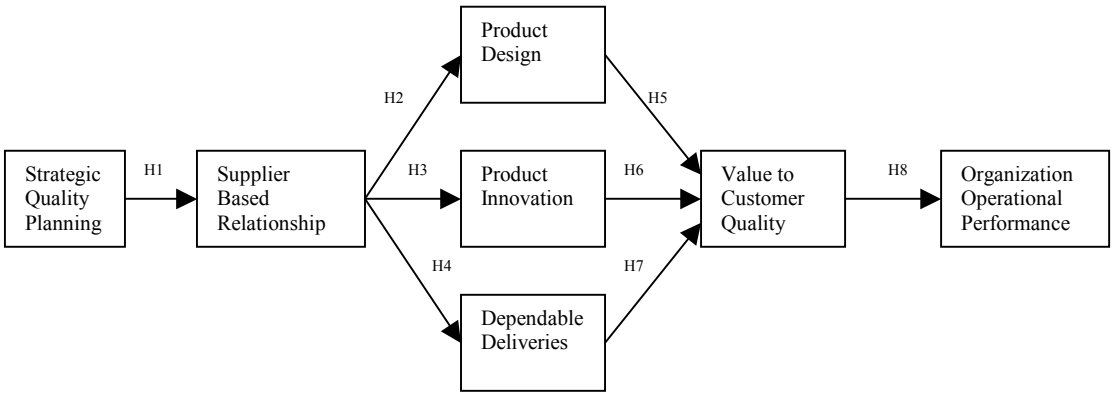

Figure 2:

Structural model with λ and t-values

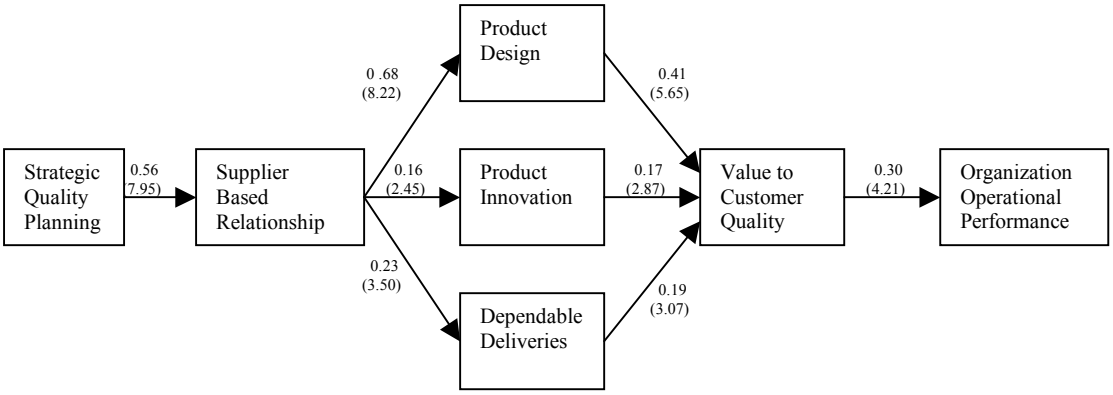

Table 1
Demographic Summary

Respondents by SIC Code		
SIC Code	Name	Percent
3400	Fabricated metal products except machinery and transportation equipment	20.3
3600	Electric and other electronic equipment and components except computers	14.5
3000	Rubber and miscellaneous plastic products	11.6
2800	Chemical and allied products	9.1
2000	Food and kindred products	6.2
3900	Miscellaneous manufacturing industries	10.0
Others		24.7
Total		100.0

Respondents by Position	
Position	Percent
Top management	29.8
Middle management	61.8
Others	8.4
Total	100.0

Firms by Size	
Number of employees	Percent
Up to 100	27.1
101 to 500	43.4
505 to 1000	11.1
1001 to 5000	10.8
Over 5000	7.6
Total	100.0

Export Activity	
Percent of Sales in Exports	Percent of Respondents
0	14.9
Less than 25	60.1
25 to 50	14.9
51 to 75	8.3
Over 75	1.7
Total	100.0

ISO-9000 POSITION	
Position	Percent
ISO-9001	34.0
ISO-9002	14.2
ISO-9003	
Not registered but planning	35.9
Not interested	15.9
Total	100.0

Respondent Level Of Education	
Education Level	Percent
High School	6.3
College	63.5
Master	26.0
Ph.D.	2.8
Other	1.4
Total	100.0

Table 2

Goodness-of-Fit Indices of the proposed Model

Degrees of freedom	291
χ^2 Statistic	444.14
p-Value	0.00
χ^2 / df	1.53
Goodness of Fit Index (GFI)	0.89
Adjusted Goodness of Fit Index (AGFI)	0.87
RMSEA	0.042

Constructs and Items	Standardised loadings (λ)	Standard errors	Cronbauch's alpha (α)
a) Strategic quality planning			.89
SP1 long-term improvement efforts	.78	.39	
SP2 company policy support	.88	.22	
SP3 strategic plan integration	.90	.19	
b) Supplier-based relationships			.83
SB1 quality based supplier selection	.66	.57	
SB2 long-term supplier focus	.77	.41	
SB3 confidence and trust	.80	.35	
SB4 supplier participation	.66	.57	
SB5 supplier continuous improvement	.67	.55	
c) Product design			.85
PD1 manufacturability	.68	.53	
PD2 supplier involvement	.75	.44	
PD3 customer-driven	.69	.52	
PD4 multi-disciplinary approach	.71	.50	
PD5 environmental and legal concerns	.57	.68	
d) Product Innovation			.91
PI1 new product features	.95	.10	
PI2 develop new products	.89	.20	
PI3 develop unique features	.80	.36	
e) Dependable deliveries			.92
DD1 provide dependable deliveries	.94	.12	
DD2 on-time deliveries	.95	.10	
DD3 correct quantity on-time	.81	.35	
f) Value-to-customer quality			.86
VCQ1 customer performance needs	.79	.36	
VCQ2 customer safe-to-use needs	.78	.37	
VCQ3 customer reliability needs	.78	.38	
VCQ4 meet pre-established standards	.71	.49	
g) Organization operational performance			.76
OP1	.88	.22	
OP2	.75	.43	
OP3	.59	.65	

NOTAS

Depósito Legal: M-20073 I.S.S.N.: 1579-4873