Quality and Business Performance:
An Empirical Study of First Tier Automotive Suppliers

by
Sime Curkovic

At: Western Michigan University
Haworth College of Business
Management Department
Kalamazoo, MI 49008-3899

and

Shawnee K. Vickery
Cornelia Droge

Both at: Michigan State University
The Eli Broad Graduate School of Management
Department of Marketing and Supply Chain Management
East Lansing, MI 48824-1112

Corresponding Author: Sime Curkovic
Tel.: 616.387.5839
E-mail: sime.curkovic@wmich.edu

ABSTRACT

Quality is a key competitive weapon in the global marketplace. Quality engenders competitive advantage by providing products that meet or exceed customer needs and expectations. In this study of first tier suppliers to the "Big 3" North American automobile manufacturers, we examine relationships between competitive dimensions of quality (e.g., design quality, conformance quality) and overall firm performance (e.g., ROI, Market Share). Our findings reveal that all competitive dimensions of quality are highly correlated with multiple measures of firm performance. Nevertheless, product support is shown to be the most consistent driver of business performance in the automotive supply industry.

Keywords: Automotive Supply Industry, Manufacturing Strategy, Quality, Survey Research

INTRODUCTION

Recent developments in global markets have highlighted the increasing importance of quality. Many experts contend that a decline in product quality had significantly eroded the competitiveness of American firms in the past (Shetty 1993). In other words, quality products and services are essential for firms seeking to compete globally. Companies that improve quality acquire a competitive advantage through quality-induced product differentiation: that is, the good or service is perceived as unique due to its superior quality. Once recognized as an order-winner, high product quality is now perceived by many purchasers as an order-qualifier (Handfield and Ghosh 1994).

Although there are many different ways to differentiate products, superior quality is one of the most effective, one which results in a defensible competitive position and insulates a firm against inroads of rival firms (Porter 1980). Quality gurus such as Crosby (1979), Deming (1982), Garvin (1983 and 1988), Juran (1970, 1978, 1989, and 1992), and Ishikawa (1976) have devoted considerable attention to identifying key practices that impact quality. Most of their research has been descriptive in nature. These experts and others have carefully studied and disseminated information concerning international quality practices with specific emphasis on Japanese methods (e.g., Hayes 1981; Weiss 1984).

Garvin (1987) contends that competitive dimensions of quality performance can be used individually or collectively to obtain a competitive advantage. This thesis is thoroughly examined in this research. First, we identify key dimensions of quality performance in the automotive supply industry. Next, the relationships of these individual quality dimensions with various measures of overall firm performance are examined. Finally, we investigate whether individual dimensions of quality combine in their effects on overall firm performance. For

example, synergies might be gained by combining the use of design quality with product support. A combination of two or more quality dimensions could also engender competitive advantage.

This paper is organized as follows. First, a review of the literature relevant to this topic is presented. Second, the theoretical model and variables of interest are identified. The methodology is described with attention given to a description of the sample, reliability and validation issues associated with the measurement instrument, and the actual measures used in the measurement instrument. This is followed by the research results, which reveal the linkages between competitive dimensions of quality performance and overall firm performance. Finally, the results are discussed and conclusions are drawn.

LITERATURE REVIEW

The Dimensions of Quality

Most quality programs identified by examining international practices have focused on improving quality control through strengthening conformance to specifications. However, conformance quality is only one dimension of quality performance. Garvin (1984b, 1987, and 1988) identified eight "Competitive Dimensions of Quality" that could be used by a firm as when guidelines deploying quality as a weapon. Garvin's eight dimensions are: 1) performance; 2) features; 3) reliability; 4) conformance; 5) durability; 6) serviceability; 7) aesthetics; and 8) perceived quality. While his proposal is the result of subjective impressions and was supported only anecdotally, it has been well-received and is generally considered a seminal work in the area of strategic quality management.

Garvin proposed that existing western perspectives on quality were reactive and defensive: that is, quality was treated primarily as something only recognized in its breach or absence. In contrast, he focused on a package of eight quality dimensions, contending that firms

which outperformed their competitors along these dimensions could use “quality” to differentiate their offerings in a favorable manner. The eight dimensions of quality could be used individually or collectively to affect overall firm performance. Garvin suggested that firms do not need to excel on all eight dimensions to be successful. For example, pursuing a quality niche focusing on a single quality dimension can improve a firm’s competitive stance, especially if the dimension chosen is important to customers.

More recently, several dimensions of quality and their relation to overall firm performance were examined in the furniture industry (Forker, Vickery, and Droge 1996). Forker et al. examined eight quality elements derived from Garvin's (1987) "quality dimensions" and Sinha and Willborn’s (1985) product/quality life cycle research. They were: 1) conformance quality; 2) product reliability; 3) product durability; 4) design quality (design innovation); 5) product improvement; 6) brand image; 7) company reputation; and 8) customer service. The relationships of these eight dimensions to nine measures of overall firm performance were examined, and numerous statistically significant relationships were identified. Each of the quality dimensions was significantly related to at least one measure of firm performance. Nevertheless, similar studies in other industries are required for external validity.

The set of quality performance variables defined for our study is based on previous research (e.g., Garvin 1987, Forker et al. 1996) and discussions with an expert panel of automotive industry experts from the Automotive Industry Action Group (AIAG), in Southfield, MI. The input of these experts ensured that our set of quality dimensions was comprehensive and meaningful within the automotive industry. The dimensions of quality used for this study are listed and defined in Table 1.

INSERT TABLE 1 ABOUT HERE

Note that product reliability, product durability, and conformance to specifications are taken directly from Garvin's seminal work. Design quality incorporates Garvin's performance, features, and aesthetics dimensions according to Forker et al. (1996). Garvin's serviceability dimension was revised to consider pre-sale customer service and product support (after-sale service) separately. This revision was recommended by our panel of automotive industry experts. Company reputation was seen as an appropriate proxy for Garvin's perceived quality dimension since "reputation is the primary stuff of perceived quality" (Garvin 1987, p. 107).

Quality and Firm Performance

For many years, empirical studies examining quality and business performance have focused on the Profit Impact of Marketing Strategies (PIMS) database (Schoeffler, Buzzell, and Heany 1979; Buzzell and Wiersema 1981a, 1981b; Craig and Douglas 1982; Phillips, Chang, Buzzell 1983). Using PIMS data, researchers found a strong positive relationship between quality and market share. High product quality was also associated with increases in cumulative production and subsequent reductions in manufacturing cost due to learning curve effects. PIMS studies have also found a strong positive correlation between quality and financial measures of profitability such as ROI. This relationship was found to be independent of a firm's market share.

Other researchers have also found relationships among quality and firm performance. The Forker et al. (1996) study referred to earlier found that quality (conformance) was significantly related to ROI growth, sales growth, and ROS growth. Reliability was significantly

related to ROA after-tax. Product durability was significantly related to ROA after-tax, ROI growth, and ROS. Design quality and product improvement were both related to ROI, ROI growth, and sales growth. Additionally, design quality was related to ROS and product improvement was related to ROS growth. Company reputation was related to market share, ROS and ROS growth, and customer service was related to ROI growth.

Our research proposes relationships between our seven dimensions of quality (see Table 1) and measures of overall firm performance. Firm performance was evaluated using a set of six fairly standard performance measures: 1) pre-tax return on assets (pre-tax ROA); 2) after-tax return on assets (after-tax ROA); 3) return on investment (ROI); 4) growth in return on investment (ROI growth); 5) market share; and 6) growth in market share. In general, we anticipate that high levels of performance along the competitive dimensions of quality will be associated with corresponding high levels of firm performance. In particular, we are interested in determining exactly which quality dimensions covary with which dimensions of firm performance.

RESEARCH METHODOLOGY

The Sampling Procedure

The sampling frame consisted of the top 150 (in terms of annual sales) independently owned first tier suppliers to the Big 3 automakers in North America (i.e., General Motors, Ford, and Chrysler). The unit of analysis was the Strategic Business Unit (SBU). These 150 suppliers were selected because they account for over 90% of the purchasing sales volume by automakers in North America. The automotive industry was selected because of its historic as well as recent emphasis on quality as a key competitive weapon.

We targeted Chief Executive Officers (CEOs) to assure that the respondents were knowledgeable of strategic quality issues and the performance of their companies relative to their competitors. Questionnaires were pre-tested and validated for face validity. The CEOs were mailed research questionnaires accompanied by explanatory letters; subsequently, repeated follow-up telephone calls were used. CEOs of multiple business units were instructed to select one of their SBUs and to forward the research questionnaire. We requested that the questionnaire be completed by the CEO or Director of an SBU which is a first tier supplier to a North American original equipment manufacturer (OEM). North America includes Mexico, Canada, and the U.S. (Please see the Appendix for further details.)

Description of the Sample

The final sample for the study consisted of 57 of the 150 firms contacted, for a response rate of approximately 38%. Mean annual sales were $501,516,415, the median was $300,000,000, and the standard deviation was 637,456,698. The mean number of employees was 2,810, the median was 1,400, and the standard deviation was 3,431. The mean percentage of sales which were direct sales to North American OEMs was 83.67%, the median was 90%, and the standard deviation was 19.31.

Since the questionnaires were not distributed anonymously, all of the nonrespondents were identified and all of them were willing to answer a few questions on the telephone. The most often cited reason for not completing the questionnaire was a lack of time. The second most prevalent reason was that company policy did not allow them to complete questionnaires because of concerns for confidentiality. To ensure that the respondent sample was not biased towards specific types of firms, early versus late respondents were compared (Armstrong and Overton 1977). A t-test was used to assess the statistical significance of differences in the

sample means between the early (first 29 questionnaires received) and late (last 28 questionnaires received) responses for all the variables used in the study. No statistically significant differences were found at α=.05.

Measurement of Quality

Strategic importance was measured by having the respondents rate each of the seven dimensions in Table 1 using a seven point scale with the endpoints "Least Important" (=1) and "Extremely Important" (=7). Quality performance was measured by having the respondents rate their firm's performance on each of the seven quality items. The respondents were asked to indicate on a seven point scale, "Poor" (=1) to "Excellent" (=7), their firm's performance relative to its major competitors.

Measurement of Firm Performance

Business performance was evaluated using a set of six firm performance measures: 1) pre-tax return on assets (pre-tax ROA); 2) after-tax return on assets (after-tax ROA); 3) return on investment (ROI); 4) growth in return on investment (ROI growth); 5) market share; and 6) growth in market share. Performance relative to major industry competitors was measured on 7-point scales anchored 1= "worst in industry" and 7= "best in industry." The means, medians, and standard deviations are in Table 2. (See the Appendix for further details).

INSERT TABLE 2 ABOUT HERE

RESULTS

Analysis of Descriptive Statistics

The means for the strategic importance and performance ratings for each competitive dimension of quality are provided in Table 3. One of the major characteristics of the mean and median importance values is that all fall at the high end of the 7-point scale. For example, five of the means are greater than 5, and the other two are greater than 6. Thus, the strategic importance of quality in the automotive supply industry appears to be critical. The two most important items are company reputation and conformance to specifications.

INSERT TABLE 3 ABOUT HERE

The mean and median performance values also fell at the high end of the 7-point scale (for example, all means are greater than 5). Conformance to specifications had the second highest rank for importance, and the highest rank for performance. However, the strategic importance ratings and performance ratings overall are not necessarily strongly related to one another. For example, pre-sale customer service was ranked the third highest in importance, but it had the lowest rank for performance. Design quality was ranked fourth highest in importance, but it had the second lowest rating in terms of performance.

Linking the Dimensions of Quality to Business Performance

Table 4 presents the results of the correlations of quality performance with the firm performance measures. As can be observed from Table 4, none of the correlations have negative signs. The lack of any negative correlations indicates that a high value on quality performance does not preclude a high value on firm performance.

INSERT TABLE 4 ABOUT HERE

Many of the seven competitive dimensions of quality are positively *and* significantly related to one or more of the six firm performance measures. The results show that:

1. product support is significantly related to all firm performance measures (five of the six relationships are significant at the .01 level or better);

2. company reputation is significantly related to all firm performance measures (two relationships are significant at the .01 level or better);

3. product reliability was significantly related to all firm performance measures (one relationship is significant at the .01 level or better);

4. product durability is significantly related to all firm performance measures (one relationship is significant at the .01 level or better);

5. pre-sale customer service is significantly related to all firm performance measures (no relationships are significant at the .01 level or better);

6. design quality was significantly related to three firm performance measures (no relationships are significant at the .01 level or better); and

7. conformance to specifications was significantly related to three firm performance measures (no relationships were significant at the .01 level or better).

Stepwise Regression Results

Stepwise regressions show which individual dimensions of quality enter the model given that other dimensions are already in. An alpha value of .10 was chosen as the entry cut-off level. Table 5 shows the results of the stepwise regression analyses. For each measure of firm performance, the model p-value, the model coefficient of determination (R^2), the adjusted coefficient of determination, the quality variables entered into the model, their beta coefficients, and the p-values for the quality variables are listed in Table 5.

INSERT TABLE 5 ABOUT HERE

All of the models were significant at the .05 level, and five of the models were significant at the .01 level. Five of the six firm performance models had only one variable enter. Specifically, product support was the only predictor for pre-tax ROA (p=.005), after-tax ROA (p=.005), ROI (p=.007), growth in ROI (p=.026), and market share (p=.007). Two variables entered into the market share growth model: product durability and company reputation. This model had the highest R^2 value of .209. The stepwise regressions underscore the importance of product support to overall firm performance for first tier automotive suppliers.

DISCUSSION

Based on the correlations in Table 4, the seven dimensions of quality were ranked on an axis named "Relationship to Business Performance", ranging from "WEAKEST" (i.e., conformance to specifications) to "STRONGEST" (i.e., product support). For example, conformance to specifications was related to the fewest number of firm performance measures; therefore, it was rank ordered as the weakest (1) among the seven quality dimensions. Likewise, product support was rank ordered the strongest (7) because it was related to the greatest number of measures. These rankings were charted and compared against Table 3's "Strategic Importance" ratings, which were also rank ordered. The perception-performance gap analysis is illustrated in Figure 1.

INSERT FIGURE 1 ABOUT HERE

The analysis illustrates a mismatch between the strategic importance placed on a particular competitive dimension of quality by senior management and the correlations between that dimension and the measures of firm performance. It could be argued that the quality dimensions which are the most consistent predictors of overall firm performance should be assigned the greatest strategic importance. Such points would fall on the diagonal line in Figure 1, illustrating a perfect alignment between the firm's strategy and outcomes. For example, the dimension which is the most consistent predictor of overall firm performance should be given the greatest amount of strategic importance. However, this is not the case: product support is significantly related to every measure of firm performance, but four other dimensions are given higher ratings in terms of greater strategic importance. In fact, the plotted points associated with every dimension of quality fall off the diagonal.

Company reputation, conformance to specifications, design quality, and pre-sale customer service fall above the diagonal. This means that these dimensions are given greater strategic importance weight than their actual relationship to firm performance warrants. For example, conformance to specifications is the second highest rated quality variable in terms of strategic importance to the firm; however, it has the weakest relationship to business performance. Conformance to specifications is significantly related to only three measures of firm performance.

The three quality dimensions falling below the diagonal include product support, product reliability, and product durability. These dimensions are perceived as less strategically important to the firm by the CEO. However, these dimensions demonstrate the strongest relationship to business performance. Figure 1 demonstrates that the first tier suppliers might benefit from realigning their strategic foci to give greater emphasis to product support, product durability, and

product reliability, vis-à-vis conformance to specifications, design quality, and pre-sale customer service. The nature of automotive products and other durable goods is such that product reliability, durability, and product support (after-sales service) are critical. The smaller contributions of conformance to specifications and design quality to business performance does not imply, however, that these dimensions do not matter. Within the automotive industry, conformance is often regarded as an order-qualifier for which high performance is required to be even given consideration as a potential supplier. Note also that all of the quality variables are consistent predictors of more than one of the overall firm performance measures. Furthermore, all of the quality variables are related to ROI, which is often recognized as an important indicator of firm performance in the automotive supply industry.

Very little research has addressed the relative effects of various dimensions of quality and how these effects might differ for various industries. However, the contributions of various quality performance measures to overall firm performance was examined in the furniture industry (Forker et al. 1996). Their highest impact quality variables were design quality, product improvement, and conformance quality. These results, especially for design quality, were very consistent with the quality literature. For example, Deming's (1982) emphasis on continuous improvement includes the continuous improvement of design quality. Juran and Gyrna (1988) highlight the importance of design quality, saying that product designs should address the critical few features that capture consumers' needs, and Crosby (1979) strongly advocated designing quality into a product. Also, design control is one of the three components of Feigenbaum's (1956, 1991) "total quality control" concept. However, the external validity of the Forker et al. research is limited because their work was specific to a single industry. It is interesting that our results are not entirely consistent with the Forker et al. (1996) furniture industry study;

specifically, we did not find design quality to be the most critical variable. This may be because design is under the complete control of a furniture manufacturer but not under the complete control of a supplier to the Big 3. Design may be virtually dictated to the supplier in the latter case.

However, our findings are consistent with and provide some support for Garvin (1984b), whose work is generally considered seminal. Garvin suggests that firms do not need to excel on all dimensions of quality in order to be successful. Pursuing a quality niche which is especially important to the customer (i.e., product support, reliability, and durability) can lead to better firm performance, especially if the dimensions singled out are ones that other firms have not targeted. Further research in other industries would be required to determine whether the impact of quality dimensions on firm performance varies significantly across industries. Future research might also empirically group Garvin's quality dimensions into individual broader categories of quality performance having strategic or managerial significance.

CONCLUSION

This research shows that quality dimensions are highly correlated with firm performance in the automotive industry. Surprisingly, the quality variables that were related to the greatest number of measures of firm performance - product support, reliability, and durability - were evaluated as less strategically important by our respondents. The quality variables which the literature identifies as being most important were indeed given the greatest amount of strategic importance by the executives in our sample of firms - conformance to specifications, design quality, and pre-sales customer service. However, these quality variables were not necessarily related to all firm performance measures.

A longitudinal study within a single industry such as the automotive supply industry would help determine if these quality dimensions and their impact on firm performance change over time. Conformance, design quality, and pre-sale customer service probably had a great impact on firm performance in the past, but customer requirements and expectations have changed as a result of industry trends (e.g., outsourcing, strategic alliances, just-in-time). Once recognized as order-winners in this industry, these dimensions now only allow a supplier to exist (but not excel) in the marketplace. The quality dimensions impacting firm performance have changed, but the strategic importance placed on the dimensions have not necessarily changed. By the time product support is given the attention it deserves, there might be a new dimension which will win orders and have a greater impact on firm performance. This would be expected in a highly volatile and dynamic industry with intense international competition.

APPENDIX

Sample

The study focuses on first tier suppliers because they are more likely than lower tier suppliers to be actively engaged in strategic quality initiatives. Under the provisions of QS-9000, the Big 3 are requiring their first tier suppliers to upgrade their competitive quality programs and methods (Eastman 1995). Among first tier suppliers there exists variety in products, process types and technologies, as well as competition for Big 3 business. The population was identified with the assistance of a panel of experts from the Automotive Industry Action Group (AIAG). AIAG is a professional association with over 1,000 members including automakers such as General Motors, Ford, and Chrysler.

A key advantage of a single industry study such as this one is that some variance due to industry specific conditions can be controlled. For example, quality dimensions may differ across industries in number, identity, and relative strategic importance. Industries are also affected by the business cycle which impacts performance. Controlling for industry effects can compensate for variability between industries, in terms of work force management, competitive forces, union policies, etc. The major drawback of a single industry study is reduced external validity. However, a profile of the first tier automotive suppliers reveals some degree of diversity as mentioned earlier. For example, our sample includes manufacturers of seating systems and manufacturers of anti-lock braking systems. Thus, external validity is not as severely compromised by focusing on this industry as compared with focusing on a more homogenous industry group.

We targeted CEOs for two reasons. First, research suggests that greater attention to informant selection can help to overcome the common method variance problem when practical

considerations require single respondents (Miller and Roth 1994). Second, Phillips (1981) indicates that high ranking informants tend to be more reliable sources of information than their lower ranking counterparts.

Validation of the Questionnaire

The AIAG expert panel assisted in the identification and validation of the constructs and variables in our study. In addition, the panel assisted in pre-testing the survey instrument. The final research questionnaire was validated for comprehension, completeness, and face validity in advance through interviews with AIAG experts. One member of the research team also shared insights based on seven years of experience in the automotive industry. All items appearing on the research questionnaire were defined. The expert panel reviewed the definitions of terms and recommended changes to ensure that there were no items with ambiguous or multiple interpretations.

Measurement of Quality

Note that 7 point scales were used throughout. Seven point scales were used instead of a five point scale to alleviate the problem of attenuation due to restriction of range. Nemetz (1990) found that attenuation affected perceptual data on quality and, to a lesser extent, other competitive dimensions (e.g., cost, flexibility, time). Attenuation due to restriction of range weakens correlations when variation in the data is small. Several studies show that improved reliability is achieved by increasing scale points to seven but there is no marginal improvement beyond seven (Komorita and Graham 1965; Lissitz and Green 1975; Cicchetti, Showalter, and Tyrer 1985).

Measurement of Firm Performance

Performance relative to each of the six measures was assessed in two ways:

1. a **subjective** assessment, i.e., the SBU's performance relative to its major industry competitors was assessed by the respondent on a seven point scale with endpoints "Worst in Industry" (=1) and "Best In Industry" (=7); and

2. an **objective** assessment, i.e., actual values for each of the non-growth focused measures were obtained from respondents willing to disclose such information. These were used to calculate objective measures for the two growth measures.

The correlations of the subjective versus the actual ratings were all significant: ROI at the .10 level, and the rest at <.05. The correlations between the subjective rating and the actual objective value were: 1) pre-tax ROA=0.61; 2) after-tax ROA=0.65; 3) ROI=0.31; 4) ROI growth=0.69; 5) market share=0.49; and 6) market share growth=0.34. Past research has also found that managerial assessments are consistent with objective internal performance and even with external secondary data (Dess and Robinson 1984; Venkatraman and Ramanujam 1986; Vickery, Droge, and Markland 1994).

The sample sizes for the "actual" values were between 23 and 31, much smaller than those for the "subjective" measures at 51-55. This is due to the unwillingness of many CEOs to release financial information. Since the subjective ratings were highly positively correlated with the actual values, the subjective ratings were used in all analyses to take advantage of the larger sample sizes. Larger sample sizes provide some assurance that statistical nonsignificance does not occur only because the sample sizes are too small.

REFERENCES

Armstrong, J.S., and Overton, T.S. 1977. Estimating nonresponse bias in mail surveys. *Journal of Marketing Research* 14: 396-402.

Buzzell, R.D., and Wiersema, F.D. 1981a. Modeling changes in market share: A cross-sectional analysis. *Strategic Management Journal* 2(1): 27-42.

Buzzell, R.D., and Wiersema, F.D. 1981b. Successful share-building strategies. *Harvard Business Review* 59(1): 135-144.

Cicchetti, D.V., Showalter, D., and Tyrer, P.J. 1985. The effect of number rating scale categories on levels of interrater reliability: A Monte Carlo simulation. *Applied Psychological Measurement* 9(1): 31-36.

Craig, C.S., and Douglas, S.P. 1982. Strategic factors associated with market and financial performance. *Quarterly Review of Economics and Business* 22(2): 101-111.

Crosby, P. 1979. *Quality is free: The art of making quality certain*, New York: Hodder & Stoughton.

Deming, W.E. 1982. *Quality, productivity, and competitive position*, Cambridge, MA: MIT Center for Advanced Engineering.

Dess, G.S., and Robinson, R.B. 1984. Measuring organizational performance in the absence of objective measures. *Strategic Management Research* 5(3): 265-273.

Eastman, M. 1995. The common code. *Cutting Tool Engineering*: 22-28.

Feigenbaum, A.V. 1956. Total quality control. *Harvard Business Review* 34(6): 93-101.

Feigenbaum, A.V. 1991. *Total quality control*, New York: McGraw-Hill.

Forker, L.B., Vickery S.K., and Droge, C.L. 1996. The contribution of quality to business performance. *International Journal of Operations & Production Management* 16(8): 44-62.

Garvin, D.A. 1983. Quality on the line. *Harvard Business Review* 61(5): 65-75.

Garvin, D.A. 1984b. What does 'product quality' really mean? *Sloan Management Review*, Fall, 26(1): 25-43.

Garvin, D.A. 1987. Competing on the eight dimensions of quality. *Harvard Business Review* 65(6): 101-109.

Garvin, D.A. 1988. *Managing quality*, New York: The Free Press.

Handfield, R.B., and Ghosh, S. 1994. Creating a quality culture through organizational change: A case analysis. *Journal of International Marketing* 2(3): 7-36.

Hayes, R.H. 1981. Why Japanese factories work. *Harvard Business Review* 59: 56-66.

Ishikawa, K. 1976. *Guide to quality control*, Tokyo: Asian Productivity Organization.

Juran, J.M. 1970. *Quality planning and analysis*, New York: McGraw-Hill.

Juran, J.M. 1978. Japanese and Western quality - a contrast. *Quality Progress* 11: 10-18.

Juran, J.M., and Gyrna, F.M. 1988. *Juran's quality control handbook*, 4th edition, New York: McGraw-Hill.

Juran, J.M. 1989. *Juran on leadership for quality: An executive handbook*. New York: The Free Press.

Juran, J.M. 1992. *Juran on quality by design*, New York: McGraw-Hill.

Komorita, S.S., and Graham, W.K. 1965. Number of scale points and the reliability of scales. *Educational and Psychological Measurement* 4: 987-995.

Lissitz, R.W., and Green, S.B. 1975. "The effect of the number of scale points on reliability: A Monte Carlo approach. *Journal of Applied Psychology* 60(1): 10-13.

Miller, J.G., and Roth, A.V. 1994. A taxonomy of manufacturing strategies. *Management Science* 40(3): 285-304.

Nemetz, P.L. 1990. *Bridging the strategic outcome measurement gap, in manufacturing organizations, in manufacturing strategy: The research agenda for the next decade*. In: Ettlie, J.E., Burstein, M.C., Feigenbaum, A. (Eds.). Manufacturing Strategy, The Research Agenda for the Next Decade. Proceedings of the Joint Industry University Conference on Manufacturing Strategy, Ann Arbor, MI: 63-74.

Phillips, L.W. 1981. Assessing measurement error in key informant reports: A methodological note on organizational analysis in marketing. *Journal of Marketing Research* 18: 395-415.

Phillips, L.W., Chang, D.R., and Buzzell, R.D. 1983. Product quality, cost position, and business performance: A test of some key hypotheses. *Journal of Marketing* 37: 26-43.

Porter, M.E. 1980. *Competitive Strategy*, New York: The Free Press.

Schoeffler, S., Buzzell, R.D., and Heany, D.F. 1979. Impact of strategic planning on profit performance. *Harvard Business Review* 52(2): 137-145.

Shetty, Y. K. 1993. The quest for quality excellence: Lessons from the Malcolm Baldrige Quality Award. *S.A.M. Advanced Management Journal*, Spring: 34-40.

Sinha, M. N., and Willborn, W.O. 1985. *The Management of Quality Assurance*, John Wiley & Sons, New York, NY.

Venkatraman, N., and Ramanujam, V. 1986. Measurement of business performance in the absence of objective measures. *Strategic Management Review* 11(4): 801-814.

Vickery, S.K., Droge, C., and Markland, R.E. 1994. Strategic production competence: Convergent, discriminant, and predictive validity. *Production and Operations Management* 3(4), 308-319.

Weiss, A. 1984. Simple truths of Japanese manufacturing. *Harvard Business Review* 62, 119-125.

Table 1. Competitive Dimensions of Quality

1. **Product Reliability:** the ability to maximize the time to product failure or malfunction.

2. **Product Durability:** the ability to maximize the time to product replacement.

3. **Conformance to Specifications:** the ability to manufacture a product whose operating characteristics meet established performance standards.

4. **Design Quality:** the ability to provide a product with capabilities, features, styling, and/or operating characteristics that are either superior to those of competing products or unavailable with competing products.

5. **Company Reputation:** the ability to create a positive or favorable image in the customer's mind when he/she hears the company's name.

6. **Pre-Sale Customer Service:** the ability to service the customer during the purchase decision process (i.e., before the customer buys the product).

7. **Product Support:** the ability to service the customer in providing product support after the sale of the product to ensure continuing customer satisfaction.

Table 2. Descriptive Statistics of the Business Performance Measures

Performance Measure:	n	Mean	Median	Standard Deviation
Pre-Tax ROA	52	4.90	5	1.38
After-Tax ROA	52	4.96	5	1.31
ROI	51	5.08	5	1.31
Growth in ROI	53	4.53	5	1.38
Market Share	52	4.85	5	1.51
Growth in Market Share	55	4.82	5	1.36

Table 3. Descriptive Statistics for Strategic Importance and Quality Performance

Competitive Dimensions of Quality	Strategic Importance: 1 = Least Important, 7 = Extremely Important			Performance Relative to Major Competitors 1 = Poor, 7 = Excellent		
	Mean	Median	Std. Deviation	Mean	Median	Std. Deviation
1. Product Reliability	5.73	6	1.29	5.88	6	0.91
2. Product Durability	5.25	6	1.34	5.75	6	1.02
3. Conformance to Spec's	6.05	6	1.11	5.95	6	0.91
4. Design Quality	5.94	6	1.04	5.59	6	1.07
5. Company Reputation	6.16	6	0.83	5.66	6	1.32
6. Pre-Sale Customer Service	5.96	6	1.00	5.50	5	1.02
7. Product Support	5.84	6	1.16	5.64	6	1.08

Table 4. Correlations of Quality Performance with Firm Performance Measures

Quality Performance (Intermediate Outcome Measures)	Firm Performance (Final Outcome Measures)					
	Pre-Tax ROA	After-Tax ROA	ROI	ROI Growth	Market Share	Market Share Growth
Product Support	.38***	.39***	.38***	.31**	.37***	.40***
Company Reputation	.25**	.27**	.27*	.22*	.36***	.40***
Product Reliability	.31**	.31**	.35***	.19*	.24**	.19*
Product Durability	.21*	.19*	.28**	.20*	.29**	.32***
Pre-Sale Customer Service	.21*	.22*	.24*	.28**	.23*	.23**
Design Quality	.27**	.27**	.31**	.12	.12	.13
Conformance to Specifications	.19*	.21*	.25**	.11	.08	.08

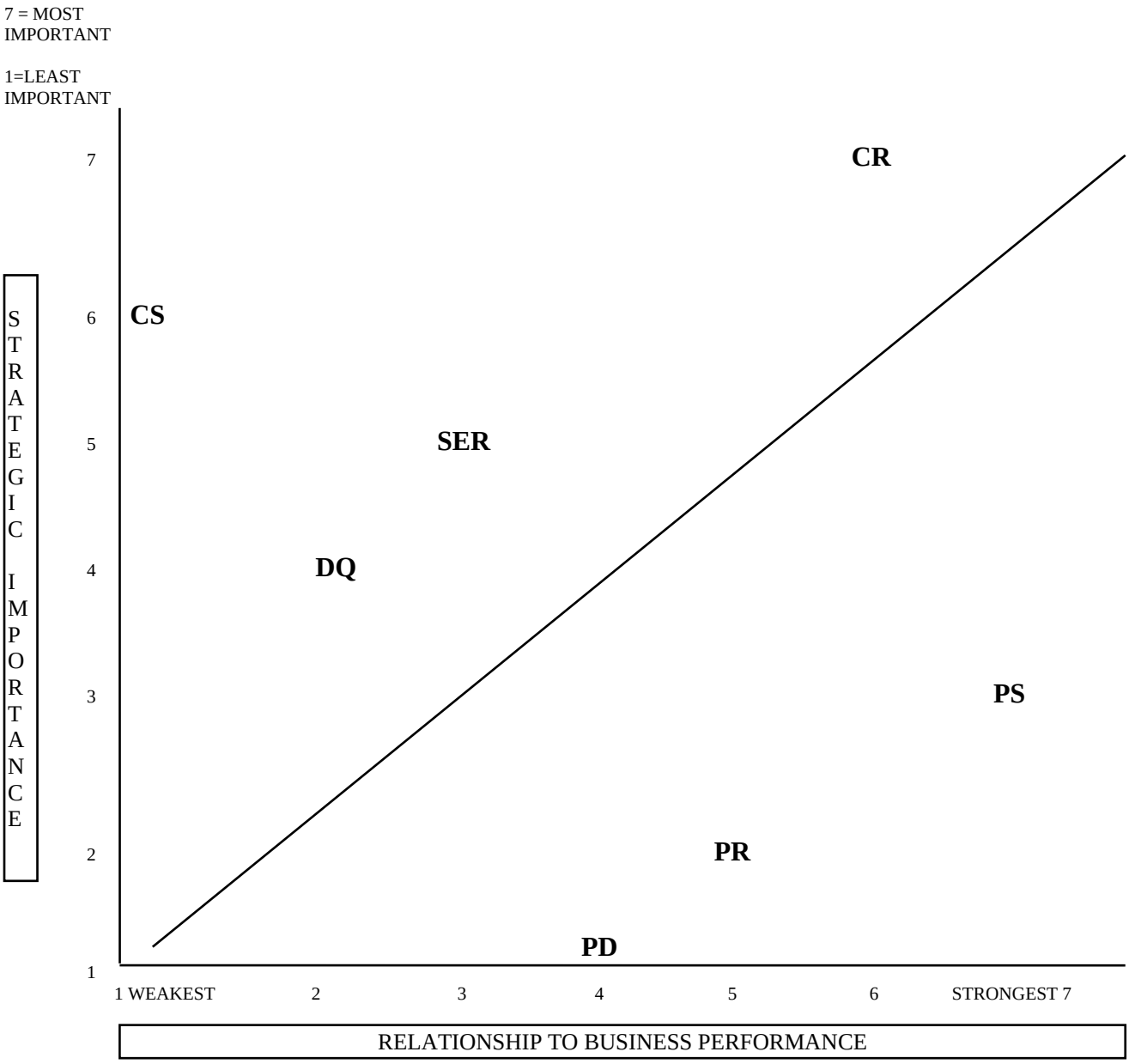
***, **, and * significant at the .01, .05, and .10 levels respectively.

Table 5. Stepwise Regressions

Business Performance Measure	Model p Value	R^2	Adjusted R^2	Quality Variables Entered	Beta Coeff.	Entry p-Value
Pretax ROA	.005***	.145	.128	Product Support	.381	.005***
After tax ROA	.005***	.150	.133	Product Support	.387	.005***
ROI	.007***	.140	.123	Product Support	.375	.007***
Growth in ROI	.026**	.093	.078	Product Support	.305	.026**
Market Share	.007***	.138	.121	Product Support	.372	.007***
Growth in Market Share	.002***	.209	.179	Company Reputation Product Durability	.339 .228	.011** .081*

***, **, and * significant at the .01, .05, and .10 levels respectively.

Figure 1. Perception-Performance Gap Analysis of Quality Dimensions



CS = Conformance to Specifications
DQ = Design Quality
SER = Pre-Sale Customer Service
PR = Product Reliability
PD = Product Durability
CR = Company Reputation
PS = Product Support