Improving operational and business performance in the petroleum industry through quality management

Mahour Mellat Parast

*Department of Economics, Finance, and Decision Sciences,
University of North Carolina-Pembroke, Pembroke,
North Carolina, USA*

Stephanie G. Adams

*Department of Mechanical Engineering, Virginia Commonwealth University,
Richmond, Virginia, USA, and*

Erick C. Jones

*Department of Industrial and Manufacturing Systems Engineering,
University of Texas at Arlington, Arlington, Texas, USA*

Abstract

Purpose – The purpose of this paper is to investigate empirically the effects of quality management practices on operational and business performance.

Design/methodology/approach – A reliable and valid survey instrument was used for data gathering from managers in the petroleum industry. A multiple regression analysis was conducted to determine the effect of quality management practices on operational and business performance.

Findings – The results indicate that top management support, employee training, and employee involvement are significant variables explaining the variability of operational performance. Furthermore, a multiple regression analysis on business performance indicated the significance of top management support on business performance. The study also shows that customer orientation is not a significant predictor of business performance in the petroleum industry. In addition, focus on practices associated with human resource management (employee training and employee involvement) is critical in improving operational performance.

Research limitations/implications – Managers in the oil and gas industry need to emphasize practices associated with human resource management. Future studies should replicate this study with a larger sample size.

Originality/value – The study contributes to theory validation and development in quality management by investigating the effects of quality management practices on operational and business performance. The paper adds to the body of knowledge in quality management in the international context, specifically in the Middle East. In addition, it advances the literature on the practice of quality management in process industries, such as the petroleum industry.

Keywords Quality management, Oil industry, Petroleum, Human resource management, Iran

Paper type Research paper

1. Introduction

Quality management has emerged as a management paradigm for enhancing organizational effectiveness and competitiveness (Grandzol and Greshon, 1997; Dow et al., 1999; Sanchez-Rodriguez and Martinez-Lorente, 2004; Sila, 2007). Several empirical studies suggest that firms achieve higher levels of profitability and organizational performance through successful implementation of quality management (Powell, 1995; Easton and Jarrell, 1998; Das et al., 2000, Kaynak, 2003; Yeung et al., 2006; Santos-Vijande and Álvarez-González, 2009).

Due to the significant differences in terms of construct development and research methodology research in quality management has produced mixed results. For example, process management programs appear to improve profitability in the auto industry while they deteriorate profitability in the computer industry (Ittner, and Larcker, 1997). Furthermore, operationalizing quality management as single or multiple constructs, measuring performance in one level or multiple levels, and differences in data analysis techniques have contributed to producing mixed results in the relationship between quality management and firm performance (Kaynak, 2003; Molina et al., 2007).

However, there are other factors that have had a great impact on producing mixed results. Researchers have utilized different theoretical frameworks for understanding the effect of quality management on firm performance. While some have focused on the viewpoint of the pioneers of quality management and have framed their model on the perspective of founders of quality management such as Deming and Juran (e.g. Anderson and Rungtusanatham, 1994; Anderson et al., 1995; Rungtusanatham et al., 1998), most recent studies have employed the Baldrige criteria as the reference model for quality management (Samson and Terziovski, 1999; Evans and Jack, 2003; Lee et al., 2003; Bou-Llusar et al., 2009). In addition, there is not much consistency in the selection of industries as the research context. While some have focused on manufacturing firms (e.g. Wilson and Collier, 2000) there are some studies where firms in different industries have been mixed (Saraph et al., 1989; Flynn et al., 1994; Ahire and Golhar, 1996; Rao et al., 1999). It has been shown that contextual variables such as the industry structure and competition affect the strategic planning of quality of firms (Das et al., 2000; Lai and Cheng, 2003; Zhao et al., 2004). Differences in theoretical framework and industry selection as well as differences in construct development have been resulted in mixed and somewhat confusing results in the effect of quality management on firm performance. It has been suggested that more industry-specific and cross-cultural research in quality management is needed to validate the effect of quality management on firm performance (Sila and Ebrahimpour, 2003). Industry-specific studies help us to better understand the determinants of performance (Garvin, 1988).

This study seeks two objectives. First, it attempts to validate the effect of practices associated with quality management on operational and business performance in the petroleum industry. Second, the study determines the critical success factors that affect the operational and business performance in the petroleum industry. Accordingly, the study contributes to theory validation and development in quality management by investigating the effect of quality management practices on operational and business performance[1]. The paper adds to the body of knowledge in quality management in the international context, specifically in the Middle East. Our understanding of the practice of quality management in the Middle East enhances our knowledge regarding

the practice of quality in the global context. It advances the literature on the practice of quality management in process industries, such as the petroleum industry.

The remainder of this paper is organized as follows. In the next section, we discuss the theoretical framework of the paper and the scholarly literature on quality management and firm performance. Next, we discuss the methodology for empirically investigating the effect of quality management practices on organizational performance as well as the sampling frame and data analysis. Then, we report our result and discuss its implication to the theory and practice. Finally, we discuss limitations and future research.

2. Literature review and theoretical background

2.1 Theoretical background

The conventional quality management framework has been built based on the findings of firms in the developed nations, where its applicability and generalizability should be limited to those countries (Jun *et al.*, 2006). To extend the practice of quality management to other regions or countries, researchers should utilize sound theoretical frameworks to determine the applicability of the practices associated with quality management. In other words, researchers and practitioners should determine whether certain management practices that are developed in specific regions or specific industries are applicable to other regions and/or industries. That is true for quality management where it has been mainly developed in the USA and Japan but has been utilized throughout the world. Whether practices associated with quality management is universal (context-free) or contingent (context-dependent) remains a controversial issue (Sousa and Voss, 2001; Rungtusanatham *et al.*, 2005). It has been argued that as the result of globalization and international business, management practices (e.g. quality management) converge over time (Mellat Parast *et al.*, 2006; Schniederjans *et al.*, 2006). This phenomenon is well explained by the convergence theory of management.

The convergence theory (e.g. Form, 1979) asserts that learning will lead managers from different cultures to adopt the same efficient management practices. Competitive market forces and intense competition will force firms to improve their processes and procedures so that they can stay competitive. From this perspective, while firms may adopt different management practices at the very early stage of competition those practices will change, improve, and finally converge overtime to resemble the best practices. In fact, the convergence theory incorporates both the culture-free (e.g. Rao *et al.*, 1999) and culture-specific (e.g. Ralston *et al.*, 1997) theories in the evolution of management practices. From this perspective, while there might be differences in management practices due to cultural differences these differences disappear over time because of market forces and competition. That is especially the case for organizations and industries that have a long history of competing in the global markets (such as the petroleum industry).

Institutional theory provides another sound argument for the prevalence of convergence theory in practice of quality management. According to the institutional theory, to be more adaptive and flexible to environmental uncertainty and complexity firms tend to imitate the structure, processes, norms, rules, practices, and processes of a dominant institution. The outcome of such adaptive processes will lead to organizational isomorphism – "the resemblance of a focal organization to other organizations in its environment" (Deephouse, 1996). From this perspective, firms that share common norms

and practices will become similar over time. This provides another argument for the convergence of quality management across different industries. Therefore, we believe the convergence theory provides sound theoretical lenses for understanding quality management practices across nations and/or industries.

Accordingly, we argue that the practice of quality management will converge over time across industries and nations. Taking into account the structure of the petroleum industry (for its long-term presence in the international markets within the last 50 years) we believe that practices associated with quality management have been transferred within the petroleum industry across nations. Therefore, we hypothesize that the findings of this study should be consistent with previous studies on quality management, while being tested in an entirely new context and within a specific industry.

2.2 Quality management and firm performance

The development of different measurement instruments for quality management practices has helped us to determine the effect of quality management on firm performance. The Appendix provides a comprehensive overview of the research on quality management and firm performance. The overall findings suggest that quality management practices affect firm performance, but it happens indirectly through other variables (Ho *et al.*, 2001).

Previous research in quality management has revealed the importance of top management in effective implementation of quality management (Wilson and Collier, 2000; Pannirselvam and Ferguson, 2001; Sharma and Gadenne, 2008). It is believed that the most decisive element in the success or failure of a quality management initiative is the extent to which top managers provide personal leadership (Juran, 1994). In the Malcolm Baldrige framework, leadership is the driver of quality systems (Wilson and Collier, 2000). Quality improvement can be enhanced by increasing knowledge about quality, customer focus, and management involvement. In addition, quality management programs affect firm performance but through other variables (Adam *et al.*, 1997). Through their study on quality management practices in India, China, and Mexico, Rao *et al.* (1997) did not find any significant difference between the quality results in these countries.

In short, previous studies indicated that top management support was the most significant factor affecting other quality management practices. The implication of these results is that top management support is a must for quality. Top management should be made aware of the importance of quality and how to maintain quality. From a practitioner's viewpoint, the results of these studies indicate that companies planning to locate facilities or enter into partnerships in other countries should obtain the commitment and involvement of top management and pay greater attention to quality assurance, information analysis, and planning systems. Accordingly, we propose that

H1. Top management support is significantly related with internal quality results.

H2. Top management support is significantly related with external quality results.

Quality management is a complex phenomenon and measuring the effect of such practices on firm performance has been a challenge for researchers. There are several debates on measuring quality management related performance. These results may

not be valuable if the effect of quality management on firm performance is measured too early or too late (Hackman and Wageman, 1995). There is also concern with publicly reported indexes such as profitability, share price and market share. While profitability can be easily distorted, market indexes might be specific to the scoping of the market (Kaplan and Norton, 1992). An alternative approach that is used for obtaining a valid measure for performance in quality management is through perceptual judgment (Powell, 1995; Ahire and Golhar, 1996; Choi and Eboch, 1998; Douglas and Judge, 2001). This approach has been widely used in empirical research as a primary technique for capturing firm performance in multiple levels (Dess, 1987; Covin *et al.*, 1994). Subjective information obtained from the key participants is closer to reality and provides better and more realistic information (Meredith, 1995). In the context of the petroleum industry it has been found that there was no consistent way of defining objective measures of success across the variety of organizations, and perceived performance of the projects were judged to be a surrogate measure for actual performance (Asrilhant *et al.*, 2007).

Research on quality management and firm performance addresses two major questions:

(1) Do quality management practices affect performance?

(2) If so, how does quality management affect firm performance?

We investigate these questions in the context of the petroleum industry.

While previous research in quality management has provided valuable insight on the effect of quality management on firm performance, little industry-specific research has been conducted in quality management. In that regards, more industry-specific research in quality management is needed to validate the effect of quality management on firm performance (Sila and Ebrahimpour, 2003). Focus on a specific context can help scholars to develop theories that allow the consumers of the research to better assess and implement the applicability of the theory or findings (Bamberger, 2008). The current research attempts to uncover some of the above shortcomings in the literature, addressing the practice of quality management and its effect on operational and business performance in the petroleum industry.

To validate the previous findings on the effect of quality management practices on organizational performance, we propose the following hypotheses. These hypotheses have been proposed through the lenses of convergence theory and institutional theory of management, arguing that quality management practices converge over time (convergence theory) and institutions attempt to imitate best practices in the industry (institutional theory). Justification for the hypotheses is provided in Table I.

Human resource management

    H3. Employee training is significantly related with internal quality results.

    H4. Employee involvement is significantly related with internal quality results.

Information systems

    H5. Quality information usage is significantly related with internal quality results.

Hypothesis	Justification
H1. Top management support is significantly related with internal quality results	Previous studies emphasize the critical role of top management in driving overall quality systems in the organization (Anderson *et al.*, 1995, Flynn *et al.*, 1995). In the Baldrige model, top management is the major driver of a quality system where it affects organizational performance and profitability (Wilson and Collier, 2000)
H2. Top management support is significantly related with external quality results	
H3. Employee training is significantly related with internal quality results	The success of quality programs is contingent upon improving employees' knowledge about quality. Education and training in quality tools and techniques is critical in process improvement. As the result of training, operational performance will be improved and productivity will increase (Ahire and Dreyfus, 2000; Kaynak, 2003). Adam *et al.* (1997) showed that employee involvement and recognition is correlated with financial performance
H4. Employee involvement is significantly related with internal quality results	
H5. Quality information usage is significantly related with internal quality results	Lee *et al.* (2003) empirically showed that quality information and analysis has a significant effect on process management. Furthermore, the development of necessary infrastructures for quality such as access to and availability of information systems improves productivity (Flynn *et al.*, 1995)
H6. Quality information usage is significantly related with external quality results	
H7. Customer orientation is significantly related with internal quality results	Lee *et al.* (2003) justified that customer orientation is positively related to process improvement. It is shown that process improvement will lead to higher level of internal and external quality results (Ahire and Dreyfus, 2000)
H8. Customer orientation is significantly related with external quality results	
H9. Benchmarking is significantly related with internal quality results	Lee *et al.* (2003) showed empirically that quality information and analysis have a significant effect on process management. Monitoring best industry practices along with the information obtained from competitors will help the organization to improve its operations and processes, accordingly enhancing internal and external quality results
H10. Benchmarking is significantly related with external quality results	
H11. Quality citizenship is significantly related with internal quality results	Top management enhances an organization's role in the society (Rao *et al.*, 1999) and shows organizations' commitment to its community and the society. Environmentally conscious production initiatives improve productivity and reduce environmental costs (Florida, 1996)
H12. Quality citizenship is significantly related with external quality results	

Table I.
Proposed hypotheses and relevant justification

H6. Quality information usage is significantly related with external quality results.

Customer orientation

H7. Customer orientation is significantly related with internal quality results.

H8. Customer orientation is significantly related with external quality results.

We propose the following hypotheses that have not been investigated in previous studies that are focused on the practices associated with benchmarking and quality citizenship.

Benchmarking

H9. Benchmarking is significantly related with internal quality results.

H10. Benchmarking is significantly related with external quality results

Quality citizenship

H11. Quality citizenship is significantly related with internal quality results.

H12. Quality citizenship is significantly related with external quality results.

2.3 Variables and measures

It has been argued that understanding quality management should be achieved through defining, analyzing and measuring specific practices associated with quality management (Zu *et al.*, 2008). For the purpose of this study, the 13 constructs identified by Rao *et al.* (1999) were considered to serve as a framework for quality management. The Baldrige criteria not only address core concepts of quality management, but also present strategies for companies to effectively compete in the changing global business environment (Lee *et al.*, 2006). While the Baldrige model consists of seven constructs, the survey instrument in this study consists of 13 constructs for quality management. Through implementation, verification, and empirical analysis of the original instrument new constructs have been added so that the survey instrument can capture all aspects of quality management (Rao *et al.*, 1999). The constructs are explained below. The abbreviation in parentheses refers to the variables to be used in the data analysis section.

- *Top management support (tms)* addresses the critical role of management in driving company-wide quality management efforts (Flynn *et al.*, 1994; Puffer and McCarthy, 1996; Ahire and O'Shaughnessy, 1998).

- *Strategic quality planning (spqm)* incorporates the integration of quality and customer satisfaction issues into strategic and operational plans, which allows firms to set clear priorities, establish clear target goals, and allocate resources for the most important things (Barclay, 1993; Godfrey, 1993).

- *Quality information availability (qia)* refers to the availability of quality information for effective and efficient quality management practices (Juran, 1986; Taylor and Wright, 2006). The availability of such information helps managers in making decisions.

- *Quality information usage (qiu)* indicates how much quality information is used by managers in making decisions (Taylor and Wright, 2006).

- *Employee training (et)* explains the level of continuous and intensive training as an essential part of quality management (Ahire and O'Shaughnessy, 1998).

- *Employee involvement (ei)* relates to the involvement of employees in problem solving, and decision making at all levels in the organization (Oliver, 1988; Mohrman *et al.*, 1995).

- *Product/process design (pd)* indicates the implementation of product/process management techniques that reduce process variation and affect internal quality performance (Kaynak, 2003).
- *Supplier quality (sq)* acknowledges the importance of suppliers in achieving higher levels of quality in an organization (Deming, 1986; Lascelles and Dale, 1989; Flynn *et al.*, 1994).
- *Customer orientation (cfs)* refers to the extent the organization evaluates the feedback from its customers in improving quality (Doll and Vonderembse, 1991; Schonberger, 1994; Forza and Flippini, 1998).
- *Quality citizenship (qc)* stresses the practice of company responsibility and its social role in society, such as improvement of education, safety, and health care in the community (Florida, 1996; Punter and Gangneux, 1998; Castka and Balzarova, 2008).
- *Benchmarking (b)* is defined as the search for industry best practices that lead to superior performance (Powell, 1995).
- *Internal quality results (iqr)* determines how much quality management practices have affected internal quality measures, such as defect rates, reprocessing rate, production lead time, and productivity (Deming, 1986; De Ceiro, 2003).
- *External quality results (eqr)* refers to the improvement of external performance of the firm, which is measured by competitive market position, and profitability (Deming, 1982; Deming, 1986).

3. Methodology
3.1 Survey instrument
A survey instrument was used to gather information on quality management practices. The quality management instrument developed by Rao *et al.* (1999) was based on the Malcolm Baldrige National Quality Award Model. This instrument was selected after a careful review of the literature. It that has been tested, validated, and refined in an international context. The survey solicits information from the participants about their perceptions of quality management practices. A five-point Likert scale (an interval scale) was used on the instrument. The scale ranged from 1 to 5, indicating 1 = very low, 2 = low, 3 = medium, 4 = high, and 5 = very high, from strongly disagree (representing 1) to strongly agree (representing 5).

3.2 Instrument development and validation
The following steps were taken to develop and validate the measurement instrument. The theoretical dimensions underlying quality practices were conceptualized and a questionnaire was developed to measure them. Data was collected in multiple countries. The sample was divided randomly in half. Testing and purification of the constructs were done using the first half, while the second half was used as a hold-out sample to confirm the validity of the constructs. Structural equation modeling (LISREL) was used in the analysis and validation. The instrument has been administrated to multiple industries in multiple countries, and it has a very good external validity (Rao *et al.*, 1999).

For this study, the original questionnaire was translated into Persian using the following process: first, the researcher, who has sufficient knowledge of the subject and

command of both English and Persian languages, translated the English version of the questionnaire into Persian. Another native of Iran, who has sufficient knowledge of both English and Persian, also translated the English version into Persian. The two Persian versions of the questionnaire were compared to each other. More than 95 percent of translation in the two versions was the same. Finally, a third person, who was a professor at a university, whose area of research was quality management and who had good command of both English and Persian, evaluated the translation and provided comments on the translation. The final version was used for the survey.

3.3 Sample

Iran was selected as the representative country in the Middle East because of the major role it plays in the petroleum industry in the world. Iran is the fourth largest oil producer in the world, has the second largest reserves of oil and gas in the world, and is a major power in the international oil and gas market.

A list of organizations in the production and exploration section of the petroleum industry was solicited through contact with the Ministry of Petroleum. A total number of 61 companies were identified. Because of the focus of the research on production and exploration segment of the petroleum industry, it was important to identify companies that are within production and exploration. The list of managers was obtained by contacting the advisor to the Ministry of Petroleum. A total number of 61 managers (top level) were identified. We received 31 usable surveys, indicating a response rate of 52 percent. Focus on a single industry enables the researcher to better understand the processes and practices which facilitates comparison among firms (Tsikriktsis, 2007). By focusing on a single industry the determinants of performance can be precisely identified (Garvin, 1988). Therefore, we believe this approach is appropriate to study the research questions.

4. Data analysis

4.1 Demographic information

In the sample 100 percent of the participants were male. This gender homogeneity was not unusual, since most managers and consultants at that level in Iran are male. The average age for the respondents was 49 years. All respondents have been in the oil/gas industry for at least five years. The lowest educational level of the participants was a Bachelor's degree.

4.2 Descriptive statistics

The mean and standard deviation along with measures of skewness and kurtosis for each variable were calculated and the results are provided in Table II. As an alternative test we used the Kolmogorov-Smirnov test of normality. The result showed that the requirement for normality has been satisfied.

4.3 Empirical validation of the measures

4.3.1 Construction of the instrument and content validity. According to Churchill (1979), construct validity measures the correspondence between a concept and the set of items used to measure the construct. This process starts with the assessment of content validity (O'Leary-Kelly and Vokurka, 1998). Content validity refers to the extent to which a measure represents all aspects of a given concept (Nunally and Bernstein,

Variables	Mean	SD	Skewness	Kurtosis
tms	2.58	0.46	− 0.71	0.68
spqm	2.50	0.44	− 0.25	− 0.35
qia	1.70	0.56	0.69	0.89
qiu	2.22	0.48	0.67	1.87
et	2.65	0.52	0.20	− 0.47
ei	2.52	0.52	0.27	0.12
pd	2.27	0.34	0.22	− 0.62
sq	2.43	0.55	0.11	− 0.26
cfs	2.20	0.32	− 0.13	− 0.15
qc	2.22	0.54	1.18	2.54
b	2.10	0.53	0.25	0.76
iqr	2.92	0.54	− 0.20	1.17
eqr	2.84	0.53	− 0.46	0.54

Table II.
Descriptive statistics

1994). One of the approaches to ensure content validity is through reviewing the literature and using experts' opinion on the given construct (Churchill, 1979; Kerlinger, 1986). In terms of the content validity, the instrument meets the requirement, since:

- it has been developed based on extensive review of the literature; and
- it has been reviewed by scholars and practitioners in quality management.

This procedure for assessing content validity has been used in previous studies in quality management (e.g. Dow *et al.*, 1999). In addition, the content validity of a quality management instrument based on MBNQA has been validated in various studies (e.g. Curkovic *et al.*, 2000; Flynn and Saladin, 2001). Therefore, we can conclude that the instrument meets the requirements of content validity.

4.3.2 Reliability. Table III shows Cronbach's coefficient α for the constructs considered in the study. Cronbach's α is used to measure internal consistency of the instrument (Cronbach, 1951). Most of the constructs have a coefficient α value of 0.7, or higher which is an acceptable value for survey research (Nunally and Bernstein, 1994; Streiner, 2003). Only one construct (product/process design) has a relatively low

Variable	Number of items	Cronbach's α
Top management support (tms)	7	0.79
Strategic quality planning (spqm)	4	0.67
Quality information availability (qia)	3	0.87
Quality information usage (qiu)	3	0.67
Employee training (et)	4	0.75
Employee involvement (ei)	5	0.67
Product/process design (pd)	5	0.50
Supplier quality (sq)	6	0.80
Customer orientation (cfs)	8	0.65
Quality citizenship (qc)	4	0.81
Benchmarking (b)	4	0.79
Internal quality results (iqr)	5	0.81
External quality results (eqr)	4	0.77

Table III.
Reliability of the constructs

reliability (0.50). In addition, four constructs have reliabilities between 0.65 and 0.7. Given the relatively small sample size it is possible that outliers may have heavily influenced this result. In total, the instrument has an acceptable reliability, indicating a high level of internal consistency. Thus, items assigned to each construct measured the same factor.

4.3.3 Non-response and common method bias. Non-respondents could be a concern in survey research. They may indicate a bias among the sampled population away from those hypothesized. As the initial step to minimize non-response bias we worked directly with the Ministry of Petroleum. We assigned a representative to work with the companies. Formal letters, frequent visits to the companies, follow-up phone calls, and the support from the Ministry of Petroleum were utilized to effectively communicate the significance of the project to minimize non-response bias (Lambert and Harrington, 1990). For estimating non-response bias we utilized the procedure suggested in the literature (Armstrong and Overton, 1977). The procedure compares parameters estimated between groups of respondents based on the timing of the receipt of their replies. If there is no significant difference in estimates between early and late respondents, then non-response bias is not a concern. We compared the estimates for early and late respondents. We did not find any significant differences. Common method bias is related to the deviation in survey responses due to the implementation of a common method for data collection (Podsakoff *et al.*, 2003). Several attempts can be done to minimize this issue. In that regard, the survey instrument has been carefully selected and translated to minimize the respondents' ambiguity, lack of interest and other similar biases.

4.4 Correlation

The correlation between variables is presented in Table IV. Due to the relatively small sample size we regressed each pair of variables to see if the correlations are still significant. The result of the regression was consistent with the result from Table IV.

The findings from Table IV suggests that top management support is significantly correlated with internal quality results ($r = 0.52$, $p = 0.003$) and external quality results ($r = 0.493$, $p = 0.05$). Therefore, *H1* and *H2* are supported. Employee training and employee involvement appear to be significantly correlated with internal quality results ($r = 0.615$, $p = 0.001$, and $r = 0.549$, $p = 0.001$, respectively). Therefore, *H3* and *H4* are supported. Quality information usage (qiu) appears to be significantly correlated with external quality results ($r = 0.379$, $p = 0.036$). Therefore, *H6* is supported. However, it is not significantly correlated with internal quality results ($r = 0.141$, $p = 0.448$). Accordingly, *H5* is not supported. We found significant correlation between customer orientation and internal quality results ($r = 0.557$, $p = 0.001$). Therefore, *H7* is supported. The correlation between customer orientation and external quality results is not significant ($r = 0.144$, $p = 0.440$). Accordingly, *H8* is not supported.

We also investigated the effect of benchmarking and quality citizenship on organizational performance. These two constructs have been not been fully investigated in previous studies in quality management. As shown in Table IV, there is not significant correlation between benchmarking and internal quality results ($r = 0.265$, $p = 0.149$). In addition, it appears that benchmarking is not significantly correlated with external quality results ($r = 0.199$, $p = 0.282$). Therefore, *H9* and *H10*

Table IV. Correlations

	tms	spqm	qia	qiu	et	ei	pd	sq	cfs	qc	b	iqr	eqr
tms	1	0.388* 0.0031	0.400* 0.001	0.571** 0.001	0.427* 0.017	0.352 0.052	0.472* 0.007	0.287 0.117	0.413* 0.021	0.386* 0.032	0.401* 0.025	0.52* 0.003	0.493* 0.005
spqm		1	0.562** 0.001	0.612** 0.000	0.01 0.956	0.170 0.360	0.057 0.761	0.570** 0.001	−0.291 0.112	0.178 0.339	0.305 0.096	−0.108 0.563	0.306 0.094
qia			1	0.654** 0.0001	0.220 0.234	0.461** 0.009	0.425* 0.017	0.535** 0.002	−0.063 0.738	0.427* 0.017	0.317 0.082	0.229 0.215	0.218 0.240
qiu				1	0.361* 0.046	0.398* 0.027	0.443* 0.012	0.602** 0.000	−0.056 0.764	0.515** 0.003	0.538** 0.002	0.141 0.448	0.379* 0.036
et					1	0.372* 0.039	0.286 0.119	−0.133 0.474	0.478** 0.007	0.453* 0.011	0.169 0.362	0.615** 0.001	0.317 0.082
ei						1	0.551** 0.001	0.292 0.111	0.320 0.080	0.419* 0.019	0.505** 0.004	0.549** 0.001	0.150 0.419
pd							1	0.457** 0.010	0.206 0.266	0.340 0.062	0.595** 0.0001	0.373* 0.039	0.286 0.119
sq								1	−0.308 0.092	0.337 0.064	0.490** 0.005	−0.133 0.474	0.125 0.504
cfs									1	−0.031 0.868	−0.137 0.464	0.557** 0.001	0.144 0.440
qc										1	0.591** 0.0001	0.396* 0.027	0.121 0.515
b											1	0.265 0.149	0.199 0.282
iqr												1	0.487** 0.005
eqr													1

Notes: *Correlation is significant at the 0.05 level (two-tailed); **correlation is significant at the 0.01 level (two-tailed)

are not supported. Finally, the effect of quality citizenship on internal quality results is significant ($r = 0.396$, $p = 0.027$) which supports *H11*. It is not significantly correlated with external quality results ($r = 0.121$, $p = 0.515$). Therefore, *H12* is not supported.

4.5. Regression analysis
4.5.1 Multiple regression analysis on internal quality results. A practical approach that helps in identifying significant variables is stepwise regression. The advantage of stepwise regression is that at each stage it determines the contribution of each predictor (independent variable) already in the model. This procedure helps identify predictors that were considered useful at an early stage but have lost their usefulness/contribution when additional predictors were brought into the model (Pedhazur, 1997).

The following tables show the results of a multiple regression analysis on internal quality results. After running a regression analysis, employee training (et) and employee involvement (ei) emerged as the two significant variables. Table V presents the R^2 value for the regression on internal quality results.

The results from the coefficients (Table VI) indicate that both Model 1 and Model 2 are statistically significant. This suggests that the relationship between employee training and employee involvement with internal quality results is statistically significant.

4.5.2 Multiple regression analysis on external quality results. Multiple regression analysis was used to identify the statistically significant variables explaining variability in external quality results (eqr). The following tables show the results of a stepwise regression. Table VII shows the R^2 value, which indicates that 24 percent of variability in external quality results has been explained by top management support.

	Model	R	R^2	R^2 (adj.)	Standard error of the estimate	R^2 change	Change statistics F change	df_1	df_2	Sig. F change
Table V. Model summary (iqr)	1	0.615	0.378	0.375	2.1692	0.378	17.658	1	29	0.001
	2	0.705	0.497	0.461	1.9854	0.119	6.618	1	28	0.016

	Model	B	SE	B (Standardized)	t	Sig.
	1 Constant	6.172	2.039		3.027	0.005
	et	0.795	0.189	0.615	4.202	0.001
	Constant	1.978	2.478		0.798	0.432
Table VI. Coefficients (iqr)	et	0.616	0.186	0.477		0.003
	ei	0.483	0.188	0.371		0.016

	Model	R	R^2	R^2 (adj.)	Standard error of the estimate	R^2 change	Change statistics F change	df_1	df_2	Sig. F change
Table VII. Model summary (eqr)	1	0.493	0.243	0.217	1.8498	0.243	9.312	1	29	0.005

Table VIII provides the coefficient value and its corresponding p-value. It shows that the model is a significant predictor of external quality results.

5. General findings

Multiple regression analysis was used to determine the significant variables on internal quality results. The results of the regression analysis showed that employee training and employee involvement were statistically significant, explaining 46 percent of the variability in the internal quality results. It has been argued that quality management practices that result in knowledge creation could enhance the competitive position of firms (Linderman *et al.*, 2004). With reference to employee training and employee involvement as quality management practices that facilitate knowledge generation processes within a firm, our findings validate the role of human resource management as an important practice of quality management that enhances operational performance.

Multiple regression analysis has been used to determine the significant variables on external quality results. The results of the regression analysis showed that only top management support was statistically significant. It explains 22 percent of the variability of the external quality results. Overall, it can be concluded that management support, employee training, and employee involvement contribute significantly to performance outcomes. Since top management support is the driving force behind the implementation of quality practices, it could be argued that top management support affects performance outcomes through employee training and employee involvement. Due to the small sample size and the number of constructs, this cannot be validated empirically.

6. Discussion

The results from the correlation matrix reveal that top management support is significantly correlated with both internal quality results and external quality results. This shows that top management plays a critical role in promoting quality management implementation in the petroleum industry. This finding is consistent with the Malcolm Baldrige Award Criteria, where top management is considered the driving force for quality management implementation (Wilson and Collier, 2000; Kaynak, 2003). Similar results have been reported on the role of top management in capital-intensive industries (e.g. the airline industry). The Iranian petroleum industry is regulated, and organizations should do business according to the rules and policies set by the government. Within the US airline industry it has been argued that in the regulatory environment the profitability of an air carrier was ultimately determined by organizational leaders (Ramaswamy *et al.*, 1994). In that regard, the result of this study confirms the role of top management in enhancing organizational performance in a regulatory environment.

Model	B	SE	B (standardized)	t	Sig.
1 Constant	5.587	1.919		2.911	0.007
tms	0.319	0.105	0.493	3.052	0.005

Table VIII.
Coefficients (eqr)

The correlation between top management support and employee involvement was not found to be statistically significant. This is surprising, since it is the management's responsibility and commitment to empower employees and involve them in the organization-wide decision making process (Rao *et al.*, 1999). The same relationship was found between top management support and supplier quality; top management support was not significantly correlated with supplier quality. While previous empirical research validates such a link (e.g. Kaynak, 2003) it would be interesting to investigate why top management support is not significantly correlated with employee involvement and supplier quality. One possible argument is that managers in the oil and gas industry are primarily concerned with internal business activities and pay little attention to the external environment (Asrilhant *et al.*, 2007).

This result of this study is consistent with previous studies that show a significant relationship between leadership and human resource management (Kaynak, 2003; Sila and Ebrahimpour, 2003). The above findings imply that to improve operational performance (internal quality results), managers in the petroleum industry should focus on three elements:

(1) top management support;

(2) employee training; and

(3) employee involvement.

With regard to external quality results, the correlation matrix (Table IV) indicates that top management support, quality information usage, and internal quality results are significantly correlated with external quality results. The regression analysis indicates that only top management support (tms) is the significant predictor of external quality results. The model explains 22 percent of the variability of the external quality results. In addition, there is a significant correlation between internal quality results and external quality results. This indicates that external quality results are achieved as the result of improvement in the internal quality systems. Similar results have been reported in other capital-intensive industries such as the airline industry, where productivity and operational improvement are the determinants of profitability (Tsikriktsis, 2007). The implication for managers in the petroleum industry is that profitability is achieved when there is improvement in internal quality systems – i.e. operational performance.

It is interesting to note that customer orientation was not a significant predictor of external quality results. Theoretically, one of the main focuses of quality management is customer-driven quality practices (Flynn *et al.*, 1994, 1995). Recently Fuentes-Fuentes *et al.* (2007) have shown that implementation of quality management practices depends on the competitive forces and industry environment in which a firm competes. It could be argued that the high demand for oil from customers and the high bargaining power of oil-producing companies affects the customer-buyer relationship in the petroleum industry. Another explanation might be the fact that most managers in the oil and gas industry mainly take an internal business perspective and pay little attention to the environment and external factors (Asrilhant *et al.*, 2007).

Furthermore, the results indicate that it is the people side of quality management that has a significant impact on internal/external quality results. Benchmarking, quality citizenship, and strategic planning of quality were not statistically significant

variables in explaining variability in external quality results. In one aspect, the results validate previous findings on the importance of the "soft side" of quality – such as top management support and an open culture – on firm performance (Powell, 1995; Rahman and Bullock, 2005). This is also consistent with previous findings which assert that managers in the upstream oil and gas industry view "soft internal elements" to be a key to success (Asrilhant *et al.*, 2007). Another conclusion is that quality management has not been incorporated into the strategic and long-term view of the firms. Strategic planning for quality was not significantly correlated with either internal or external quality results. This shows that quality is still regarded as an operational level strategy and that there is much work left to be done to relate it to business-level strategy.

6.1 Limitations

There are some limitations to this study that must be mentioned. Above all, the sample size was relatively small. This sample size prevents us from performing more complex analysis on the data set. It is highly recommended that future research be conducted with a larger sample size. Another concern in this study was the low reliability of process/product design. There might be several explanations for that. Such a relatively low reliability (0.50) is mainly because of the nature of the petroleum industry with rigid processes and little emphasis on process/product design. It is recommended that this construct be revisited and validated, especially with respect to safety management.

The focus of this research was on production and exploration. While production and exploration constitutes a considerable portion of the petroleum industry, we cannot easily generalize the findings of this study to the other sections of the petroleum industry. Accordingly, more research is needed to generalize the results of this study to other sections of the petroleum industry, such as petrochemicals, transportation and distribution.

6.2 Future research

It is recommended that the same study be conducted with a larger sample size. With a larger sample size, it is also possible to use more advanced statistical tools, such as structural equation modeling. Future research could address the nature of customer orientation in the petroleum industry. In this study, customer orientation did not emerge as a significant variable in explaining variability in external quality results. In that regard, research is needed to address the role of customer orientation in the petroleum industry. In investigating the perception of managers in the petroleum industry regarding customer orientation, qualitative studies (e.g. interview, case study) are recommended.

This research took a culture-free approach toward quality, assuming that the practice of quality is not affected by the national culture. It is recommended that future research incorporate the role of culture in quality management.

Note

1. Operational performance and business performance have been used to refer to internal quality results and external quality results, respectively.

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Appendix

Study	Operationalization of TQM	Main findings
Anderson *et al.* (1995)	Multidimensional construct Visionary leadership Internal and external cooperation Learning Process management Continuous improvement Employee fulfillment Customer satisfaction	Employee fulfillment has a significant effect on customer satisfaction. No significant relationship exists between continuous improvement and customer satisfaction
Flynn *et al.* (1995)	Multidimensional construct Process flow management Product design process Statistical control/feedback QM infrastructure practices Customer relationship Supplier relationship Work attitudes Workforce management Top management support	Statistical control/feedback and the product design process have positive effects on perceived quality market outcomes, while the process flow management and statistical control/feedback are significantly related to the internal measure of the percentage that passed final inspection without requiring rework. Both perceived quality market outcomes and the percentage that passed final inspection with no rework have significant effects on competitive advantage
Powell (1995)	Multidimensional construct Executive commitment Adopting the philosophy Closer to customers Benchmarking Training Employee empowerment Zero-defects mentality Flexible manufacturing Process improvement Measurement	Executive commitment, open organization, and employee empowerment show significant partial correlations for both total performance and TQM program performance. A zero-defects mentality and closeness to suppliers correlate with TQM performance, but with total performance only marginally
Hendricks and Singhal (1996, 1997)	Single construct (winning of a quality award is a proxy for the effective implementation of TQM programs)	Implementing an effective TQM program improves performance of firms
Adam *et al.* (1997)	Multidimensional construct Employee involvement Senior executive involvement Employee satisfaction Compensation Customers Design and conformance Knowledge Employee selection and development Inventory reduction	Employee knowledge about quality improvement, what quality of product customers receive and perceive, employee compensation and recognition and management involvement are significantly and inversely correlated with the total cost of quality and average percent of items defective. Financial performance is positively correlated with senior management involvement and with employee compensation
Choi and Eboch (1998)	Single construct (in this study, various dimensions of TQM were examined: however, a single TQM construct is used to analyze the relationship between TQM and performance)	TQM practices have a stronger effect on customer satisfaction than they do on plant performance. The plant performance has no significant effect on customer satisfaction

(*continued*)

Table AI.
Quality management and
firm performance

Study	Operationalization of TQM	Main findings
Ahire and O'Shaughnessy (1998)	Multidimensional construct Management commitment Employee training Employee empowerment Employee involvement Internal quality information Supplier quality management Design quality management Statistical process control Customer focus Benchmarking	Firms with high top management commitment produce higher quality products than those with low top management commitment. Customer focus, supplier quality management and empowerment emerge as significant predictors of product quality
Easton and Jarrell (1998)	Single construct (in this study, various dimensions of TQM were examined; however, a single TQM construct is used to analyze the relationship between TQM and performance)	For the firms adopting TQM, financial performance has increased
Rungtusanatham et al. (1998)	Multidimensional construct Visionary leadership Internal and external cooperation Learning Process management Continuous improvement Employee fulfillment Customer satisfaction	Continuous improvement has a positive effect on customer satisfaction. Employee fulfillment seems to have no effect on customer satisfaction
Dow et al. (1999), Samson and Terziovski (1999)	Multidimensional construct Leadership Workforce commitment Shared vision Customer focus Use of teams Personnel training Cooperative supplier relations Use of benchmarking Use of advanced manufacturing systems Use of just-in-time principles	Employee commitment, shared vision, and customer focus in combination has a positive impact on quality outcomes. Leadership, human resource management and customer focus (soft factors) are significantly and positively related to operating performance
Das et al. (2000)	Multidimensional construct High-involvement work practices Quality practices	High-involvement practices are positively correlated with quality practices; quality practices are positively correlated with customer satisfaction; customer satisfaction is positively correlated with firm performance
Wilson and Collier (2000)	Multidimensional construct Leadership Information and analysis Strategic planning Human resource management Process management	Process management, and information and analysis have significant and positive direct effects on financial performance
Douglas and Judge (2001)	Single construct (in this study, various dimensions of TQM were examined; however, a single TQM construct is used to analyze the relationship between TQM and performance)	The extent to which TQM practices are implemented is positively and significantly related to both the perceived financial performance and the industry expert-rated performance

Table AI.

(*continued*)

Study	Operationalization of TQM	Main findings
Lee *et al.* (2003)	Multidimensional construct Leadership Quality information and analysis Customer and market focus Strategic quality planning Human resource management Process management Quality results	Quality information and analysis has strong, positive impact on strategic quality planning and process management, and quality results are affected by human resource and process management
Kaynak (2003)	Multidimensional construct Management leadership Training Employee relations Quality data and reporting Supplier quality management Process management Product/service design Inventory management performance Quality performance Financial and market performance	Management leadership is directly related to training, employee relations, supplier quality management, and product design, and indirectly related to quality data and reporting, and process management. Quality data and reporting does not have any direct effect on any of the (financial) performance measures. Supplier quality management emerges as an important component of TQM. It is the only TQM practice that has a direct effect on inventory turnover. Improving operating performance results in increased sales and market share, thereby providing companies with a competitive edge
De Ceiro (2003)	Multidimensional construct Practices relating to the design and development of new products Production process Links with suppliers Links with customers Human resource management	The results show a significant relationship between the level of implementation of quality management practices and improvement in operational performance in cost, quality and flexibility. Quality management practices related to product design and development, together with human resource practices, are the significant predictors of operational performance
Lai and Cheng (2003)	Multidimensional construct People and customer management Supplier partnerships Communication of improvement information Customer satisfaction orientation External interface management Strategic quality management Teamwork structures for improvement Operational quality planning Quality improvement measurement systems Corporate quality culture	Significant contrast exists between public utilities/service industries and manufacturing/construction industries, with the former group having a higher level of quality management implementation and achieving better quality outcomes. The emphases that they placed on their quality management implementation also seem to differ

Table AI.

Study	Operationalization of TQM	Main findings
Lai (2003)	People and customer management Supplier partnerships Communication of improvement information Customer satisfaction orientation External interface management Strategic quality management Teamwork structures for improvement Operational quality planning Quality improvement measurement systems Corporate quality culture	The results suggest that market orientation factors (i.e. market intelligence generation, market intelligence dissemination, responsiveness to market intelligence) are positively correlated with quality management factors and business performance
Rahman and Bullock (2005)	Multidimensional construct Customer satisfaction Employee morale Productivity Defects as a percentage of production volume Delivery in full on time to customer Warranty claims cost as percentage of total sales Cost of quality as a percentage of total sales	The paper investigates the direct impact of soft TQM on the diffusion of hard TQM, and then assesses the direct impact of hard TQM on performance. Analysis of 261 Australian manufacturing companies revealed significant positive relationships between soft TQM and hard TQM elements. In addition to direct effects, soft TQM also has an indirect effect on performance through its effect on hard TQM practices (indirect effect)
Sila (2007)	Multidimensional construct Leadership Strategic planning Customer focus Information and analysis Human resource management Process management Supplier management	The results show that the implementation of all TQM practices is similar across subgroups of companies within each contextual factor. In addition, the effects of TQM on four performance measures, as well as the relationships among these measures, are generally similar across subgroup companies. Thus, for the five contextual factors analyzed, the overall findings do not provide support for the argument that TQM and TQM-performance relationships are context-dependent

Table AI.

Corresponding author
Mahour Mellat Parast can be contacted at: mahour.parast@uncp.edu