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A CAUSAL RELATIONSHIP BETWEEN QUALITY MANAGEMENT PRACTICES, SUPPLY-CHAIN PRACTICES, DEMAND-CHAIN PRACTICES, AND COMPANY PERFORMANCE

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ABSTRACT

Studi ini mengembangkan suatu hubungan kausal antara lima konstruk penelitian Quality Management Practices (QMP), Supply-Chain Practices (SCP), Demand-Chain Practices (DCP), Company Performance (Value-Gain Performance atau VGP dan Monetary-Gain Performance atau MGP) dengan menggunakan Structural Equation Modeling (SEM)—studi kasus pada industri migas di Indonesia. Model konseptual penelitian ini merupakan kolaborasi dari berbagai penelitian sebelumnya yang terkait dengan enam dimensi praktik manajemen kualitas berbasis Deming's 14 points sebagai variabel independen, manajemen rantai pasokan yang terintegrasi (sektor hulu dan sektor hilir migas) sebagai variabel mediator, dan kinerja perusahaan (non keuangan dan keuangan) sebagai variabel dependen.

Berdasarkan model struktural akhir menunjukkan paraktik manajemen kualitas (QMP) memiliki pengaruh positif lebih besar ke praktik rantai pasokan (SCP) daripada ke praktik rantai permintaan (DCP). QMP berpengaruh langsung ke kinerja non keuangan perusahaan (VGP) dan tidak berpengaruh langsung ke kinerja keuangan perusahaan (MGP). QMP juga berpengaruh tidak langsung ke MGP melalui SCP, DCP, dan VGP. DCP berpengaruh langsung lebih besar ke VGP daripada ke MGP, sedangkan SCP hanya berpengaruh langsung ke VGP. Hasil hubungan kausal antar lima konstruk penelitian memberikan gambaran bahwa perusahaan migas di Indonesia perlu mempertimbangkan kinerja non keuangan (VGP) untuk meningkatkan kinerja keuangan perusahaan (MGP). Sebagai contoh kaitannya dengan ketepatan waktu pasokan dan dsitribusi merupakan faktor kunci untuk perbaikan secara sistemik.

Hasil model struktural akhir didukung oleh nilai X^2/df*, GFI, AGFI, CFI, RMR, RMSEA, P, ECVI yang secara simultan menunjukkan the best fit to the data. Hasil ini memberikan kontribusi bahwa model penelitian ini sangat berpotensi untuk dilakukan studi replikasi baik untuk industri manufaktur maupun jasa. Penelitian berikutnya perlu membuktikan persamaan dan perbedaan antara industri manufaktur dan jasa melalui model struktual dari industri migas di Indonesia. Bagi pihak manajemen perusahaan migas di Indonesia, hasil penelitian ini bisa digunakan untuk membuat skala prioritas perbaikan terpadu. Sebagai contoh dengan penerapan UU Migas yang baru UU (Nomor 22/2001), bagaimana suatu perusahaan migas mampu mengoptimalkan perannya (sektor hulu atau sektor hilir atau kombinasi keduanya) dengan menyeimbangkan orientasi kebijakan peningkatan kinerja berbasis non keuangan (VGP) dan keuangan (MGP) secara simultan.*

***Keywords**: Quality Management Practices, Supply-Chain Practices, Demand-Chain Practices, Value Gain Performance, and Monetary Gain Performance*

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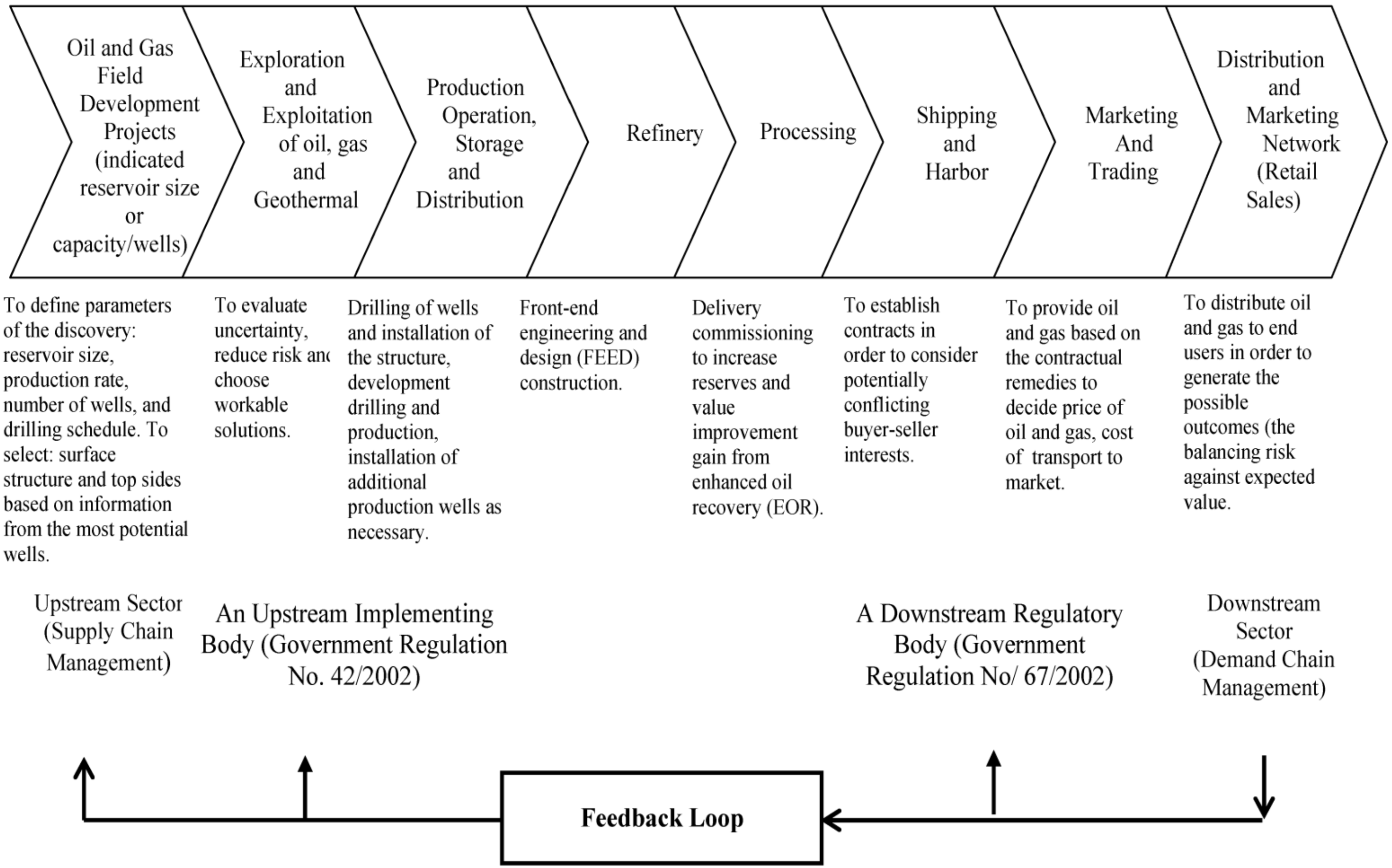
INTRODUCTION

An integrated oil and gas industry is a multiplicity of micro sub processes, all synergistically building to the macro process of that oil and gas chain activities. All processes have suppliers and customers; these suppliers and customers can be internal or external to the oil and gas companies. A customer can be an end user or the next operations downstream (demand-chain of oil and gas). The customer does not even have to be a human; it can be an exploration system. A vendor can be another firm supplying raw stocks or storage or distribution services, or the prior operations upstream (supply- chain of oil and gas) (Gitlow, *et al.,* 2005; Treville *et al.,* 2004). An oil and gas chain activities executes upstream (supply-chain practices) as well as downstream oil and gas operations (demand-chain practices). The objectives of oil and gas chain activities include supply fuel required domestically, exporting oil and gas to increase the state revenue and developing geothermal energy as an alternative energy for the future.

The Indonesia's oil and gas industry is committed to adopting the following Total Quality Management (TQM) principles in its journey to world-class orientation: Quality Leadership, Stakeholders Focus, Integrated Business Strategy, Teamwork, Empowerment, Process Management, Asset Management, Continuous Improvement, Learning Organization, and Measurement of Company Performance (Hakim, 1996). Although TQM has been implemented, the management of oil and gas companies in Indonesia realized that to reach their vision to be world-class companies, they must fundamentally rethink their way of conducting business. The management of oil and gas companies have encouraged themselves to restructure the TQM implementation by developing a causal relationship between quality management practices, supply-chain practices, demand-chain practices, and company performance.

The period of 2001 – 2005 is important transition years for Indonesia's Oil and Gas Industry, following passage of a new oil and gas law in October 2001 (Embassy of the USA, 2004). The Indonesian Parliament passed the oil law on October 23, 2001 (Law 22/2001). This new Law, which replaced the 1960 Oil and Gas Law and Law for State Owned Company 8/1971, required the upstream (supply-chain) and downstream (demand-chain) sectors to deregulate within four years (2001-2005). The amendment of law created two new governmental bodies: the Executive Body that takes over State Owned Company's upstream functions and the Regulatory Body that supervises downstream operations.

The Executive Body (Oil and Gas Upstream Implementing Body) was established on July 16, 2002 (Government Regulation No. 42/2002). It took over State Owned Company's upstream regulatory functions and management of oil and gas contractors. The Regulatory Body (Oil and Gas Downstream Regulatory Body) was established on December 30, 2002 (Government Regulation No. 67/2002) (the Government of Republic of Indonesia, 2001). The main obligation of downstream operators is to assure sufficient natural gas and domestic fuel supplies and the safe operation of refining, storing, transport and distribution of petroleum products. The oil and gas supply and demand-chain activities as an integrated oil and gas industry is shown in Figure 1. A feedback loop relates information about the market products (outputs) from any stage or stages back to another stage or stages so that an analysis of continuous improvement process can be made (Gitlow *et al.*, 2005).



Source: Directorate General of Oil and Gas, Department of Energy and Mineral Resources of the Republic of Indonesia. (2004) and Embassy of the United States of America. 2004

Figure 1 The Oil and Gas Supply and Demand-Chain Activities

To assess how TQM is actually practiced in the Indonesia's oil and gas industry, the author addresses two questions. *First*, in what ways are contemporary implementations of TQM consistent with the founder's tenets (Deming's 14 points)? Second, in what ways do current practices differ from the Deming's 14 points, and do those differences enrich the core ideas of TQM or diverge from them? Answering the two questions will contribute to a deeper understanding of the relationship between the role of each the elements of TQM (Deming's 14 points) and company performance. This would help managers with the allocation of resources to those categories that have the most significant effect on company performance (Samson and Terziovski, 1999). Samson and Terziovski stated that only a small percentage of over 1000 articles on the TQM philosophy and methods attempted to test the strength of the relationship between TQM and company performance.

In addition, attempts are needed to realize that TQM practices need not to operate in isolation from other initiative programs, such as supply-chain management and demand-chain management—it could be integrated. This study investigates the rational of linkage (a marriage) between five constructs (quality management practices as the derivative of Deming's 14 points, supply-chain practices, demand-chain practices, and two distinct types of company performance—monetary- and value-gains performance. Although TQM program had been, and will continue to be vital part of companies' operations, companies must fundamentally rethink their ways of conducting business and have the courage to implement quality management practices where necessary to achieve the real changes in company performance (monetary-gain and value-gain performances) through supply-chain and demand-chain practices.

The rest of this paper is organized as follows. The next sections of this study discuss objectives of the study, related literature and assess TQM practices, review of methodology, research framework, and interpretation of results. The conclusions and contributions are provided at the last session.

THE OBJECTIVES OF THE STUDY

To validate the oil and gas companies' claim to total quality management (TQM) practices, a causal relationship between quality management practices based on Deming's 14 points, supply-chain practices, demand-chain practices, and company performance (value-gain performance and monetary-gain performance) has been developed through this study. In light of these research constructs, the objectives of this study are twofold:

(1) To develop a path analytic framework or structural equation model which includes the interrelationships between five research constructs: quality management practices as the independent variables, supply-chain and demand-chain practices constructs as the mediating variables and further, the importance of considering two distinct types of company performance (monetary gain performance and value gain performance) as the dependent variables were examined;

(2) To generate the relationships among five research constructs that is both substantively meaningful and statistically well-fitting for the Indonesia's oil and gas industry.

RELATED LITERATURE AND ASSESSING TQM PRACTICES

A number of research studies of TQM and quality awards systems have been conducted, and led to a debate about the effectiveness of such awards and of the various TQM elements. These studies have been either perceptual studies or small-scale empirical works (Samson & Terziovski, 1999; Tamimi *et al.*, 1995). The present study is a large cross-sectional examination of 140 SBUs in oil and gas companies with 1332 respondents (multiple informant). In this section the author examines some of the key existing empirical studies.

Tamimi (1998) in his study of a second-order factor analysis of critical TQM factors stated that the effective transformation to the total quality management (TQM) organization has been linked to the extent to which firms successfully implement certain critical TQM practices. Tamimi (1998) developed a second-order factor model to test whether a set of critical quality management factors load on an overall construct that may be termed Total Quality Management. Using survey data collected from 173 manufacturing and service firms, the LISREL VII computer program is used to estimate and validate the proposed model. The results provide the eight factors collectively load on a single factor called TQM. The eight critical factors of TQM were top management commitment, supervisory leadership, education, cross-functional communications to improve quality, supplier management, quality training, product/service innovation, and providing assurance for employees.

Saraph *et al.* (1989) provided a synthesis of the quality literature by identifying eight critical factors of quality management in a business unit. The eight critical factors of quality management based on Saraph *et al*. (1989) are: the role of management leadership and quality policy, role of the quality department, training, product/service design, supplier quality management, process management, quality data and reporting, and employee relations. Operational measures of these factors are developed using data collected from 162 general managers and quality managers of 89 business units or 20 companies. Researchers can use such measures to better understand quality management practice and to build theories and models that relate the critical factors of quality management to the organization's quality environment and quality performance.

Black & Porter (1996) extracted a series of items from the Baldrige Model and established literature. These items formed the basis of a questionnaire sent to over 200 managers. Data was examined using several well-established analytical techniques that identified 10 critical factors of TQM. These ten critical factors were people and customer management, supplier partnership, communication of improvement information, customer satisfaction orientation, external interface management, strategic quality management, teamwork structures for improvement, operational quality planning, quality improvement measurement systems, and corporate quality culture. The findings can be used to improve existing self-assessment frameworks such as the Baldrige and European Quality Award criteria.

Samson and Terziovski (1999) examined the TQM practices and operational performance of a large number of manufacturing companies (1200 companies) in Australia and New Zealand in order to determine the relationships between these practices, individually and collectively, and firm performance. The study showed that the relationship between TQM practice (leadership, management of people, and customer focus) and organizational operational performance is significant in a croos-sectional sense.

Antony *et al*. (2002) provided an empirical study on the identification of the critical success factors (CSFs of TQM) implementation in Hong Kong industries. Through a thorough and detailed analysis of the literature, 11 success factors with 72 elements were identified to develop a questionnaire. These items were empirically tested by data collected from 32 companies in Hong Kong. A factor analysis was carried out that identified seven CSFs with 38 elements of the implementation of TQM. These CSFs were training and education, quality data and reporting, management commitment, customer satisfaction orientation, role of the quality department, communication to improve quality, and continuous improvement.

However, there is certainly not a clear agreement as to what the "real" factors of TQM are, and there will always the disagreements as to 'how to best cut the TQM cake' into factors or elements (Samson & Terziovski, 1999, Tamimi & Gershon, 1995). Nothing that the differences exist and are generally not major, the author prefers to use a well established factor set, the quality management practices, and move on to test the correspondence of these factors, individually and collectively, with supply-chain practices, demand-chain practices and company performance measures, which is an additional step from Tamimi's contribution.

The author's motivation is based on wishing to contribute to knowledge about 'What works?' This means using methods similar to those of Saraph *et al.* (1989), Black and Porter (1996), Tamimi (1998), and Samson and Teziovski (1999) but also using matched supply-chain practices, demand-chain practices, and company performance, to test linkages of the established quality management practices to company performance through supply-chain practices and demand-chain practices.

REVIEW OF METHODOLOGY

Two thousand and eight hundred (2800) questionnaires were distributed to the participating oil and gas companies in a qualified sample of 140 Strategic Business Units (SBUs)— through mail survey, internet survey and face-to-face interview. Survey was undertaken in 49 oil and gas companies with 140 SBUs. These fall into 26 supply-chain companies with 88 SBUs, and 23 demand-chain companies with 52 SBUs. A total of 1,332 individual usable questionnaires (include staffs from implementation body and regulatory body) were returned thus qualified for analysis, representing an effective response rate of 50.19 percent. This research used a quantitative-deductive (theory-driven) method design (the explanatory research design). The primary unit of analysis of the study is the SBU level in the Indonesia's oil and gas industry. The survey was administered to every level of management at each SBU (Top, Middle, and Low Level Management).

A multiple informant sampling unit was used to ensure a balanced view of the causal relationships between the research constructs, and to collect data from the most informed respondents on different level of management. The surveys were undertaken during five months through traditional postal questionnaire surveys, and internet or questionnaire e-mailed/web surveys to distribute and to complete the questionnaires directly at a single point in time (a cross-sectional study). The survey instrument used a comprehensive set of 38 questions that were directly tied to the five constructs of the study. Participants answered using a five-point interval Likert scale (1 = not at all true; 2 = slightly true; 3 = somewhat true; 4 = mostly true; and 5 = completely true).The researcher borrowed the original version of the questionnaire (in English) from the previous studies and then translated it into Indonesian language using the backward translation method, so nothing any discrepancies (Brislin, 1986). The second version of the questionnaire in Indonesian language was used in the survey.

THE RESEARCH FRAMEWORK

The research framework which identifies a nine-stage path analytic model delineating the factors involved in a sequential research model. This study explores the linkages between Quality Management Practices (6 dimensions), Supply-Chain Practices (5 dimensions), Demand-Chain Practices (4 dimensions), and Company Performance (Monetary Gain Performance, 3 dimensions and Value Gain Performance, 6 dimensions) at the strategic business unit (SBU) level in the integrated oil and gas industry in Indonesia (a single industry) using a cross-sectional analysis. Figure 2 depicts the integrative research framework that demonstrated into measurement and structural components.

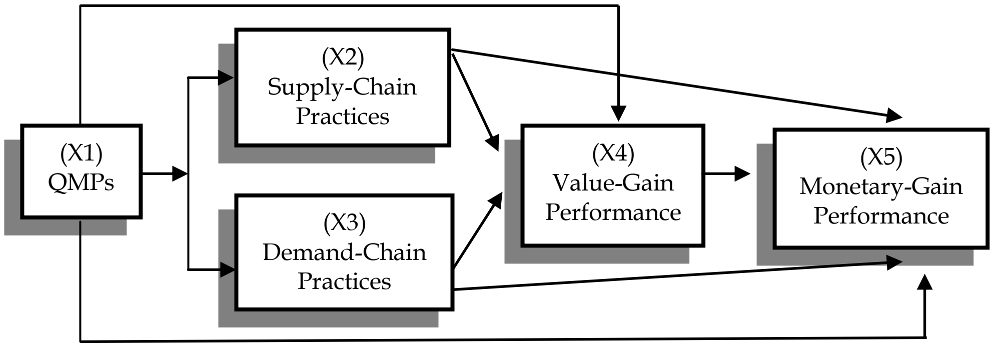


Figure 2. A Sequential Model Research Framework

Definition and Operationalization of Variables

The researcher has developed a framework of the study (Figure 2) to illustrate the linkages between Quality Management Practices (QMPs), Supply-Chain Practices (SCP), Demand-Chain Practices (DCP), and Company Performance (Value-Gain Performance or VGP, Monetary-Gain Performance or MGP). In this framework, the researcher argues that QMPs (as independent constructs) improve MGP (as a dependent construct) through three intervening constructs of SCP, DCP, and VGP. The constructs of this study were operationalized as follows.

Quality Management Practices (QMP) were operationalized using a set of 50 quality management dimensions (qm1-50). A thorough investigation of 50 quality management dimensions (Deming's 14 points) using exploratory factor analysis indicated that the six factors were meaningful and accounted for 56.188% of the total variation among the 50 items. The six factors may be interpreted, respectively, as quality improvement program, supervisory leadership, and supplier involvement, top management commitment, training to improve products/services and cross functional team relationships among SBUs. Points 7-14 of Deming's principle, however, were not clear enough to be meaningfully interpreted. Interestingly, six QMPs closely resembled of the factor that were developed by Saraph *et.al.* (1989), and Tamimi's study (1995 & 1998) which reduced Deming's 14 points into a smaller set of meaningful factors (Quality Management Practices/QMPs construct) for easier implementation. This study used the extracted factors to gain better understanding of Deming's principles of quality management for the Indonesia's oil and gas industry that has been empirically tested by Tamimi.

Supply-chain management has been defined as "the integration of key business processes from end-user through original suppliers that provides products, services, and information that adds value for customers and other stakeholders" (Lambert at al., 1998 in Treville *et al.*, 2004). Frohlich and Westbrook, 2002 in Treville *et al.*, 2004) divided such integration into supply-chain and demand-chain integration or practices).

Supply-Chain Practices (SCP) was operationalized using five dimensions of just-in-time (JIT) delivery, reduction of the supplier base, evaluating suppliers based on agile and delivery performance, establishing long-term contracts with suppliers, and the elimination of paperwork (Treville *et al.*, 2004; Trombly, 2000).

Demand-Chain Practices (DCP) was developed using four key dimensions of agile market competition: enriching the customer, cooperating to enhance competitiveness, organizing to master change and uncertainty, and leveraging the impact of people and information (Goldman *et al.*, 1995). Companies are implementing corporate strategy to achieve these four dimensions of agility. The appropriate corporate strategy followed will differ for each company, and each company must base its corporate strategy upon an understanding of its customers and markets, products, strengths and weaknesses, and resources. Various combinations of strategies (proactive and interactive) are being pursued by companies with a heightened emphasis on providing greater value to the customer through the ability to offer customized products, services, and information.

Company Performance was conceptualized by Cook and Verma's study (2002) according to two dimensions. The first dimension is relating to financial or monetary gain or MGP (i.e., profit, market-share enhancement, and cost reduction). The second dimension is relating to non financial or value-gain or VGP ((i.e., product/service quality enhancement, delivery performance, customer and employee satisfaction, and community development impacts). Based on Cook and Verma (2002), the study described the company performance into two constructs: value-gain performance construct and monetary-gain performance construct. Competitive pressures on private businesses, and performance improvement and reform pressures and public sector organizations, mandate that organizations continually worry about executing good strategy well, at the same time that they worry about running business operations efficiently. Today's organizations need to be both strategically and operationally excellent to survive and meet tomorrow's challenges. One concept of company performance that helps achieve the required balance between strategy and operations is by considering both value-gain and monetary gain performances (Rohm, 2002).

HYPOTHESES DEVELOPMENT

Figure 2 depicts the integrative research framework that demonstrated into measurement and structural components.

Based on the sequential research model of a causal relationship between Quality Management Practices, Supply-Chain Practices, Demand-Chain Practices, and Company Performance (Value-Gain Performance, and Monetary-Gain Performance), the study consists of eleven hypotheses:

1. H1: QMPs have direct and significant effects on Monetary Gain Performance (MGP).
2. H2: QMPs have direct and significant effects on Value Gain Performance (VGP).
3. H3: QMPs have direct and significant effects on Supply-Chain Practices (SCP).
4. H4: QMPs have direct and significant effects on Demand-Chain Practices (DCP).
5. H5: SCP has a direct and significant effect on Value Gain Performance (VGP).
6. H6: DCP has a direct and significant effect on Value Gain Performance (VGP).
7. H7: SCPhas a direct and significant effect on Monetary Gain Performance (MGP).
8. H8: DCP has a direct and significant effect on Monetary Gain Performance (MGP).
9. H9: VGP has a direct and significant effect on Monetary Gain Performance (MGP)
10. H10: QMPs have indirect and significant effects on Monetary Gain Performance (MGP) through its direct effect on Supply-Chain Practices (SCP).

11. H11: QMPs have indirect and significant effects on Monetary Gain Performance (MGP) through its direct effect on Demand-Chain Practices (DCP).

DATA ANALYSES METHODS

The data (quantitative) generated in the preceding stage were analyzed using factor analysis (confirmatory factor analysis or CFA and exploratory factor analysis or EFA), structural equation modeling or SEM and path analysis. These statistical methods were selected because they were most appropriate for this study, given its objectives.

Factor Analysis is a data reduction technique used to reduce a large number of variables to a smaller set of underlying factors that summarize the essential information contained in the variables. For testing a theory about the structure of a particular domain, confirmatory factor analysis is appropriate. Factor analysis is used an exploratory technique when the researcher wishes to summarize the structure of a set of variables (Coakes and Steed, 2003).

The software programs AMOS (Analysis of Moment Structures or Analysis of Mean and Covariance Structures) version 4.01 (Arbuckle, 1999), SPSS 11.0 (Coakes and Stead, 2003) were used to the quantitative data analyses. As one of the SEM (Structural Equation Modeling) software program, AMOS facilitates the specification process by automatically incorporating the estimation of variances by default for all independent factors (Byrne, 2001; Anderson & Gerbing, 1988).

Path analysis is used to analyze the effect of quality management practices (QMPs) on value-gain performance (VGP) and monetary-gain performance (MGP) and to investigate the interrelationships between quality management practices (QMPs), supply-chain practices (SCP), demand-chain practices (DCP), VGP and MGP.

DATA SCREENING

The first step in the factor analysis process is to explore the characteristics of the data. It is often useful to be able to conduct normality and multicollinearity. Analysis on subsets of the data and to make conditional transformations of variable (Coakes & Steed, 2003). These can be achieved using the normality and multicollinearity assumptions and practical considerations underlying the application of principle axis factoring (PAF) and principle components (PC).

Assessing Normality

Factor analysis is robust to assumptions of normality. However, if variables are normally distributed, then the solution is enhanced (Coakes & Steed, 2003). An examination of the skewness and kurtosis statistics indicates that all items are reasonably normally distributed.

Assessing Multicollinearity

According to Gujarati (2003) the variance inflation factor (VIF) is an indicator of multicollinearity. The larger is the value of VIF, the more troublesome or collinear. The rule of thumb if the VIF of a variable exceeds 10 that variable is said to be highly collinear. An examination of the collinearity statistics indicates that a considerable number of VIFs are far below 10.

According to Coakes & Stead (2003), the anti-image correlation matrix is used to assess the sampling adequacy each variable. The measures of sampling adequacy are displayed on the diagonal of the anti-image correlation matrix. Variables with a measure of sampling accuracy that falls below the acceptable level of 0.5 should be excluded from the analysis. Bartlett's test of sphericity and the Kaiser-Meyer-Olkin measure of sampling adequacy are both tests that can be used to determine the factorability of the matrix as a whole. If Bartlett's test of sphericity is large and significant, and if the Kaiser-Meyer-Olkin measure is greater than 0.6, then factorability is assumed.

An examination of the correlation matrix indicates that considerable number of correlations exceed 0.3 and thus the matrix is suitable for factoring. The result of Bartlett's test of sphericity is large and significant and that the Kaiser-Meyer-Olkin measure of sampling adequacy is greater than 0.6. Measures of sampling adequacy are printed on the diagonal. Inspection of the anti-image correlation matrix reveals that all measures of sampling adequacy are well above the acceptable level of 0.5. Table 1 informs the results of normality and multicollinearity statistics tests.

Assessment of Measurement Model Fit: Exploratory Factor Analysis (EFA)

Sixty eight (68) questionnaire items represented five latent constructs for this study. After reversed scores were adjusted, items representing the constructs and dimensions were subjected to reliability and validity tests.

Rigorous statistical analysis is required in order to meet professional standards of validity and reliability. This approach would enable items to be retained or removed based on multivariate statistical analysis such as factor analysis/principle component and SEM procedures. According to Samson and Terziovski (1999) this has not been done with any statistical rigor based on a large and selected sample (n > 1,000). Previous studies have been generally based on between about 20 and 200 observations (i.e. in this study 140 Strategic Business Units and 1,332 respondents).

Table 1. Normality and Multicollinearity Statistics Tests

Variable (Construct)	VIF (< 10)	Correlation Matrix (> 0.3)	Anti-Image Correlation Matrix (Diagonal Value) (> 0.5)	Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy (> 0.6)	Bartlett's Test of Sphericity (Large & Significant)	Normally Distributed
QMP1-6	2.573	0.494-0.776	> 0.900	0.848	40216.150; df 253 (significant, p<0.000)	Standard deviation 0.52 Mean 3.14
SCP	3.269	0.557-0.651	> 0.680	0.931	114895.300; df 8515 (significant, p<0.000)	Standard deviation 0.44 Mean 3.03
DCP	1.990	0.511-0.648	> 0.791	0.830	3105.893; df 10 (significant, p<0.000)	Standard deviation 0.71 Mean 3.47
MGP	1.812	0.387-0.741	> 0.678	0.712	1023.040; df 3 (significant, p<0.000)	Standard deviation 0.55 Mean 2.79
VGP	2.108	0.494-0.741	> 0.832	0.864	3187.373; df 15 (significant, p<0.000)	Standard deviation 0.48 Mean 2.75

a. Reliability of measures

Cronbach's alpha coefficients were computed to estimated the reliability of each scale (observed variable or indicator). Item to total correlation was used to refine the measures and eliminate items whose inclusion resulted in lower alpha coefficients. Items with item to total correlation coefficients less than 0.50 were eliminated. However, items with item to total correlation coefficients less than 0.50 were retained if eliminating those items would result in lower Cronbach's alpha coefficient of the related scale (Hair *et al*., 1998). The Cronbach's alpha of the measures are ranging from 0.7720 to 0.9106, which, according to DeVellis (1991), are respectable to very good. Table 2 shows the reliability of the measures. Table 3 informs the number of items retained of the constructs.

Validity of measures

After the scales had met the necessary levels of reliability, the scales were assessed for validity. Confirmatory factor analysis was to assess the validity of each scales, which consisted of the retained items or manifest indicators. All loadings (path coefficients or regression weights) from a latent construct to their corresponding manifest indicators were significant (critical ratio values > 1.96). Thus provided evidence of convergent validity.

This study also assessed the discriminant validity of the latent constructs. Discriminant validity is the degree to which two conceptually similar constructs are distinct. According to Anderson and Gerbing (1988), when the confidence interval of ± two standard errors around a correlation estimate between two factors (constructs) does not include the value 1, that is evidence of discriminant validity for the two constructs. None of the confidence intervals in this study includes one.

Construct Reliability (α)

The composite reliability of each latent construct (α) measures the internal consistency of the construct indicators, depicting degree to which they indicate the common latent (unobserved) construct. High reliability of measures provides the researcher with greater confidence that the individual indicators consistently measure the same measurements. The threshold value for acceptable reliability is 0.70. (Hair *et al*., 1998).

Table 2. Reliability Coefficients (Cronbach's Alpha) of the Constructs

Construct	Number of Items in the Questionnaire	Number of Items Retained	Cronbach's Alpha
QMP	14 Items	6 Items	0.8933
QMP1	9 Sub-Items	7 Sub-Items	0.8768
QMP2	7 Sub-Items	5 Sub-Items	0.8643
QMP3	7 Sub-Items	4 Sub-Items	0.8032
QMP4	7 Sub-Items	6 Sub-Items	0.8886
QMP5	6 Sub-Items	3 Sub-Items	0.7720
QMP6	3 Sub-Items	3 Sub-Items	0.8089
SCP	5 Items	4 Items	0.8475
DCP	4 Items	3 Items	0.9106
MGP	3 Items	3 Items	0.8119
VGP	6 Items	6 Items	0.8702

Table 3. Number of Items Retained of the Constructs

Construct's Name	Construct Item Code	Sub Construct Item Code
Quality Management Practices (QMP)	QMP1 QMP 2 QMP 3 QMP 4 QMP 5 QMP 6	qmp40,41,43,45,47,48,49 qmp22,23,24,26,27 qmp9,10,11,12,15 qmp1,3,4,5,6,7 qmp16,18,19 qmp30,31,32
Supply-Chain Practices (SCP)	SCP1 SCP2 SCP3 SCP4	**SC** (SC1, SC2, SC3, SC4)
Demand-Chain Practices (DCP)	DCP1 DCP2 DCP3	**DC** (DC1, DC2, DC3)
Monetary Gain Performance (MGP)	MGP1 MGP2 MGP3	**MGP** (MGP1, MGP2, MGP3)
Value Gain Performance (VGP)	VGP1 VGP2 VGP3 VGP4 VGP5 VGP6	**VGP** (VGP1, VGP2, VGP3, VGP4, VGP5, VGP6)

Fixing the Error Terms and the Lambdas

Single indicators measured latent constructs of this study; however, in each case, the indicator was a multiple-item scale. It is unlikely that a single indicator perfectly measures a construct; therefore, this study estimated the measurement error terms. The measurement error terms were fixed at $(1- \alpha) \sigma^2$ and the corresponding lambdas—the loading from a latent construct to its corresponding indicator—were fixed at $\alpha^{1/2} \sigma$ (Howell, 1987). For the non-latent (observed) variables, the error terms were fixed at 0 and the corresponding lambdas were fixed at 1.

The measure of this study consists of indicators five latent variables measured on a 5 point scale. Therefore, before fixing the error terms and the lambdas for the samples, the study converted those latent variables into standard scores (Z scores) by subtracting the mean and dividing by the standard deviation for each variable. Using standardized variables eliminates the effects due to scale differences (Hair *et al.*, 1998). Table 4 provides the reliability of the constructs, lambdas, and error terms.

Table 4. Construct Reliability

Construct	ε	ℷ	α
ξ1 (QMP1)	0.0186	0.3642	0.8770
ξ2 (QMP2)	0.0371	0.4857	0.8641
ξ3 (QMP3)	0.0520	0.4625	0.8044
ξ4 (QMP4)	0.0210	0.4144	0.8918
ξ5 (QMP5)	0.0438	0.4010	0.7855
ξ6 (QMP6)	0.0410	0.4158	0.8097
ή1 (SCP), Before deleted component 5	0.0217	0.7866	0.9661
ή1 (SCP), After deleted components 5	0.0379	0.8186	0.9465
ή2 (DCP)	0.1387	0.5999	0.7218
ή3 (MGP)	0.0567	0.4976	0.8136
ή4 (VGP)	0.0248	0.4508	0.8912

An assessment of non response bias

An assessment of non response bias was made by using the extrapolation approach recommended by Armstrong (1979). Each individual questionnaire type (high, middle, and low level managers) was categorized by the date the completed questionnaire was received. Tests revealed no significant differences between early responders (the first wave of responses; n = 442) and late responders (the second wave of responses; n = 890) on any of the constructs. As indicated by a CFI (the comparative fit index) of 0.999 for the research model, the multi group models represent excellence fit to the data. As such, non-response bias in unlikely to be present in this data (Morgan and Piercy, 1998).

INTERPRETATION OF RESULTS

Table 1 reports the goodness-of-fit measures of Structural Equation Modeling (SEM). The ability of SEM techniques to assess relationships comprehensively has provided a transition from exploratory to confirmatory analysis (Bollen, 1989 in Samson and Terziovski, 1999).). Results of confirmatory factor analysis and exploratory factor analysis provided support for the final causal model, as proposed in Figure 2. After the scales had met the necessary levels of reliability, the scales were assessed for validity. Confirmatory factor analysis was to assess the validity of each scales, which consisted of the retained items or manifest indicators. All loadings (path coefficients or regression weights) from a latent construct to their corresponding manifest indicators were significant (the cut-off of critical ratio or CR value is > 1.96). Thus provided evidence of convergent validity.

All items loaded on their predicted factors with values of 0.5 or better. The goodness-of-fit indexes for the saturated measurement model (initial causal model) reflected a mediocre model (X^2/df = 4.183, GFI = 0.999, AGFI = 0.981, CFI = 0.999, RMR = 0.012, RMSEA = 0.049, and p-value = 0.041). The direct path from supply chain to monetary gain performance (MGP) is not significant (-0.42) and the critical ratio (CR) of the path from QMPs to MGP is below 1.96 (CR = -1.506). Therefore, these paths were eliminated and further modification was needed to improve model fit to acceptable levels.

Turning to Table 1, we see that all goodness-of-fit statistic present that the hypothesized model is a well fitting structural model (X^2/df = 2.178, GFI = 0.998, AGFI =

0.990, CFI = 0.999 RMR = 0.012, RMSEA = 0.030, and p-value = 0.088). Values of 0.90 and above on the adjusted goodness-of-fit (AGFI) indexes are considered desirable, values of 0.95 and above on the comparative index (CFI), the root mean square residual or RMR closes to 0, and p value is > 0,05 are considered strong evidence of practical significance (Bentler, 1990). Standardized root mean squared error of approximation (RMSEA) values of 0.05 or less are also considered indicators of good fit. Through the use of hierarchical modeling, final model was identified that was both theoretically meaningful and free of obvious specification errors.

The initial and final structural models also provide important insights into the lower and smallest the ECVI values (Expected Cross-Validation Index). According to Byrne (2001) the structural model having the smallest ECVI values exhibits the greatest potential for replication of the research model. Given the lower ECVI values for the hypothesized model (the initial model = 0.024 and the final model = 0.023), compared with the both independent (2.135) and saturated models (0.023), we concluded that it represents the best fit to the data.

The fully revised structural model is presented in Table 5. Seven of nine paths in the final structural model are significant (two paths were deleted), so no further model reductions were attempted.

Table 5. SEM Results (Final Causal Model)

Structural Relation (Causal Paths)	Standardized Regression Weights (y)	CR (Critical Ratio)	*error term* (ε)	Residual (ζ)
QMPs ------> MGP (Deleted)	-	-	εQMPs =0.065	ξSCP =0.069
QMPs ------> VGP	0.123	2.865	εSCP =0.069	ξDCP =0.151
QMPs ------> SCP	0.787	37.717	εDCP =0.151	ξMGP =0.218
QMPs ------> DCP	0.170	5.800	εMGP =0.218	ξVGP =0.131
SCP ------> VGP	0.085	1.958	εVGP =0.131	
DCP ------> VGP	0.655	26.543		
SCP ------> MGP (Deleted)	-	-		
DCP ------> MGP	0.142	4.409		
VGP ------> MGP	0.778	23.249		

Goodness of Fit Measures			Acceptable Parameter Level (Hair *et al*., 1998)	Desirable Parameter Level (Hair *et al*., 1998)
	Initial	Final		
Chi-Square Statistic (X^2)	4.183	6.533		
Degree of Freedom (df)	1	3		
Normed Chi-Square (X^2/df)	4.183	2.178	1 < x < 5	1 < x < 2
GFI	0.999	0.998	Close to 1 is better	
AGFI	0.981	0.990	> 0.90	
CFI	0.999	0.999	Close to 1 is better	
RMR	0.012	0.012	Close to 0 is better	
RMSEA	0.049	0.030	< 0.10	< 0.05
P	0.041	0.088	> 0.05	> 0.15
ECVI	0.024	0.023		

Figure 3 depicts the initial structural model. After eliminating the paths from QMP to MGP and SCP to MGP were iteratively used to determine whether the structural model fitted the data well. The final model (Figure 4) surpasses the hypothesized model (hypotheses 2, 3, 4, 5, 6, 8, 9, 10, and 11) on all fit criteria, which confirms that the modification was meaningful. H1 and H7 were not supported. The final model is tenable from a content and theoretical standpoint. Therefore, the deletion of these paths may be considered appropriate. The probability value (p) and normed chi-square ((X^2/df) can be improved tremendously from 0.041 to 0.088 and from 4.183 to 2.178 because all of good-of-fit statistics represent a well fitting and reasonable approximation for the population. In summary, seven of nine paths specified on the hypothesized model were found to be positive and statistically significant with the error term of five research constructs (ε) close to zero and the residual values of mediating and dependent variables (ζ) are below the cutoff point of 2.58 (Byrne, 2001).

The path analyses indicate that QMP affects supply-chain practices demand-chain practices, and value gain performance. The QMP has indirect effects on monetary gain performance and demand-chain practices only through its direct effects on demand-chain practices and supply-chain practices.

An interesting outcome of this research, however, is the path coefficients between QMP and supply-chain was 0.79, whereas the demand-chain to value-gain was 0.66. The standard coefficients between value-gain and monetary-gain was 0.78. They appear that QMP has more of direct effects on supply-chain than they do on demand-chain. Essentially the same reasoning that the demand-chain has a strong effect on value-gain, and the value-gain also has a strong effect on monetary-gain. It means that if TQM program are properly implemented, supply-chain and demand-chain can be managed better while also raising the value-gain and monetary-gain performances. The results also show that supply-chain has no direct effect on monetary-gain because supply-chain activities seem to be more cost-center rather than profit center even though the oil and gas companies have already developed the Strategic Business Units (SBUs) system as profit centers.

CONCLUSIONS and CONTRIBUTIONS

Important motivations for this study were to integrate several theoretical perspectives regarding quality management practices (Tamimi's studies, 1995 & 1998), supply and demand-chain practices (Treville *et al*., 2004) and to examine their possible relationships with oil and gas companies' performance (Cokins, 2004 and Ashere, 1976). This study had two important findings. First, the results of SEM support the importance of QMP as a correlate of monetary gain performance and value gain performance through supply-chain and demand-chain. Although causal attributions the five research constructs cannot be made because of this study's cross-sectional data, it appears that QMP pay off by improving company performance through supply-chain and demand-chain practices. Second, these results support the call for oil and gas companies to map a carefully designed QMP based on Deming's principle to achieve a success in implementing the agile supply and demand-chains simultaneously. Previous researchers in the area of TQM have not considered the impact of supply-chain and demand-chain practices on company performance. Consequently, in this study, the researcher introduced supply-chain and demand-chain practices as mediating variables to determine the impact of QMP on the company performance (monetary-gain and value-gain performances).

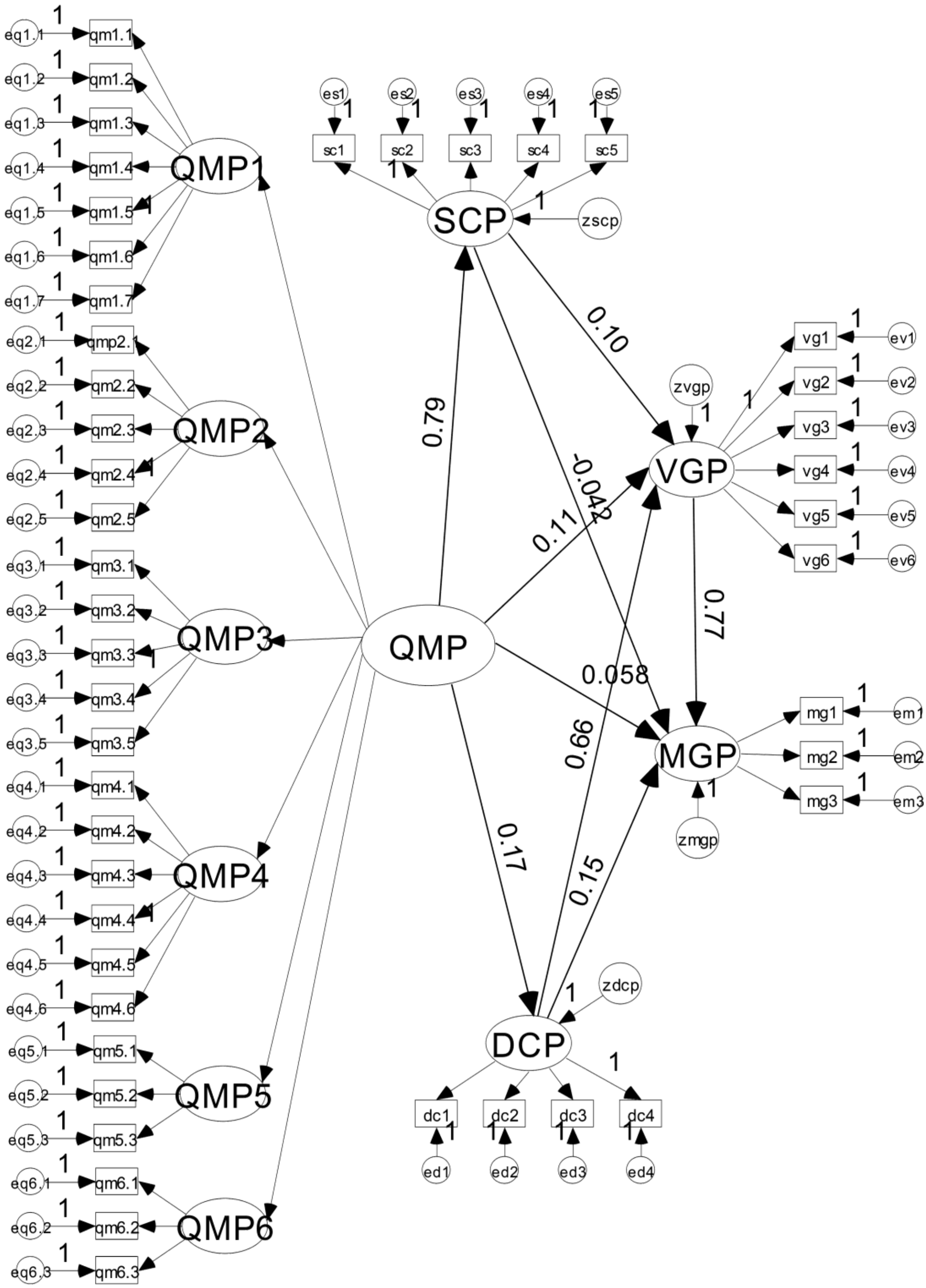


Figure 3. Initial Structural Model

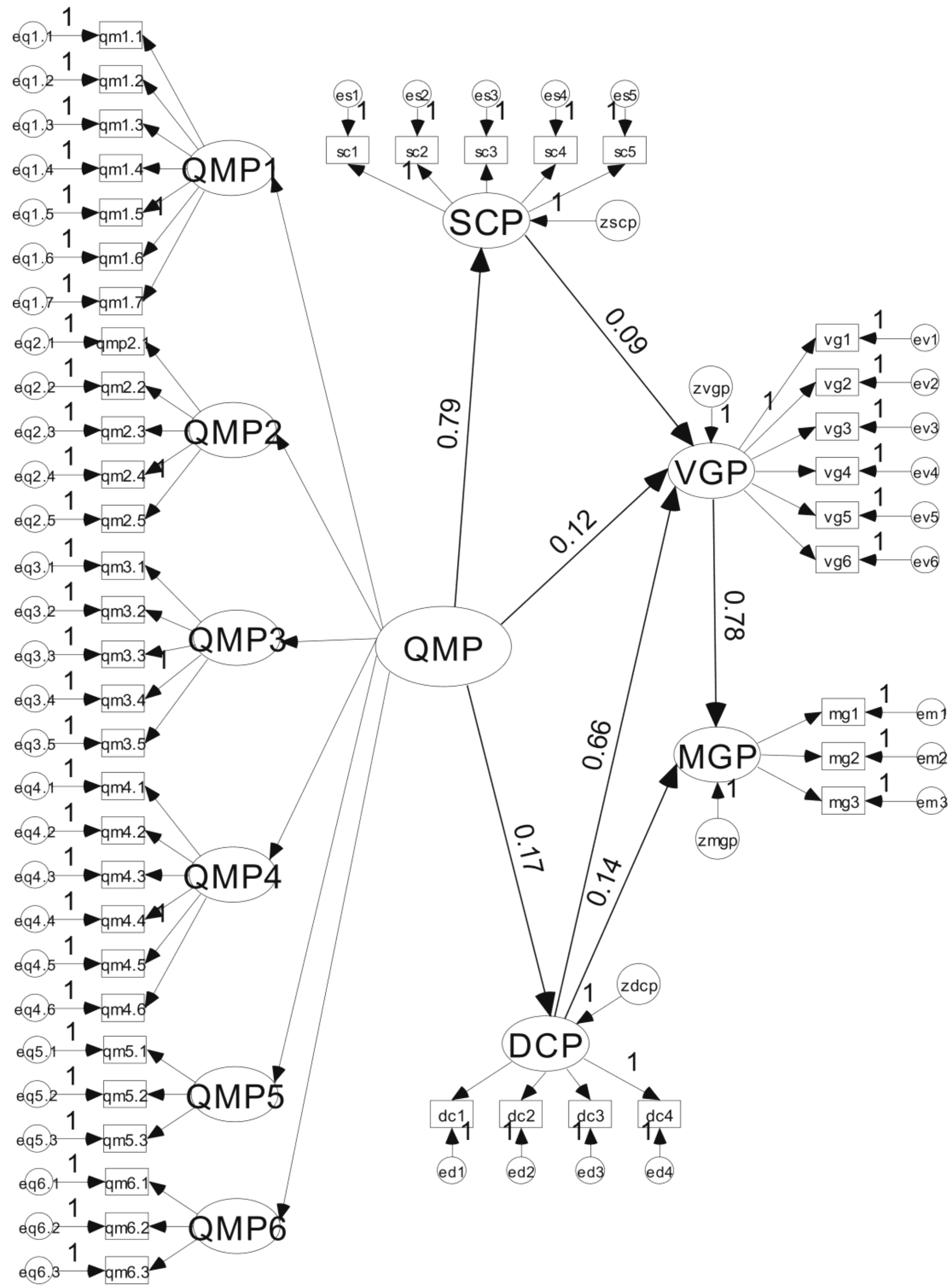


Figure 4. Final Structural Model

In summary, nine causal paths specified in the hypothesized model were found to be positive and statistically significant. Furthermore empirical results suggest that QMP has a positive and significant indirect effect on value-gain performance and monetary-gain performance through its direct effect on supply-chain; and demand-chain. The results also show that a complete model fit and the acceptable parameter level which indicate the overall parameter are good fit between the hypothesized model and the observed data. Finally, the particular design of the research and the findings suggest that the structural model of the study has a great potential for replication to manufacturing as well as service operations.

The study is more timely research in Indonesia, so that this study is important to explore and to show the relationship between QMP, supply-chain practices, demand-chain practices, and company performance. Hopefully by investigating these causal relationships, researchers will be able to advance knowledge and understanding in the area of strategic operations management (agility based competition).

This study provides several contributions to the field of quality management. First, the most contribution of the present investigation is the analysis of a large multiple informant of firms from the same industry. The advantage of concentrating on a single industry is that the model fit of structural equation modeling can be more specific because unique characteristic of the industry can be included (i.e., upstream and downstream sectors).

Second, this study demonstrates that quality management practices have significant positive and indirect effects on company performance through supply-chain practices and demand-chain practices. This result may support to quality management's notion that improvements focus on customer satisfaction (supply-chain management and demand-chain management), though often hard to quantify, are ultimately beneficial to the long-term health of the organization (Deming, 1986).

Third, this study has utilized quantitative-deductive research method and field-based research to examine concepts that seem reasonable, yet lack empirical verification. The particular design of the research and the findings suggest that much of the conceptual work in quality management practices may be applicable to manufacturing as well as service operation.

Finally, the implication of these findings for managers involved in an integrated oil and gas chain is highly significant. Because as a result of its amendment of law of the Republic of Indonesia concerning oil and natural gas, the Indonesia's oil and gas industry has a program under way to improve refinery level management, operations, and maintenance. The name of this program is Indonesia oil and gas refineries aiming for world-class operations. In addition the strong statistically significant results these relationships (Quality Management Practices, Supply-Chain Practices, Demand-Chain Practices, Value Gain Performance, and Monetary Gain Performance) suggest that the findings are quite reliable. These findings provide evidence and support for other programs to build upon in trying to ascertain emerging patterns within the oil and gas field.

LIMITATION OF THE STUDY

It is important to note that the first potential limitation of this study stems from the use of cross-sectional analysis. Cross-sectional analysis only give us portrayed at a particular point of time. The researcher can not examine the dynamic nature of trade-off which is changing overtime. In addition, the researcher encourages to think about whether the model of the study effects vary over time, either because other time the constructs are theoretically important or because the theoretical effect is unstable for some reason. Next research should be conducted longitudinally to observe the progress of improvement efforts in multiple industries both manufacturing as well as service operations (i.e., by developing Antecedent, Behavioral, Consequences/ABC analysis or by using triangulation method) (Tashakkori, A. & Teddlie, C. 2003).

A second limitation relates to the generalizability of the sample of single industry (the Indonesia's oil and gas industry; five digit of SIC Codes) to the larger population of wide variety industries (two digit of SIC Codes) employing the successful quality management implementation for World-class Performance in Operations. To address this problem, next research should not emphasize on a single industry only, but the companies come from a wide ranges of industries (e.g. the classification of responding companies based on the two or three digit of SIC Codes) using a longitudinal study. Further, in the Indonesia's oil and gas industry, the companies restructuring policy into Strategic Business Units (SBUs) was relatively new. There is a probability that SBUs lack of strategic consensus between policy maker (top level manager), middle level manager, and low level manager in the upstream, and downstream of oil and gas chains. As a result, the research findings are intended to represent the types of issues faced by strategic business units (SBUs) inexperienced in the implementation of quality management practices based on the Deming's Principle but nonetheless changed with the necessity of attaining successful quality management practices in order to develop World-class Performance in Operations in an integrated oil and gas chain.

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