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An exploration of the impact of TQM and JIT on ISO 9000 registered companies

Barbara E. Withers[a], Maling Ebrahimpour[b,*], Neset Hikmet[b]

[a] *School of Business Administration, University of San Diego, San Diego, CA 92110, USA*
[b] *Department of Management Science and Information Systems, College of Business Administration, University of Rhode Island, Kingston, RI 02881, USA*

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Abstract

This paper addresses the implications of JIT and TQM implementation on the ISO 9000 registration process. Responses from over 500 ISO 9000 registered firms in the US were analyzed to determine whether differences in ISO 9000 registration experiences exist for firms with JIT, TQM, both JIT and TQM, or neither system. Survey results revealed that TQM and JIT firms have a better understanding of the importance of top management commitment, quality training, and communication to ISO 9000 implementation.

Keywords: JIT; TQM; ISO 9000; Survey

1. Introduction

In the 20 years following World War II, the most challenging operational issue faced by management was capacity (Hammer and Champy, 1994). However, this is no longer the case. In today's global environment, comprised of increasingly more discriminating and demanding consumers, operations have moved to the forefront of strategic planning and competitive viability. Consumers' demands for value, in the form of price relative to quality, performance, and availability, have forced firms to compete on the basis of their operational capabilities in these areas (Vonderembse and White, 1996; Vasilash, 1995). Quality, however, has emerged as an imperative for firms hoping to survive in the global market (Hahn and Boardman, 1985).

Firms may need to redesign their business processes dramatically in order to achieve competitive capabilities in the areas of quality, flexibility, productivity, and time (Vonderembse and White, 1996; Jasinowski, 1995). Various approaches can be taken by firms to position themselves to compete on the basis of these criteria (Elzinga et al., 1995). However, quality initiatives by firms have captured the greatest attention, both in terms of company efforts as well as media attention. This orientation is consistent with the acknowledged role that quality plays in competitiveness (Yusof, 1995).

The role of quality has been recognized internationally and across institutions. The success of

* Corresponding author. Tel.: +401-874-4369; fax.: +401-874-4312; e-mail: maling@uriacc.uri.edu.

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Japanese products during the 1970s and 1980s brought the issue of quality to the attention of US management. In response to dramatic market share losses to Japan (Reich, 1983; Cohen et al., 1984; Pak and Solo, 1990), US firms implemented a variety of quality initiatives in an attempt to improve product quality and regain competitiveness. These initiatives included quality circles, total quality control, just-in-time (JIT), total quality management (TQM), and others.

The impacts of quality and global competitiveness on national economies have not gone unnoticed. Government entities have taken actions to encourage companies to improve quality, for example, by establishing recognition awards for companies achieving specified quality standards. As of 1995, 32 countries have established quality awards for their companies (Hromi, 1995). Governments also recognized that the plethora of quality systems, standards, and terms that had evolved within countries, between countries, and within industries, complicated the international exchange of goods and services. Unification of the European Community (EC) and the implementation of its product conformity directives served as an impetus for harmonization (Marash, 1993). The International Organization for Standardization (ISO), comprised of representative from over 90 countries, subsequently issued the ISO 9000 series in 1987. ISO 9000 continues to gain worldwide acceptance as quality standards (Ho, 1994). Worldwide registrations reached 127 389 as of the end of 1995 (Mobil Europe Ltd., 1996) an increase of 357% over the number of registrations at the end of 1992. US registrations grew from 671 to 10 377 between December 1992 and July 1996, an increase of 1446% (Irwin Professional Services, 1996).

A growing body of evidence exists to support the contention that companies that have positioned themselves to compete on the basis of quality are more successful (Belohlav, 1993; Mohrman et al., 1995). Total quality management (TQM), just-in-time (JIT), and ISO 9000 are three quality initiatives that have been most widely used by firms to impact quality, efficiency, costs, and competitiveness.

According to some, TQM has evolved into the most prevalent quality strategy (Butz, 1995; Mohrman et al., 1995). TQM is a philosophical approach to management that is based on gaining competitive advantage by focusing on customer satisfaction within a continuous improvement environment (Ho, 1994; Vonderembse and White, 1994). Other critical components of TQM are fact-based decision making, extensive employee training, employee empowerment, team problem solving, and responsiveness to consumers (Vonderembse and White, 1994). Successful implementation of TQM leads to the development of different processes or products to meet or exceed customer expectation.

JIT, on the other hand, is a process by which a product or service is completed at each stage of production just-in-time for its use and at minimum cost (Schniederjans, 1993). Two of the principles underlying the JIT philosophy are the elimination of waste throughout the organization (Hernandez, 1989) and the pursuit of product-quality perfection (Schniederjans, 1993). JIT operations incorporate quality control activities with daily activities and avoid the production of defective items (Schniederjans, 1993). Both TQM and JIT are viewed as strategic initiatives and their successful implementation hinges on the commitment and support of top management (Schniederjans, 1993; Rao et al., 1996).

The ISO 9000 series is a set of standards that addresses the quality of a company's processes. ISO 9000 is highly documentation-oriented. The philosophy underlying these standards for process documentation is that companies with solid operations and processes will be in the best position to influence the quality of their products or services. Inherent in this philosophy is the recognition that the consumer is the best judge of the quality of the final product (Garvin, 1996). Thus, the ISO 9000 series, which regulates or controls process quality rather than product quality, leads to quality consistency (Korane, 1993) and, thereby, competitiveness (Mahmoud et al., 1992).

Our review of the literature has shown extensive research published on the different issues relating to TQM, JIT, and ISO 9000 (see, for example, Morrow, 1993a,b; Ferguson, 1994; McFayden and Walsh, 1992; Hutchins, 1993; Coleman, 1994; Reddish, 1994; Crystal, 1992; Houghton, 1993; Haug; 1993; Mahesh, 1994; Atwater and Discenza, 1993;

Rayner and Porter, 1991; Mann and Kehoe, 1994; Hockman et al., 1994; Hastings, 1993; Eckersberg, 1993; Gooley, 1993). Many authors suggest that ISO 9000 is an important first step toward the implementation of other, more holistic quality initiatives (Hinton, 1996; Parisher, 1995; Dickey, 1995; Avery, 1995; Sanders, 1994). However, we were unable to find research that examines the impact that TQM and/or JIT implementation have as precursors to ISO 9000 registration. This study attempts to fill that void. An empirical analysis of ISO 9000 registered manufacturing firms in the US was conducted to identify the impacts that TQM and JIT implementation may have had on the ISO 9000 registration process. The target firms for this study were companies that have implemented JIT and/or TQM initiatives in their organizations and, subsequently obtained ISO 9000 registration. The impacts of having implemented JIT, TQM, or both were evaluated against firms that had neither system in place at the time of ISO 9000 registration.

2. Methodology

2.1. Questionnaire development

The questionnaire was developed in five steps. Step one was a comprehensive literature review, which led to the first draft of the questionnaire. Step two was an initial test for clarity by graduate students at a major US university. The third step utilized Executive MBA students as another test for clarity. The next review tested the instrument for clarity, relevance, and technical accuracy and was done by members of the ISO 9000 Round Table, an organization of managers from companies engaged in or planning to undertake ISO 9000 registration. The last step to refine and test the instrument utilized on-site visits and in-depth interviews of personnel at five ISO 9000 registered firms.

For most of the questions the survey instrument utilized a five-point Likert scale, with five representing the highest or most positive response and one representing the lowest or most negative response. For the purposes of this study, mean responses to the questions were analyzed.

2.2. Sample selection

Six major industries in the US were surveyed for this study: electric/electronic, transportation equipment, machinery, fabricated metal, rubber/plastic, and chemical. The study population, comprised of every ISO 9000 registered firm in these six industries, constituted the study sample. A total of 1 500 firms were surveyed. The survey instrument was directed to the ISO champion at each firm.

A total of 552 completed survey forms were returned, of which 541 were usable. This resulted in a 36.1% response rate. The response distribution from these industries generally followed their ISO 9000 registration distribution: 31% of the responses were from the electric/electronic industry; 20% were from the chemical industry; 14% from machinery; 11% from fabricated metal; 5% from rubber/plastic; 2% from transportation equipment; and 17% other.

Responding firms represented a wide range of firm sizes in total annual sales: 51% of the firms have annual sales of $50 million or less; 18.2% have annual sales from $51 to $100 million; 21.6% have annual sales from $101 to $500 million; 4% have annual sales from $501 million to $1 billion; and 5.2% have annual sales greater than $1 billion. Firm sizes, in terms of number of employees, were also broadly represented. Twenty-five percent of the respondents have 100 or fewer employees; 49% have between 101 and 500 employees; 14% have between 501 and 1 000 employees; and 12% have more than 1 000 employees.

For the purposes of this study, responses were categorized for analysis according to their use of quality-related system(s). Respondents were asked to indicate whether JIT and/or TQM were in place at their firms. Since every firm participating in this study is ISO 9000 registered, firms were grouped to reflect their respective use of the other two quality-related systems. The category names indicate the presence or absence of JIT or TQM implementation: *Neither JIT nor TQM* [***Neither***], *JIT only* [***JIT***], *TQM only* [***TQM***], *Both JIT and TQM*[***Both***]. The following is the breakdown of responses in these four categories: *Neither* – 87; *JIT* – 71; *TQM* – 125; and *Both* – 258.

ANOVA was used to analyze responses among the four categories. Whenever significant differences were found among the groups, further analyses were conducted using the TUKEY-HSD contrast to identify the existence of significance between groups. These analyses were tested at the 0.05 level of significance.

Statistical tests revealed that the distribution of the four groups was not significantly different across industry types, by type of position of the respondents, or by the number of employees in the firm. However, groups were significantly different in terms of their annual sales.

3. Findings

Companies were asked to indicate how important ISO 9000 registration (Table 1) is to their competitive position. The ANOVA results reveal that responses rating the importance of ISO 9000 registrations for competitive position differed significantly by type of quality system-in-use. However, the main effect was not significant. In addition, neither sales (the other control variable) nor the interaction between the control variables are significant. The TUKEY-HSD contrast shows that the only significant differences between groups occurred between companies that had *Neither* and companies that had *Both*.

Firms show no significant differences among the groups with respect to the position (person) within the firm responsible for the ISO 9000 implementation process. The same is true with respect to firms' use of consultants to aid in the registration process. However, the costs associated with achieving ISO 9000 registration differed significantly ($p < 0.001$) by firm size (as indicated by sales). The main effect is also significant (Table 2).

Two questions were asked to obtain information about the role and attitude of top management with respect to quality initiatives (see Table 3). Responses to the question of whether top management considers quality improvement as a strategic issue revealed no significant differences among the groups. On the other hand, the question concerning respondents' perceptions about top management commitment to quality improvement showed significant differences for the main effect as well as by type of quality system-in-use. The TUKEY-HSD contrast reveals significant differences between *Neither* and *TQM*, between *Neither* and *Both*, between *TQM* and *JIT*, and between *Both* and *JIT*. However, neither sales nor the interaction between the control variables were significant.

Respondents were asked to indicate the importance of corporate objectives, market pressures, and customer pressures as factors leading to their

Table 1
Importance of ISO 9000 Registration

Source of variation	SS	DF	MS	*F*
Sales	3.512	7	0.502	0.547
System-in-use	8.685	3	2.895	3.159*
Two-way interactions	12.761	19	0.672	0.733
Error	414.269	452	0.917	
Total	439.992	481	0.915	

* $p < 0.05$.

Table 2
Total registration costs

Source of variation	SS	DF	MS	*F*
Sales	132.364	8	16.545	6.318***
System-in-use	12.893	3	4.298	1.641
Two-way interactions	58.993	19	3.105	1.186
Error	1181.072	451	2.619	
Total	1393.388	481	2.897	

*** $p < 0.001$

Table 3
Top management commitment

Source of variation	SS	DF	MS	*F*
Sales	8.263	8	1.033	1.345
System-in-use	34.274	3	11.425	14.878***
Two-way interactions	22.281	19	1.173	1.527
Error	345.562	450	0.768	
Total	407.784	480	0.850	

*** $p < 0.001$.

pursuit of ISO 9000. ANOVA results reveal that no significant differences exist among firms with respect to their reasons for achieving ISO 9000 registration.

Respondents provided information about the degree to which certain factors contributed to or hindered their registration efforts. The ANOVA results indicate that *inadequate quality training* responses differed significantly by type of quality system-in-use (Table 4). No significant main effect is present. The TUKEY-HSD contrast indicates a significant difference between *JIT* and *TQM* as well as between *JIT* and *Both*. Neither of the other two primary barriers to implementation (i.e., *inadequate implementation procedures* or *inadequate documentation*) led to significant differences in the responses among respondents.

To assess the impact of ISO 9000 registration on several key quality supportive factors, respondents were asked to indicate how much their product quality, communication, and public image had improved as a result of registration. Results from this question are mixed. There are no significant differences among firms with respect to their experiences with changes in product quality. However, responses revealed that firms experienced significantly different impacts on their internal communications (Table 5). ANOVA results show significant differences by type of quality system-in-use. The main effect is not significant, nor is sales. The TUKEY-HSD contrast identifies no significance for any pairwise comparisons. The interaction between the control variables proves to be significant at the 0.01 level. With respect to the impact that ISO 9000 registration had on public image, the ANOVA indicates that responses from firms differed significantly by quality system-in-use, however, no main effects or sales effects are significant for this issue. The TUKEY-HSD reveals no significant differences for the pairwise comparisons (Table 6).

Lastly, respondents were asked to indicate the importance of the internal audit process to their ability to maintain their ISO 9000 registration. No significant differences exist among the firms for this question.

Table 4
Inadequate quality training

Source of variation	SS	DF	MS	*F*
Sales	4.212	8	0.526	0.431
System-in-use	14.680	3	4.893	4.006**
Two-way interactions	14.178	19	0.746	0.611
Error	550.862	451	1.221	
Total	583.519	481	1.213	

** $p < 0.01$

Table 5
Communication impacts

Source of variation	SS	DF	MS	*F*
Sales	7.730	8	0.966	0.891
System-in-use	11.235	3	3.745	3.455*
Two-way interactions	45.603	19	2.400	2.214**
Error	491.021	453	1.084	
Total	554.876	483	1.149	

* $p < 0.05$, ** $p < 0.01$

Table 6
Public image impacts

Source of variation	SS	DF	MS	*F*
Sales	2.070	8	0.259	0.186
System-in-use	14.369	3	4.790	3.436*
Two-way interactions	20.388	19	1.073	0.770
Error	609.245	437	1.394	
Total	646.280	467	1.384	

* $p < 0.05$

4. Discussion

The first set of questions sought to capture the conditions under which the firm's ISO 9000 registration had been achieved. To ascertain whether ISO 9000 registration had been perceived as a competitive advantage, respondents were asked to indicate the importance of ISO 9000 registration to their company's competitive position. The mean response for the Both category (4.0669) was significantly higher than the mean response for the Neither category (3.6712). This difference suggests that JIT and TQM firms are more likely to recognize

the contributions that ISO 9000 registration can have on continuous improvement efforts. Firms that have implemented both JIT and TQM have achieved two of the most widely known quality initiatives. In their on-going efforts toward continuous improvement, ISO 9000 registration represents one of the few major quality initiatives these firms could pursue.

The relevance of the position responsible for the ISO 9000 implementation effort was evaluated. Good leadership appears to be important to the successful implementation of any quality initiative. The complexity of JIT, TQM, and ISO 9000 implementations argues for a "champion". The lack of any significant differences among the firms with respect to who their champion is suggests that the position itself is less important than the role the person plays.

The use of consultants to assist with the registration process is a widespread phenomenon. Firms may use consultants for a variety of reasons, for example, to minimize the time required to achieve registration or to compensate for the unavailability of sufficient personnel resources to meet their ISO 9000 registration undertaking. Responses concerning firms' use of consultants seem to reflect this generalized practice, since there were no significant differences among the categories of firms.

The cost of registration differed significantly among the firms according to firm size as measured by sales. The main effect of registration cost was significant at the $p < 0.001$ level, as was the effect by sales. This outcome is not surprising. The ISO series are documentation-driven. Therefore, the larger and more complex the operations of the firm, the more there is to document and the greater the cost. Responses reveal that the larger firms spent significantly more to achieve registration than did smaller firms. Our analysis shows that 62% of all firms with sales of $50 million or less spent under $50 000 for registration, whereas this percentage for firms with sales of $500 million or more is 31%. On the other hand, only 10% of firms with sales of $50 million or less spent $100 000 or more for ISO 9000 registration. This percentage is 58% for firms with sales of $500 million or more.

The role and attitude of top management have proven to be critical factors in the successful implementation of TQM and JIT (Schonberger, 1990; Ebrahimpour and Withers, 1992). To ascertain the managerial environment under which ISO 9000 registrations were achieved, respondents were asked to indicate whether top management was committed to quality improvement and whether these managers demonstrated their commitment by incorporating quality improvement into their firm's strategic plans. There were no significant differences in responses with respect to the strategic role of quality improvement efforts.

There was, however, a significant main effect and effect by type of quality system-in-use with respect to top management's commitment to quality improvement efforts. The highly significant main effect reinforces the contention that top management commitment is an influential factor in quality initiatives. Further analysis revealed that top management commitment is strongest in firms with *Both* (TQM and JIT) ($\mu = 4.3672$). Firms with *Neither* (TQM nor JIT) have the weakest commitment from top managers ($\mu = 3.7083$). *TQM* and *JIT* firms fell between, with means of 4.2562 and 3.9143, respectively. TQM implementation seems to account for the significance of the differences that occurred. Groups that include TQM firms are consistent and significantly different from the groups that do not contain TQM firms. Significant differences exist between firms that have *Neither* and firms that have *TQM* as well as between firms that have *Neither* and firms that have *Both*. In addition, the differences are also significant between *JIT* firms and *TQM* firms and between *JIT* firms and firms that have *Both*. These results reflect the strong impact that the TQM philosophy has had on top management's understanding of their vital role for successful implementation of any quality initiative.

Companies may pursue ISO 9000 registration for a variety of reasons. Some companies are motivated by external pressures. They may need ISO 9000 registration as an entrée into the global marketplace or because their customers require them to have it. For other firms, however, the motivation may be internally motivated, arising from corporate goals and objectives relating to quality, continuous improvement, competitive advantages, cost, or other concerns. Many of these internally motivated reasons would be consistent with TQM

and JIT practices and philosophies. Respondents were asked to indicate the degree of importance each of the following were as reasons for seeking ISO 9000 registration: corporate objectives, market pressures, and customer pressures. There were no significant differences among the firms for any of the reasons. These results may be a reflection of the fact that ISO 9000 registration is still fairly new in the US and, therefore, regardless of any other quality initiatives in place, most US firms seeking registration are in "catch up" mode. Consequently, these firms are all experiencing similar market and customer pressures.

The ISO 9000 registration process can be a complex, time-consuming undertaking. Success, as with other major quality initiatives, requires sufficient planning to assure that training, procedure development, and documentation needs have been met. Responses regarding the degree to which these preparatory factors helped or hindered the registration effort were mixed. Inadequate quality training proved to be the most critical factor. Responses differed significantly among firms by type of quality system-in-use. Inadequate quality training created the strongest implementation barrier for JIT firms. The experiences of *JIT* firms differed significantly from the *TQM* group as well as from the *Both* group. It is noteworthy that the *Neither* group was not significantly different from the *TQM* or *Both* groups. This seems to suggest that JIT firms' emphasis on streamlining and efficiency has had a higher priority for these firms that has quality training. The other two potential implementation barriers (*inadequate implementation procedures* and *inadequate documentation*) did not result in significantly different responses among the firms.

The stated benefit of ISO 9000 registration is to assure consistency in firms' operations. However, registered firms have been the beneficiary of other positive results. Three outcomes commonly associated with continuous improvement efforts (i.e., improved product quality, communications, and public image) were evaluated to determine how much of an impact ISO 9000 registration had. Product quality changes did not differ significantly among the firms. This is not surprising since it is doubtful that any firm would chose to ignore evidence of production problems discovered during the ISO 9000 documentation effort. Consequently, regardless of the presence of other quality initiatives, firms experienced similar levels of improvement in product quality.

Improvements in internal communications among the firms, however, did differ significantly by quality system-in-use. However, the higher level of significance for the two-way interaction reveals that sales combined with quality system-in-use has a greater effect on internal communication. ISO 9000 registration appears to have differing impacts on firms' public images (by quality system-in-use). However, no differences between specific pairs could be identified. This impact may have been masked, to some degree, by whether the firm was internally or externally motivated to become ISO 9000 registered. Firms that were pressured into action by customers may be much less aware of the public image implications than would firms that sought registration specifically to improve their competitive positions or as an entrée into the global marketplace.

Annual re-audits are required for companies to maintain their ISO 9000 registration. Survey results revealed that the importance of conducting internal audits was comparable for all firms. Registration renewal is based on a firm's demonstrated adherence to the documented procedures. Therefore, it seems apparent that any firm, regardless of the implementation of other quality initiatives, would choose to confirm its adherence to the standards prior to the official audit.

5. Conclusions

Results from this study demonstrate that understanding and recognition of the value of quality initiatives increases as firms expand the breadth of their quality efforts. Results also suggest that firms approaching ISO 9000 registration with other initiatives in place have a greater appreciation of the benefits that ISO 9000 will have on their ongoing continuous improvement efforts.

Considering the comprehensiveness of JIT and/or TQM implementation, it was somewhat surprising to learn that neither of these systems impacted the cost of the subsequent ISO 9000 implementation effort. This was unexpected since both

JIT and TQM require firms to address the efficacy of their processes, suggesting that these firms would already have evaluated these procedures.

The strategic implications of quality appear to be recognized by virtually all firms. However, results did reveal that the more firms are involved with quality efforts, the greater the concomitant commitment of top management to these efforts. The statistical results suggest that TQM implementation is more influential with respect to affecting these management attitudes.

With respect to ISO 9000 preparation efforts, the study results uncovered evidence that JIT firms may actually de-emphasize quality training relative to other aspects of this system undertaking. In all groups of firms, the role of communication was recognized as important. This would be expected among TQM and JIT firms, as communication constitutes an integral component of these systems. However, in the case of ISO 9000 implementation, the improvement to and role of communication is apparently a by-product of the implementation effort (Withers and Ebrahimpour, 1996).

Our basic observations from the study are that TQM companies have a better understanding of the importance of management commitment, communication, competitive position, and quality training to their ISO 9000 efforts than do their non-TQM counterparts.

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