CHAPTER III

RESEARCH METHODOLOGY

3.1 Introduction

The main aim of the research is to study the implementation of TQM in Indonesian oil and gas industry specifically formulating several following objectives;

1. To analyze the critical factors of quality management practices that would facilitate TQM implementation;
2. To determine out the most significant influence of the critical factors of quality management practices to the world-class company practice;
3. To determine out the most significant influence of the critical factors of quality management practices to the operational excellence practice;
4. To reveal world-class company practice and company non financial performance mediate the impact of critical factors of quality management practices on company financial performance;
5. To reveal operational excellence practice and company non financial performance mediate the impact of critical factors of quality management practices on company financial performance;
6. To determine out the influence of company non financial performance to the company financial performance.

The unit of focus for this study is the SBU because competitive advantage (including TQM implementation) is ultimately won or lost primarily at the SBU level rather than the corporate level (Porter, 1980).

In this chapter, the procedures applied to produce the findings of investigation include an overview of research paradigm, research method and design, research flow, key research questions, research framework and hypotheses development, research instrumentation, sampling method, data collection process and pilot test, and data analysis method used.

3.2 Overview of Research Paradigm

A research paradigm is a set of methods commonly exhibiting the same pattern or classification (Meredith *et al*., 1989). A number of dimensions for the research activity may be classified, for example the technique used to gather some data (model, literature, survey, histories, case study, observation, interview, experiment, laboratory, analysis of archival information), the methods used to analyze the data (statistics, protocol analysis, taxonomy), the immediate purpose of the research (exploration, description, evaluation, hypothesis generation, hypothesis testing), the nature of an analysis unit (the SOGI model—societies, organizations, groups, and individuals) (Bryman and Bell, 2003), and the duration/time points of data collection (a cross sectional study, a longitudinal study) (Meredith, *et al.,* 1989).

Paradigms themselves may be defined as the worldviews or belief systems that guide many researchers (Churchill, 1979; Guba and Lincoln, 1994). During the past three decades, several debates have been raged regarding the two major paradigms in social and behavioral sciences (Tashakkori and Teddlie, 1998). These two research paradigms alternatively are known as *positivist* or *empiricist* approach to *constructivist/phenomenological* orientation (e.g., Cherryholmes, 1992; Guba and Lincoln, 1994). The positivist paradigm underlies what is called as *quantitative methods* (QUANs), while the constructivist paradigm is on *qualitative methods* (QUALs) (e.g., Guba and

Lincoln, 1994; Howe, 1988; Lincoln and Guba, 1985). That is why the debate in these two paradigms has sometimes been called as *qualitative-quantitative debate* (e.g., Reichardt and Rallis, 1994). In these situations, the advantages of combining aspects of both paradigms throughout the study (within mixed methods studies) prove advantageous to the best understanding of a research problem (Creswell, 2003; Cahn, 2005).

According to Greene *et al*. (1989) cited in Tashakkori and Teddlie (1998), there are five objectives for these mixed methods studies: (a) *triangulation* - seeking a convergence of results; (b) *complementarities* – examining some overlapping and different facets of a phenomenon; (c) *initiation* - discovering paradoxes, contradictions, fresh perspectives; (d) *development* - using the methods sequentially, such that results from the first method inform the use of the second method; and (e) *expansion* - mixing methods adding breadth and scope to a research project.

By incorporating Greene *et al*. (1989) purposes, and taking the sequence of QUAL and QUAN components, Creswell (2003) classifies the mixed methods designs into three types: *triangulation*, *explanatory*, and *exploratory*. In the triangulation mixed methods designs, the investigators are collecting both quantitative and qualitative data, merging the data, and utilizing the results to understand a research problem deeper. The explanatory design consists of collecting quantitative data and collecting qualitative data to explain or elaborate the quantitative results. The emphasis in the explanatory is on *type of theory* (theory-driven). The exploratory design lastly has an opposite sequence consisting of first gathering qualitative data to explore a phenomenon, and then collecting quantitative data to explain a relationship found in the qualitative data. The emphasis in this typology is on *type of data* (data-driven) (Tashakkori and Teddlie, 2003).

The study is developing the explanatory research design (the Quantitative-Qualitative linkages approach) as a research scenario presented in Figure 3.1. By linking up these quantitative and qualitative components, much deeper information emerges from this scientific inquiry than from the same quantity of research merely focusing on singular component. A combination of the major groupings ranging from the general level of qualitative and quantitative distinctions to the specific techniques such as in-depth interviewing, focus groups, telephone (e-mail) surveys, and mail surveys, tends to produce a more accurate multi-faceted depiction of a highly complex real situation (valid, reliable, and practical information).

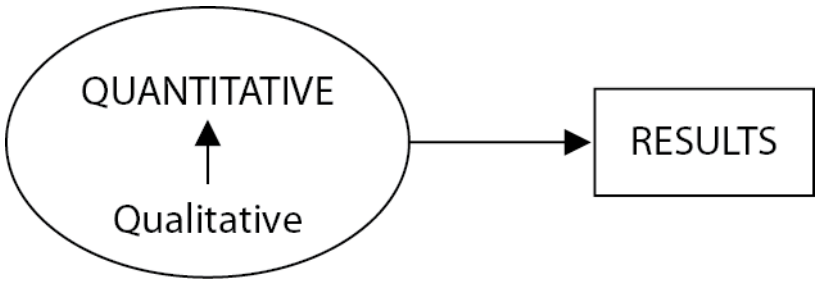


Figure 3.1
Illustration of Research Scenario for Mixed Method Study
Source: Ulin, *et.al.* (1996) cited in Tashakkori and Teddlie (1998).

Thedifferences between these two major categories of research approach are outlined in Table 3.1. According to Latu and Everett (2000), the qualitative research obtains in-depth information from a few cases through in-depth interviews and focus groups. Words and observations are the vehicles used to obtain the qualitative data. Quantitative research, meanwhile, obtains information by using numbers to represent descriptive classifications and direct measurements of attitudes, behaviors, and individual characteristics. In TQM research, this is most typically applied by telephone (e-mail) and/or mail questionnaires.

Table 3.1
Distinctions between Qualitative and Quantitative Research Approaches

	Qualitative	Quantitative
Type of Research	Exploratory	Descriptive/Statistical
Type of Question	Open-ended (probing)	Closed (Fixed options)
Number of Respondents	Few	Many
Analysis	Subjective	Statistical
Interviewer Qualifications	Special skills required	Less need for special skills
Generalization of Results	Very limited	Reasonable

Source: Dutka (1995) in Latu and Everett (2000: 8)

In distinguishing qualitative and quantitative studies, Maanen, *et al.*, (1982, p.32) stated that,

> "Quality is the essential character or nature of something; quantity is the amount. Quality is the what, quantity is the how much. Qualitative refers to the meaning, definition or analogy or model or metaphor, characterizing something, while quantitative assumes the meaning and refers to a measure of it."

The two methods are complementary with individual strengths and weaknesses on each. Once they are combined, their strengths are maximized. An initial qualitative research is helpful in the development of quantitative questionnaires. Following up the quantitative questionnaires with the qualitative research will assist in tidying up loose ends, including exploring uncertainties and new questions arising from the quantitative responses and analyses. It is also possible to combine the quantitative and qualitative methods in a questionnaire where open-ended questions are given with sufficient writing space for comments. However, traditional practitioner fields such as operations and quality management have tended to apply the quantitative approach (Latu and Everett, 2000).

3.3 Research Design and Method

At a broad level, the design of any research is divided into exploratory research and explanatory (conclusive) research. The distinction between the two designs is closely

similar to the classification of qualitative and quantitative research (Creswell, 2003). Heavily depended on qualitative of data, an exploratory research aims at obtaining information that helps researcher to gain an understanding of the extent of the problems to be researched on. In contrast, the explanatory (conclusive) research design uses the existing information, which is found in the literature review to test specific hypotheses and examine certain relationships among studied variables (Creswell, 2003). Apparently, the characteristics of an explanatory (a conclusive) research design fit the design of the current study by formulating several relevant hypotheses and explaining the structural relations among QMPs, WCC, OE, CNFP, and CFP.

This study is theory-driven. By using an explanatory (conclusive) research design, it attempts to develop a model for a comprehensive TQM implementation: empirical evidence from the oil and gas industry in Indonesia. Specifically, the development of TQM implementation model, the combination of questionnaire survey method and open-ended interviews are used to gather evidence for the study. For these reasons it is a suitable research method for a descriptive research design. Survey in a form of mailed and e-mailed questionnaires were, therefore, the chosen research method utilized in this study. Attempting to offer "a snapshot of one point of time" (Cooper and Schindler, 2003, p. 148), the cross-sectional is a more suitable design to characterize the present study.

In discussing an underlying quantitative-deductive (explanatory) research approach inherent in the social and behavioral sciences research, Tashakkori and Teddlie (1998) specify ***dominant-less dominant mixed method designs,*** an experiment (QUANT) conducted in which a theory is tested. In collecting data, a short qualitative interview

(QUAL) may also occur—a QUANT + qual study (Qualitative Methods to Explain Quantitative Methods, see Figure 3.1).

This study applies a ***quantitative-deductive research approach (an explanatory research design).*** Empirical data for the cross sectional study was collected from the oil and gas companies in Indonesia under Directorate of Oil and Gas's contract system and procedure. The survey was administered to every manager (top, middle, low levels) of oil and gas companies at the SBU level.

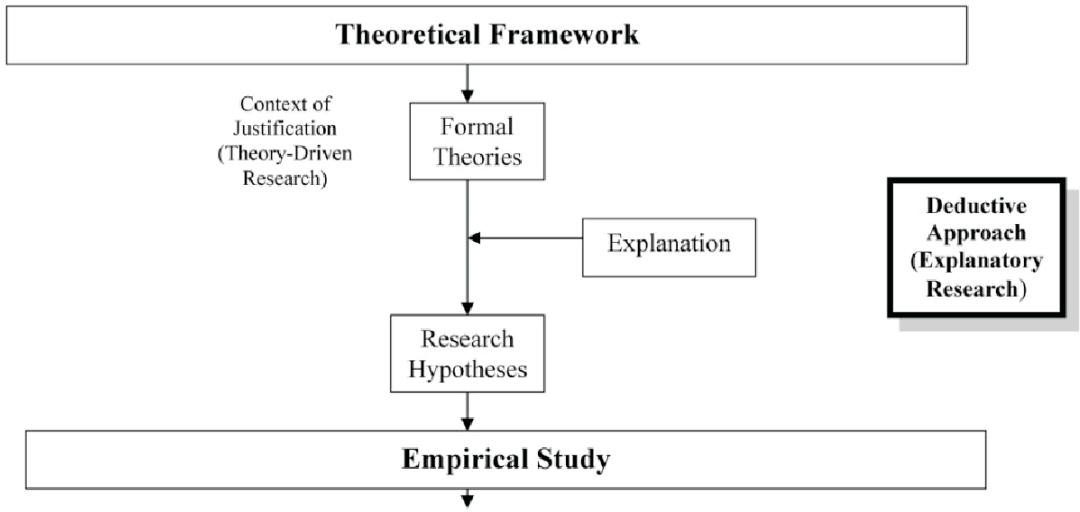
Methodologically, the researcher undertakes a combination of a detailed cross-sectional study (quantitative approach) and in-depth interview (qualitative) approach or mixed methodology to explore the theories of interest to the comprehensive TQM implementation model in a single industry; that is oil and gas industry in Indonesia (as the contextual factor). Tashakkori and Teddlie (2003) argued that unless further qualitative data analysis is undertaken to extend the result of the quantitative data analysis, it is really not able to be considered as a mixed method; rather it is the sequential QUANT-QUAL approach.

Similar with many other researches in operation management, a single industry is chosen for the study (Ahire *et al.,* 1996a and Curkovic *et al.,* 2000). This restriction permits the control of several potential confounding variables that are often different among industries, including the scope and complexity of quality issues. The oil and gas industry was selected now that it has been a leader in implementing progressive quality management strategies in Indonesia (Hakim, 1996). More specifically, the sample of the study was targeted across a 5-digit SIC code (23201-23205) within a specific oil and gas industry—Petroleum refineries, natural gas refineries products of petroleum refineries, lubricating oil, and

processed lubricant oil ("homogeneity of production" and "physical or technological structure") (Foster, 1998).

Figure 3.2 will assist to clarify the present study continuum into a research fit. At a rational pole, the present research approach should consider the following research fit requirements:

a. A theory-driven research (context of justification),
b. Quantitative-deductive tendency,
c. Explanatory (hypothesis testing) and basic study,
d. Entailing a cross-sectional study,
e. Requiring quantitative (a questionnaire survey) and qualitative (unstructured or face-to-face interview) data collections—a QUANT+QUAL study,
f. A more formally structured interview using a questionnaire, and
g. Multiple hypotheses strategy empirical study.



Dimension of the Present Research

PURPOSE FOR STUDY (GOAL OF RESEARCH)	USE OF STUDY	TIME IN STUDY (Time Horizon)	DATA COLLECTION TECHNIQUE and DATA ANALYSIS	SCIENTIFIC RESEARCH STRATEGIC
Explanatory (Hypothesis Testing) - Test a theory's prediction or principle - Elaborate and enrich at theory's explanation - Extend a theory to new issues or topics - Support or refute an explanatin or prediction - Link issues or topics with a general principle - Determine which of several explanation is best - Unit of Analysis: Managers at the Strategic Business Unit (SBU) of oil and gas companies operated in Indonesia	Basic: - The internal logic and rigor of research - Theoretical knowledge contribution	Cross-Sectional (One-shot) Study Attributes: The sample companies were targeted across a 5-digit SIC code (23201-23205) within the oil and gas industry in Indonesia	Quantitative Data: - Survey (Structured Interview/Questionnaire) - A Single Industry - A Multiple Informant Sampling Unit (a stratified random sampling): 1,332 managers - Exploratory Factor Analysis (EFA) - Confirmatory Factor Analysis (CFA) - Measurement and Structural Analyses: SEM	Multiple Hypotheses: - Objectivity - Efficiency A Single Industry: Empirical Study

Figure 3.2
Direction of Research Method and Design of the Study
Sources: Hunt, 1991; Neuman, 2000; and Tashakkori and Teddlie, 1998.

According to Armstrong (1979), three following strategies for a scientific research in management are examined: *advocacy* (one dominant hypothesis), *induction* (no hypothesis), and *multiple hypotheses* (two or more reasonable hypotheses). Advocacy of single dominant hypothesis is efficiency, but biased. Induction is not biased, it is inefficient instead. The multiple hypothesis strategy seems to be both efficient and unbiased. Multiple hypotheses about the impact of the various scientific strategies are purposed in Table 3.2 ranking the objectivity and efficiency of the strategies. The method of multiple hypotheses is used in this study with both high objectivity (rigor and or scientific) and high efficiency expected to be superior to other strategies (Armstrong, 1979).

Table 3.2
Hypothesized Rankings of Scientific Strategies

Strategy	Objectivity	Efficiency
Induction	1	3
Advocacy	3	1
Multiple Hypotheses	1	1

(1 = most preferred ranking)
Source: Armstrong, 1979, p. 424.

Empirical study has consistently been one of the most powerful research methods in operational management, particularly in the development of a new theory enriching both theory and the researchers themselves. Through conducting research in the field and being exposed to the real problems, the creative insights of people at all levels of organization, and the varied contexts of study, an individual researcher will personally benefit from the process of conducting the research (Voss, 1995). A single industry, as the one to be chosen in this research, is a unit of analysis in an empirical study. It is possible to use a different part from the same organization (for instance: SBU) to study the different issues, or to research the same issue in a variety of contexts in the same organization. The most

important contribution of the present investigation (the structural relations) is in the analysis of a sample of companies at the SBUs level from the same industry (a single industry—oil and gas industry). The advantage of concentrating on a single industry is that the SEM of the relations between ten research constructs could be more complete since the unique characteristics of the industry could be included.

3.4 Research Flow

To achieve the objectives of this study, the following quantitative analysis is performed. Quantitative data analysis is made with a measurement analysis (data screening, EFA, CFA), SEM and decomposision of effects in path analysis—empirical evidence from oil and gas industry in Indonesia.

Such combination of the qualitative method to explain quantitative results in a single figure is illustrated in Figure 3.3 presenting a research flow of quantitative research. This figure shows the phases organized into a quantitative research (scheduled from January until June 2005) followed by a qualitative research (scheduled from July until October 2005). The researcher also presents and submits parts of the result of the research model in the management of oil and gas companies in Indonesia and in several international seminars in order to obtain the constructive feedbacks.

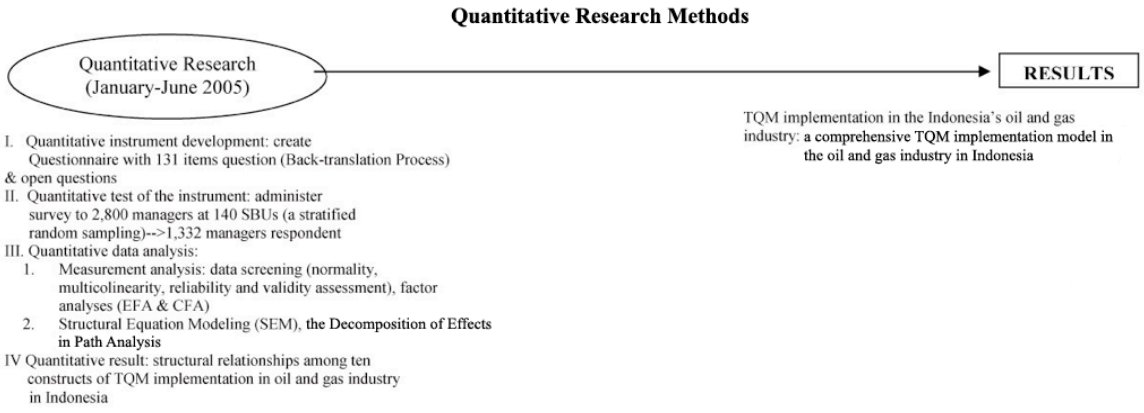


Figure 3.3
Research Flow

3.5 The Key Research Questions

The key research questions are as follow.

1. What are the critical factors of quality management practices that would facilitate TQM implementation model in oil and gas industry in Indonesia?
2. What are the most significant influence of the critical factors of quality management practices to the world-class company practice?
3. What are the most significant influence of the critical factors of quality management practices to the operational excellence practice?
4. How do world-class company practice and company non financial performance mediate the impact of critical factors of quality management practices on company financial performance?
5. How do operational excellence practice and company non financial performance mediate the impact of critical factors of quality management practices on company financial performance?
6. What is the influence of company non financial performance on the company financial performance?

3.6 Hypotheses Development and Research Framework

The research framework of the study (the structural relations between QMPs, WCC, OE, CNFP, and CFP) which identifies a fifteen-stage path analytic model delineating the factors. It is getting involved in sustainability and comprehensive TQM implementation model. This study explores the structural relations among QMPs, WCC, OE, CNFP, and CFP at the SBU level at oil and gas industry in Indonesia.

3.6.1 Hypotheses Development

On the basis of a review of the diffusion of distinctive literatures, the researcher posits three research hypotheses to test the research framework of the study (the proposed structural relations model).

3.6.1a Critical Factors of Quality Management Practices

A set of QMPs is defined in that a limited number of the dimensions of quality management practices – if they are satisfactory – will ensure a successful TQM implementation for an organization (Soliman *et al*., 2001; Rockart, 1982). QMPs are operated using a set of 50 quality management methods that can be explained and summarized by a smaller set of meaningful factors of quality management practices using exploratory factor analysis (Ahire *et al*., 1996a; Saraph *et al.*, 1989; Tamimi, 1995 & 1998). In addition, a set of QMPs is needed to make better improvement efforts and to facilitate successful TQM implementation in an organization. Real improvements will occur in quality performance, and ultimately result in improved non financial and financial performance for the organization (Cokins, 2004).

QMPs have been defined as an approach to management made up of a "set of mutually reinforcing principles, each of which is supported by a set of practices and techniques" (Dean and Bowen, 1994), which has achieved discriminant validity with respect to other strategies for improving the organization's performance (Hackman and Wageman, 1995 cited in Molina *et al*., 2007). According to Hoskinsson *et al.* (1999) cited in Molina *et al.* (2007), studies of strategic management explain an improvement in the firm's performance along two lines: (a) the classic studies of the industrial economy, which believe that improvement in a performance comes from better positioning of the firm, that is, from finding an environment that favors the firm; and (b) the vision of resources and capacities, which believes that the firm should focus on improving its contextual factors (i.e. knowledge and abilities about WCC and OE) to improve its performance (CNFP and CFP).

The link between QMPs and company performance is thus based on management of internal/contextual factors, since the improvement is achieved by implementing the principles and elements of quality management practices within the firm (Chiles and Choi, 2000). To determine the degree to which QMPs have been implemented in the oil and gas industry in Indonesia, the researcher developed the proposed structural relations model of the study.

3.6.1b The Proposed Structural Relation Model

Various empirical researches were involved in developing the impact of QMPs on overall company performance, and have reported the mixed results (Gale, 1994). This may suggest that the achievement of CFP from QMPs is related to a complex relations between the contextual factors of organization and market variables (Maiga and Jacobs, 2005). The adaptation of QMPs in the contextual factors of the organization has attracted the attention

of numerous authors. The literature has discussed such contextual issues as the need for establishing sustainability and comprehensive TQM implementation model.

The characteristic of sustainability and comprehensive TQM implementation encourages organizations to address quality on a broad range of contextual issues (i.e., WCC, OE, CNFP, and CFP) (Bou-Llusar *et al*. 2009). In addition, sustainability and comprehensive TQM implementation model (the proposed structural relations model) could be applied to test instrument validation and modify instrument for more rigorous statistical analysis.

The structural relations can be characterized in many ways. In this study, the researcher described the structural relations in SEM. SEM in turn enables the researcher to examine structural relations among variables (six independent variables—QMPs, three mediating variables—WCC, OE, and CNFP, and one dependent variable—CFP) in a way (simultaneously) that many other techniques cannot (Hair *et al.*, 2006). Mediation is one of two of the common types of relationships, besides moderation.

3.6.1c Mediation Relationships

Wright and Geroy (2001) argue that world-class performance in operations is derived from a complex set of interacting practices between WCC and OE—the contextual factors of oil and gas companies. The term WCC is used since the firms are associated with an outstanding performance in the global business environment. Parker (1999) defines OE as a systematic management of safety, environment, health, reliability, and efficiency (SEHRE) while achieving a world-class standard. Implementing WCC and OE require QMPs (Parker, 1999). The leveraging of world-class performance in operations (WCC and OE), much as the leveraging of CNFP, results in a reduction in overall costs, allowing the firm to be more

competitive in price and accordingly more sustainable competitive advantage (Reed *et al.*, 2000). Companies capable of minimizing overall costs potentially are able to efficiently provide customers with its market offerings, thus maximizing returns to the firm. As previously mentioned, CNFP is a leading indicator of CFP (Ittner and Larcker, 1998).

According to Hakim (1996), the companies in the oil and gas industry should handle hazardous fluids and gases through a variety of processes. Considerations in safety and security of the personnel (both staff and public), environment protection and business continuity may require a high level of operational integrity. A specific guidance of operational integration practices across the industry's total value-chain (upstream and downstream) contains a valuable new technical specification. It aims at the development of QMS providing a continual process improvement, emphasizing on defect prevention and the reduction of variation and waste in the supply-chain and from service providers or demand-chain, and incorporating the world-class standards/requirements to the international oil and gas industry (API, 2003).

This view is supported in the explanation of Antill and Arnott (2002) saying: "It has been argued that operational integration increases a company's ability to gain access to information across the industry's total value chain making it easier to assess both internal and external opportunities. A fully integrated chain might also give rise to greater opportunities for cost saving and may enable a company to optimize capacity in all areas of its operations. However, one good reason to justify operational integration is to strengthen the firm's sustainable competitive advantage position. Indeed it is for this reason that oil and gas industry has historically had the urge to integrate."

The ultimate goal of the operational integration implementation in oil and gas industry is to obtain worldwide acceptance by developing an integration among QMPs, OE, WCC, and company performance—CNFP and CFP (API, 2003). By doing so the researcher theorizes the positive relations between QMPs and CFP through the mediating variables (partial mediation) of WCC, OE, and CNFP.

Adapting Demirbag *et al.*'s (2006) and Molina's (2007) studies, the mediating role of world-class performance in operations (WCC, OE, and CNFP) among QMPs will be found to be only partial (partial mediation). In fact, the mediation role could be full (complete) as well. In the present study, one of the objectives is to explore the mediating role (partial mediation) of WCC, OE, and CNFP between QMPs and CFP.

In this study, a multi-informant sampling unit (three different levels of managers—top, middle, and low) is used to ensure a balanced view of the structural relations among the research constructs. The literature of TQM widely accepts that the success of TQM implementation is guaranteed when the responsiveness for quality is extended throughout all levels of managers' abilities in the organization. For this reason, the different levels of managers are given totally greater consideration during the implementation of TQM (including the contribution of the hierarchical level of managers' abilities in evaluating the results of the structural relations between QMPs and CFP). The managers' evaluation (confirmation) in terms of the results of the structural relations between QMPs and CFP is very useful to capture most of the important aspects of an effective TQM implementation (Motwani, 2001).

According to Katz (1974), the major contribution of the hierarchical level of managers' abilities is how to make decisions (policies) for organization. Katz also finds that the relative importance of three essential skills or abilities (technical, interpersonal, and conceptual) vary according to the manager's level. Top level managers' abilities are deemed the most capable of making significant decisions or policies because of their broad sources of power and influence (conceptual skills, more autonomy). Conversely, lower level managers' abilities find it more difficult of making significant decisions or policies in the organizational system because of bureaucratic control processes (technical skills, lack of autonomy). Therefore, the researcher expects that the three levels of managers have a specific recommendation (confirmation) in evaluating the results of the quantitative data analyses of the study.

Following the above statements, the study posits six hypotheses:

H1 : Fifty items related to TQM implementation could be extracted (classified) into a set of critical factors of quality management practices.

H2a-f : All critical factors of quality management practices have strong positive impacts on world-class company practice.

H3a-f : All critical factors of quality management practices have strong positive impacts on operational excellence practice.

H4a-f : World-class company practice and company non financial performance partially mediate the impact of critical factors of quality management practices on company financial performance.

H5a-f : Operational excellence practice and company non financial performance partially mediate the impact of critical factors of quality management practices on company financial performance.

H6 : Company non financial performance has a strong positive impact on company financial performance.

3.6.2 Research Framework

Researchers like Ettlie (1983); Ettlie, *et al.* (1984); and Kamm (1987) suggest two possible approaches of the association model between the dimensions of a company innovation/improvement strategy and company performance (Zahra and Das, 1993). First, innovation/improvement strategy dimensions are assumed to influence a company performance directly and simultaneously (a simultaneous model of innovation/improvement strategy—company performance links). The second approach suggests a logical sequence between innovation/improvement strategy variables and its contextual factors (a sequential model of innovation/improvement strategy—company performance links). Hence, the associations between certain innovation/improvement strategy dimensions and company performance may be indirect; that is, the effect of one dimension may be mediated by the influence of other dimensions (contextual factors).

This study posits a logical sequence of sustainability of TQM implementation program among the six improvement strategy dimensions (six QMPs), reflecting an ordered set of structural relations among QMPs (as independent variables), WCC, OE, CNFP—as mediating variables, CFP (dependent variable). Certain choices (e.g., QMPs—as independent variables) must precede others (e.g., WCC and OE—as mediating variables). The sequential model also acknowledges a potential indirect influence of QMPs on CNFP (a mediating variable). Even though a variable may not influence CNFP directly, it may still influence other important dimensions that, in turn, affect CNFP. This occurs due to the

improvement strategy dimensions (QMPs) may depend on one another, as depicted in Figure 3.4.

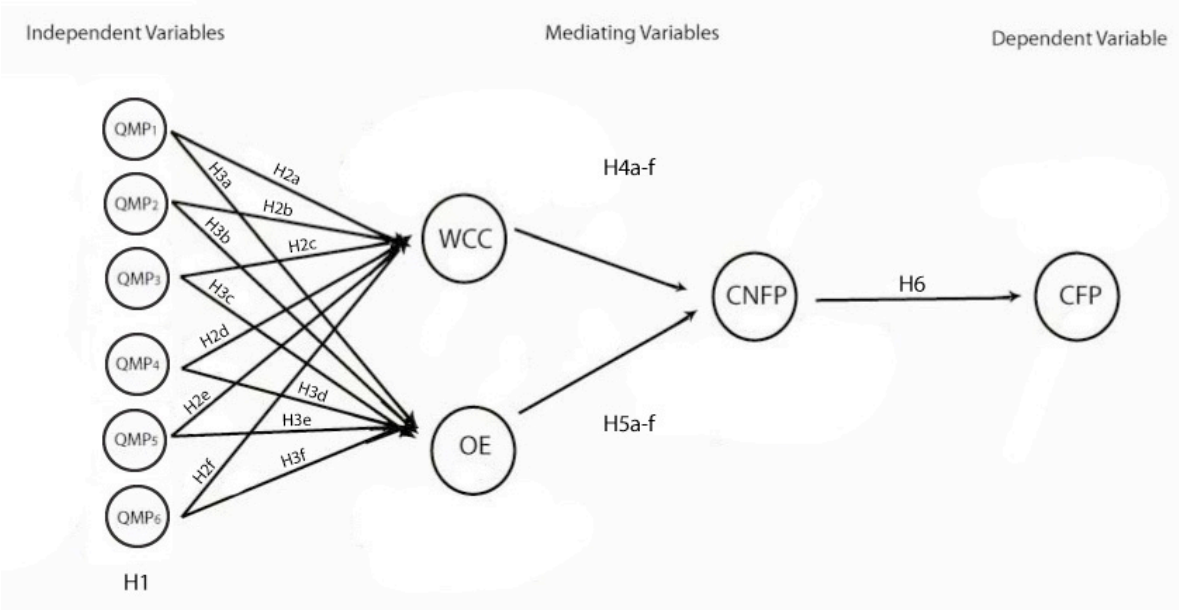
To describe the logical framework of the sequential models of this study, the researcher follows the sequences which have already been used by Zahra and Das's study. Figure 3.4 shows the sequential models and the hypothesized order of structural relations among the dimensions of improvement strategy or TQM implementation. The rationale for sequencing the variables in the order shown is based on theory. The logical starting point in Figure 3.4 is the oil and gas company choice to its intended QMPs. The firm makes this choice based on its chosen external environment, appropriate contextual factors (WCC and OE), and the balance scorecard of company performance—its CNFP and CFP.

Three main types of variables (1 observed/dependent variable, 9 latent constructs—6 independent variables, 3 mediating variables) are illustrated in this integrative research framework. *First*, the dependent variable (observed variable) is a CFP. *Second*, six QMPs are the independent variables, which influence the dependent variable either in a positive or in a negative way. *Third*, the research framework has three mediating variables: WCC, OE, and CNFP. Mediation here means that there are intervening variables or mediators on which variation in the dependent variable (sharing) depends on.

The hypothesized overall structural relations model is portrayed in Figure 3.4 in terms of EQS notation presenting a typical covariance structure model. It is important to recognize that Figure 3.4 is evaluating a series (a sequential) of structural relations between QMPs and CFP through some mediating variables (WCC, OE, and CNFP). The analyses of this structure are best accomplished by the combination among *factor analysis* (EFA and CFA),

and SEM. Factor analysis was used to assess both convergence and discriminant construct validity.

The subsequent analyses for testing overall model and developed hypotheses utilize SEM by operating AMOS program. The objectives of the tests are to asses the goodness-of-fit between the model and the sample data, and to identify the decomposition of effects into direct and indirect components (Byrne, 2001; Alwin and Hauser, 1975). In addition to the lack of empirical research related to these interrelationships among ten constructs, this study is unique in that the objectives are merely investigated within a singular oil and gas industry setting (a single industry).



Note:

- QMPs: Quality Management Practices
- OE: Operational Excellence Practice
- WCC: World-class company practice
- CNFP: Company Non Financial Performance
- CFP: Company Financial Performance

Figure 3.4
The Proposed Structural Relations Model

The proposed structural relations model of the study develops the previous studies by Maiga and Jacobs (2005) and Demirbag *et al*. (2006). Maiga and Jacobs investigate: (1) the influence of management control systems (i.e., quality goal, quality feedback, and quality incentives) on quality performance; (2) the influence of quality performance on both customer satisfaction (non financial performance) and financial performance; and (3) the impact of customer satifaction on financial performance at the business unit level. They use a structural equation modeling to find out the strength of the relations among management control system (MCS), quality improvement, customer satisfaction, and financial performance of manufacturing business units that have adopted TQM. The overall theoretical framework is illustrated in Figure 3.5.

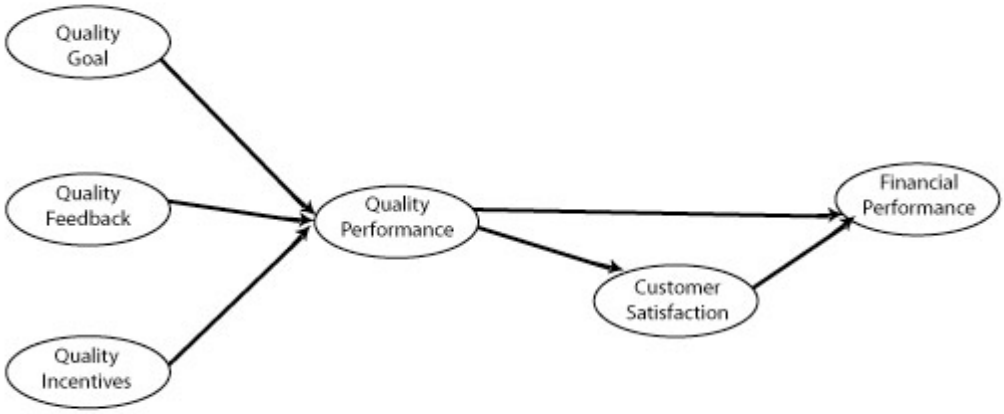


Figure 3.5
The Effect of Quality Performance on Both Customer Satisfaction and Financial Performance
Source: Maiga and Jacobs, 2005

Demirbag *et al.* (2006) meanwhile investigate the relationship between the implementation of TQM practices and organizational performance in small and medium enterprises (SMEs). *First*, they examine the relations between the critical factors of TQM and their effect on both non financial performance and financial performance. *Second*, they investigate to what extent non financial performance mediates the relationship between TQM practices (TQM_{1-6}) and financial performance. SEM was employed to investigate the structural relationships between the implementation of TQM practices and organizational performance. The structural relations between TQM practices and financial performance with a mediation of non financial performanace is illustrated in Figure 3.6.

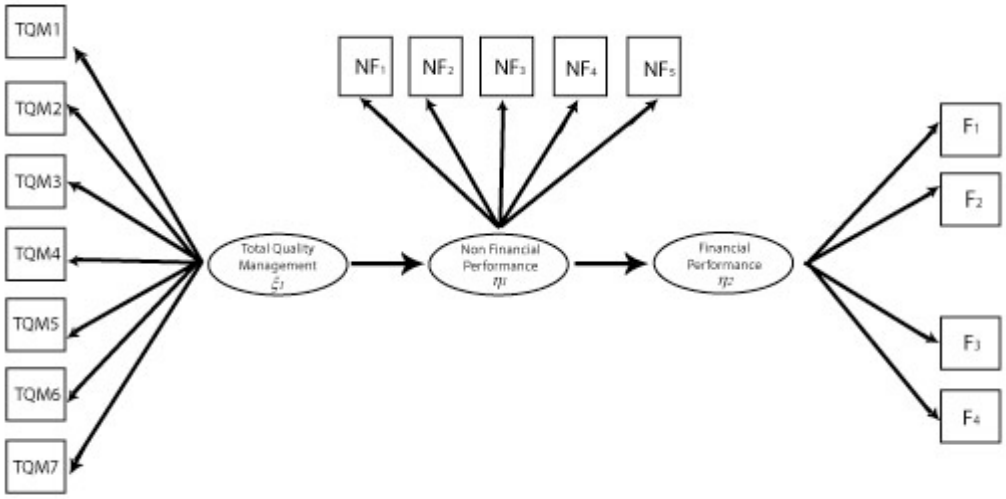


Figure 3.6
The Structural Relations between TQM Practices and Financial Performance with a Mediation of Non Financial Performance
Source: Demirbag *et al.* (2006)

3.7 Research Instrumentation

In general, a research is a methodical process in obtaining information and solving specific problems by particularly examining the relationships among certain variables. At the theoretical level, variables are known as the constructs of which they can not be observed and the meanings are conceptualized for a given context depending on the purpose of the research. At the empirical level, a variable is a property being studied and used to test hypotheses established at the early stage of research (Cooper and Schindler, 2003).

The researcher has developed a research framework of the study (the structural relationships model) that illustrates how QMPs affect CFP through three mediating constructs of WCC, OE, and CNFP.

3.7.1. Measurement of Constructs

The structural relations model previously presented in Figure 3.4 suggests the sequential relations among ten constructs including the dependent variable CFP, the independent variables (six QMPs) the mediating variables (WCC, OE, and CNFP). The constructs of this structural relations model are functioned as follows.

3.7.1a Independent Variables (Six QMPs)

Six QMPs are applied by using a set of 50 items of *quality management method* (qmm1-50). These fifty quality management methods (QMMs) can be extracted (classified) by six of meaningful dimensions of six QMPs using exploratory factor analysis—quality improvement program (QMP1), supervisory leadership (QMP2), supplier involvement (QMP3), top management commitment (QMP4), training to improve products/services (QMP5), and cross functional team relationships among strategic business units (QMP6). Fifty quality management methods are developed to measure Deming's 14 points based on a thorough literature review focused on the writings of Ahire *et al*. (1996a), Saraph *et al.* (1989), Tamimi (1995 and 1998).

3.7.1b Mediating Variables (World-Class Performance in Operations: WCC, OE, and CNFP)

A mediating variable is an element postulated to be a determinant of one or more dependent variables, and concurrently functioned as a consequence of one or more independent variables. In essence, a mediating variable explains the extent to which "it accounts for the relation between the predictor and the criterion" (Baron and Kenny, 1986, p.1176). In the case of the relations between six QMPs (as independent variables) and CFP (as a dependent variable), the review of relevant literature and contextual factors in the oil and gas industry

(i.e. world-class performance in operations) have revealed that WCC, OE, and CNFP can be the mediating variables that links these two variables.

This study employed world-class performance in operations for the mediating construct. Wright and Geroy (2001) argue that world-class performance in operations is derived from a complex set of interacting practices between WCC and OE—the contextual factors of oil and gas companies. In developing world-class performance in operations, the managers consider that most of SBUs in the Indonesia's oil and gas industry are cost centers. They rely much on non-financial performance. In addition, if a non financial performance is excellent, it may be sufficient to gain better financial performance and to lead to business success. According to Ittner and Larcker (1998), non-financial measures are leading indicators of financial performance. Moreover, non financial performance becomes key business processes such as quality of product and service offerings, delivery of product and service offerings, variety of products and service offerings, customer satisfaction, employee satisfaction, community involvement. "Generally, non financial performance has no any intrinsic value for company directors. Rather, this non financial performance can be used as a leading indicator of financial performance and, specially, future financial performance that is not contained in contemporary accounting measures" (Prieto and Revilla, 2006, p. 171)—the linkage between CNFP and CFP.

Oil and gas managers that wish to compete in the world-class competition must produce evidence of leadership and commitment, initiate verifiable cross-functional communications, address the happiness and well-being of the workforces through better non-financial performances, and, above all, work toward their sustainable competitive advantage achievement—"from TQM to corporate sustainability based on a stakeholder

management" (Zink, 2007, p. 394). According to Prajogo and Sohal (2004), sustainability of TQM implementation needs to be implemented and aligned with the company's business strategy. Also, organizations need to simultaneously pursue several multiple aspects of performance, including quality and innovation.

World-Class Company Practice (WCC) is applied by using sixty seven Hayes and Wheelwright dimensions. Hayes and Wheelwright (1984) developed their concept of world-class manufacturing based on six principles. Specifically, a confirmatory factor analysis is employed to determine whether Hayes and Wheelwright's 67 dimensions possess a positive and significant effect on the six principles of Hayes and Wheelwright. The study develops a second-order confirmatory factor analysis to test whether a set of Hayes and Wheelwright principles lands on an overall construct that may be termed as a WCC. The measure is developed by Flynn *et al*. (1999). The term of WCC is applied since these firms are associated with an outstanding performance in the global oil and gas industry.

Operational Excellence Practice (OE) is applied by using five dimensions of operational excellence practices in oil and gas industry—safety, environment, health, reliability, and efficiency. The measures are adapted from Parker (1999) and Chevron Texaco's program (2003). It is the policy of Chevron-Texaco Corporation to protect the safety and health of people and the environment, and to conduct the operations reliably and efficiently. The systematic management of safety, environment, health, reliability, and efficiency to achieve world-class performance is defined as an OE.

Company Non-Financial Performance (CNFP) is applied as an ability of a company to increase its financial performance by increasing its non financial performance. The measures are adapted from Carpenter and Sanders, 2007; Cook and Verma 2002; and Demirbag *et al*., 2006. CNFP consists of six items (product/service quality enhancement, delivery performance, delivery of product/service, customer satisfaction, employee satisfaction, and community development impacts). These non financial measures can be better indicators of future financial performance. By implementing non-financial measures, oil and gas managers can communicate its vision and mission and provide incentives for managers in achieving profitability, competitive strength, and longer-term strategic goals (Knowledge@wharton, 2000).

3.7.1c Dependent Variable (Company Financial Performance)

Company financial performance (CFP) or monetary-gain performance consists of three items (profit, market-share enhancement, and cost reduction). The measures are adapted from Carpenter and Sanders, 2007; Cook and Verma 2002; and Demirbag *et al*., 2006. Financial measures generally focus on a short-term performance against financial/accounting data. Richardson *et al.* (2002) argued that although improvements in financial performance is critical to many organizations, firms may also regard paying attention to the significance of non financial performance factors. Banker *et al.* (2000) reported that few studies have addressed a correlation between non financial and financial performance (Dunk, 2005). Hence, this study develops a linkage between non financial and financial performance as an integral part of the structural relations between QMP and CFP.

As the financial and non-financial data in this study were collected from oil and gas managers on the basis of their subjective evaluations (perceptions), objective financial and

non-financial performance indicators were not employed in the analysis. Overall financial and non financial performances were measured subjectively. Subjective performance measures are widely accepted in organizational research (Lawrence and Lorsch, 1967; Dess, 1987; Powell, 1992 cited in Powell, 1995). This research included 47 privately-held oil and gas firms that would not have provided confidential financial information as a matter of policy. Table 3.3 summarizes the definitions of all ten latent variables measured in this study, their procedures, and the corresponding support in the literatures.

Table 3.3
Definition and Operationalization of Variables

Variable	Definition	Operationalization	Support in the Literature
Critical Factors of Quality Management Practices	Six of meaningful dimensions of *quality management practices* or six QMPs—quality improvement program **(QMP1)**, supervisory leadership **(QMP2)**, supplier involvement **(QMP3)**, top management commitment **(QMP4)**, training to improve products/services **(QMP5)**, and cross functional team relationships among strategic business units **(QMP6)**.	A fifty item asking top, middle, and low levels of managers from not at all true to completely true that characterize their implementations of Deming's 50 quality management methods.	Deming (1982), Ahire *et al.* (1996a), Saraph *et al.* (1989), Tamimi (1995 and 1998).
World-Class Company Practice	Six dimensions of world-class company **(WCC)**: HWP1: workforce skills and capabilities; HWP2:management technical competence; HWP3:competing through quality; HWP4:workforce participation; HWP5: rebuilding manufacturing engineering; HWP6: incremental improvement approaches	A sixty seven item asking top, middle, and low levels of managers from not at all true to completely true that characterizes their implementation of Hayes and Wheelwright's 67 principles.	Hayes and Wheelwright (1984), Flynn *et al*., 1999
Operational Excellence Practice	Five dimensions of operational excellence practices in oil and gas industry—**s**afety, **e**nvironment, **h**ealth, **r**eliability, and **e**fficiency –**SEHRE (OE).**	Five item measuring top, middle, and low levels of managers' perception on the five dimensions of operational excellence practices from poor to excellence.	Parker (1999) and Chevron Texaco's program (2003).
Company Non Financial Performance	Company non financial performance (value-gain performance) consists of six items (product/service quality enhancement, delivery performance, customer and employee satisfaction, and community development impacts)—**CNFP**.	Six item measuring top, middle, and low levels of managers' perception on the six items of company non financial performance.	Carpenter and Sanders (2007); Cook and Verma 2002; and Demirbag *et al*., 2006.
Company Financial Performance	Company financial performance (monetary-gain performance) consists of three items (profit, market-share enhancement, and cost reduction)—**CFP.**	Three item measuring top, middle, and low levels of managers' perception on the three items of company financial performance.	Carpenter and Sanders (2007); Cook and Verma 2002; and Demirbag *et al*., 2006.

(See Appendix I: Measurement Items of Research Instruments)

3.7.2 Questionnaire

A survey instrument to measure the proposed constructs was developed by questionnaire to examine the underlying factors that may contribute to the perception of the managers towards the implementation of TQM in oil and gas industry in Indonesia (quantitative research). A five-point Likert scale was used to measure each item in the questionnaires with some of the items being reverse-coded. To test the survey instrument, the questionnaires were pre-tested in a pilot test by distinguishing them to different levels of oil and gas managers via email. The feedback was used to amend the questionnaire before distributing it via mail survey, internet survey, and face-to face survey to respondents from oil and gas companies in Indonesia.

The questionnaire contains five broad types of questions (Appendix II and Appendix III). The first section required the managers at the SBU level to respond to a set of fifty quality management practices synthesized from Deming's philosophy of their establishments on a five-point interval scale (1 = not at all true; 2 = slightly true; 3 = somewhat true; 4 = mostly true; and 5 = completely true). The second section contained a series of questions measuring WCC on five-point scale. The third section required the managers to rate their relative safety, environmental, health, reliability, and efficiency as the dimensions of OE; also on five-point scale. Sections four and five contained the company performance dimensions (company financial or monetary-gain performance and company non financial or value-gain performance). The section on CFP contained three questions related to the financial performance, market performance, and operating cost performance in oil and gas companies at the SBU level on a five-point interval scale (1 = poor; 2 = below average; 3 = average; 4 = very good; and 5 = excellent). The section on company non financial performance contained six questions related to quality of product and service, delivery of

product and service, variety of product and service offered in oil and gas companies at the SBU level, customer satisfaction, employee satisfaction, and community involvement.

The researcher adopted an original version of the questionnaires (in English, see Appendix II) from the previous studies and then translated it into Indonesian language (see Appendix III) by using the back-translation method, so there is no any inconsistency in this case (Brislin, 1986). During the translation process, the wording of some items was adapted to achieve the closest equivalence meaning in Indonesian language. Each manager completed the questionnaire and provided feedback regarding the wording of items, their understandability, and the overall organization of the instrument. The measurement instrument was adjusted accordingly based on their feedback. Participants answered using a five-point *Likert-type* scale ranging from ***not at all true*** to ***completely true*** and from ***poor*** to ***excellent***. The second version of the questionnaire in Indonesian language was used in the survey.

In this study, multi-item scales furthermore are applied to collect data on most of the research constructs. Simplicity in scoring is sought by using a balanced five-point *Likert-type* scale that is easy to master. Likert scale is a scale used in which respondents indicate the extent of their agreement or disagreement with statements of moderate attitudinal intensity (Jaques, 1990 cited in Pollock, 2002). Basically, each respondent is required to indicate the extent to which he/she disagreed or agreed with the statement provided, such that 1 = strongly disagree and 5 = strongly agree (see Table 3.4).

Table 3.4
Some Likert

	Scale Type	
Value	**Satisfaction**	**Agree/Disgreee**
5	Very satisfied	Strongly agree
4	Satisfied	Agree
3	Neutral	Neutral
2	Dissatisfied	Disagree
1	Very dissatisfied	Strongly disagree
0		Don't know/not applicable

Source: Pollock, 2002; p. 237

3.8 Sampling Method

Sampling refers to the information regarding the characteristics of the population under study. Hence, descriptions of the samples, sample size, and sampling unit are presented below.

3.8.1 Sample

The samples of this study were obtained from oil and gas managers (top, middle, and low levels of managers) in an individual SBU level. Oil and gas managers were selected here because in oil and gas industry, the corporate managers delegate the managers in SBUs to implement for most quality management programs. Furthermore, many studies have shown (Saraph *et al*. 1989; Curkovic, 2000) that quality investments vary between plants or SBUs within the same firm, indicating that a more aggregated unit of analysis.

3.8.2 Sample Size

An analysis using SEM generally expects a sample size that ranges from 150 to 200. However, a large sample size (i.e., more than 1,000) is more preferable as the larger sample

is, the easier the structural relations model to converge properly or achieve accurate solution (Anderson and Garbing, 1988). One rule of thumb is to allow at least five respondents for each parameter estimate if other multivariate assumptions are met (Bentler & Chou, 1987). In this study, the total number of parameter estimates (items) is 141 (131 items of close questions with a five-point Likert scale and 10 items of open questions), and in order to follow Bentler and Chou's standard, the minimum sample should be 705 (141 x 5).

3.8.3 Sampling Unit

Sampling unit concerns with the source of sample gathered. In this study, the samples are from three different levels of oil and gas managers (top, middle, and low levels of managers) at the SBUs working in oil and gas companies in Indonesia.

3.9. Data Collection Process and Pilot Test

3.9.1. Data Collection Process for Quantitative Research

The survey method was administered to every level of management (top, middle, and low levels of managers) at each SBU. The researcher obtained the cooperation from the Directorate General of Oil and Gas of Republic of Indonesia to send a letter to the fifty five oil and gas contractor companies requesting the SBUs to participate in the study (49 companies participated in this study consist of 140 SBUs and 6 companies declined to participate). Each SBU received twenty copies of the survey instrument. The covering letter explained the purposes of the study and offered the respondents a copy of the results in exchange for their co-operation.

The surveys and data for testing the research hypotheses were collected for six months (January-June 2005) and couriered by the researcher for analysis through, traditional postal questionnaire (mail) surveys, internet or questionnaire e-mailed/web surveys, and face-to face surveys to distribute and to complete the questionnaires directly at a single point in time.

Empirical data for this study were collected from oil and gas companies of the integrated oil and gas industry in Indonesia (based on the new law of oil and gas number 22/2001 of the Republic of Indonesia consists of seven group companies); containing 49 oil and gas companies and 140 SBUs. Forty seven of which are privately owned and two of which are in the public sector (state owned) companies. The SBU is the level of implementation for most quality management programs (Hakim, 1996). Furthermore, studies have shown (e.g. Saraph *et al*., 1989 cited in Curkovic, 2000) that quality investments vary between plants or SBUs within the same firm, indicating that a more aggregated unit of analysis would likely obscure the important differences (Curkovic, 2000).

From 1,478 questionnaires obtained in the fieldwork, 146 questionnaires were not usable due to the incomplete information. It means that a total of 1,332 individual usable questionnaires were returned and made it qualified for analysis for representing an effective response rate of 50.19 percent. Of these, 354 were from top level managers, 447 from middle level managers, and 531 from low level managers.

3.9.2 Pilot Test

To determine whether the measurements developed for this study posse the level of reliability, which is accepted in the literature, a pilot study was administered to managers of

oil and gas companies at the SBUs in Indonesia. Thirty questionnaires were personally handed over to five SBUs, amounting to one hundred and fifty questionnaires in total. Through the attached cover letter, the respondents were requested to complete the questionnaires and return them to the researcher within three weeks. A week after the submission of questionnaires, the researcher was reminded by phone calls of the forthcoming collection of the completed questionnaire. For a response rate of 52%, a total of 78 completed questionnaires were personally retrieved by the end of week three.

According to Nunnally (1978), Cronbach's Alpha is a superior estimate of internal consistency of measures. A value that ranges from 0.5 to 0.6 is considered to be sufficient in early stages of research. The lowest value of Cronbach's Alpha is 0.7218 (OE) while the highest is 0.9661 (WCC). None of the instrument subscales indicates any value below the threshold level. Overall, the pilot test had confirmed that all instruments that were used for this study had achieved an adequate level of reliability.

Another measure to establish reliability is by inspecting the correlated item-to-total correlations of each measurement scale that provide information on the degree of correlations among indicators of the same scale. Item with a value less than 0.25 is considered very weak and plays very little role in conceptualizing the given factor (Nunnally, 1978). No item is found to be correlating very low with respective factors (the correlated item-to total correlations were ≥ 0.3898). Taking this reason into account, all items were kept to the final sample.

In order to perform a bivariate correlation analysis, the analyzed samples have to be equal. Hence, 39 subjects were randomly selected from the portion in the first manager sample to

match with the 39 subjects in the second manager sample. The first managers' responses on the research questionnaire were then correlated with the second managers' ones. The correlation between the first managers' responses and the second manager's ones is significant ($p<.05$) with Pearson Correlation value of above 0.4.

3.10 Data Analysis Method Used

This study used both types of data analysis method—quantitative and qualitative data analyses at two stages. The researcher performed an EFA with a *varimax* rotation to determine several underlying QMPs. Then, the researcher also evaluated the measurement models of WCC, OE, CNFP, and CFP by using a second-order CFA. The researcher measures the impact of QMPs on CFP through the mediating variables of WCC, OE, and CNFP by using SEM. For the third step of quantitative data analyses, the researcher applied the decomposition of effects in path analysis to determine whether WCC, OE, and CNFP partially mediate the impact of QMPs on CFP. The flow of data analysis can be drawn in the following Figure 3.7.

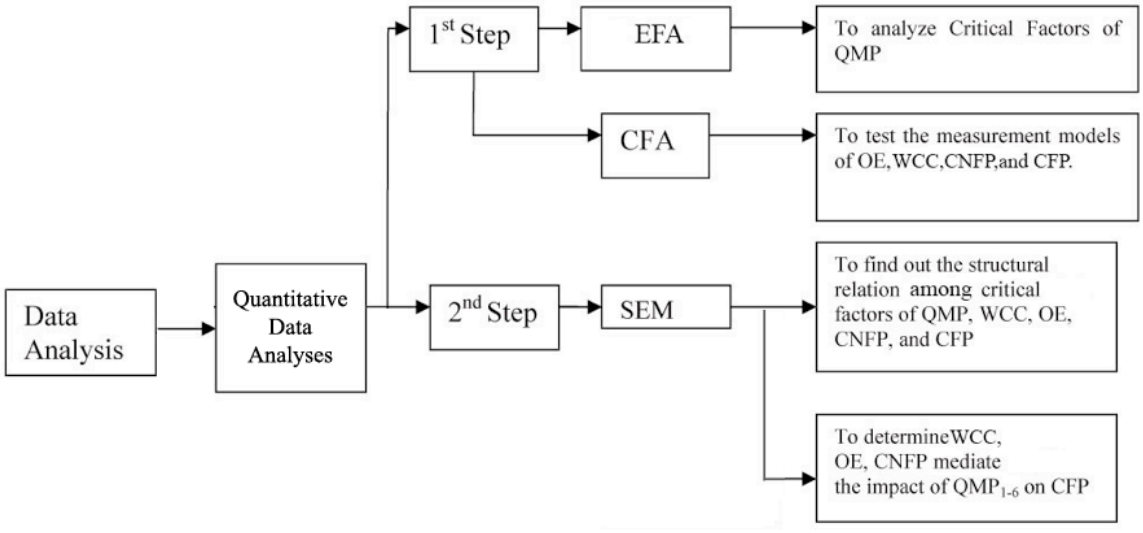


Figure 3.7
The Flow of Data Analysis

3.11 Quantitative Data Analysis Procedures

1. Scale Purification

Six hypotheses (H_1-H_6) have been established to achieve the stated objectives in this study. Before testing hypotheses, the utilized instruments were required to undergo scale purification process, which involves examination of Cronbach's Alpha and item-to-total correlations (Churchill, 1979). Cronbach's Alpha is measure to gauges the extent to which an internal consistency exits among the indicators within the same factor while item-to-total correlations refer to a correlation of indicators with their own respective factors (Hair *et al*., 2006). Churchill's method of such scale purification process is found to be a common practice in many empirical studies. In addition to the assessment of the Cronbach's Alpha and item-to-total correlations, Hair *et a*l. (2006) suggest the purification of scales also to be conducted based on the result evaluation of EFA.

2. Multivariate Assumptions

The first step in a statistics analysis (a multivariate analysis) is to explore the data characteristics since it is frequently useful to be able to conduct normality, outliers, linearity, homoscedasticity; and multicollinearity tests. Analysis itself lies on subsets of the data and aims to make some conditional transformations of variable (Coakes *et al.*, 2009). These afterward could be achieved by using the normality, outliers, linearity, homoscedasticity; and multicollinearity assumptions and practical considerations underlying the application of *principle axis factoring* (PAF) and *principle components* (PC).

a. Assessing Normality, Outliers, Linearity, and Homoscedasticity

Normality is used to describe a symmetrical and bell-shaped curve. The highest score frequency is depicted in the middle with lower frequencies towards the extremes (Gravetter and Wallnau, 2000). In SEM the most employed techniques for estimating models assume univariate and multivariate normality (Ullman, 2006). Normality (univariate and multivariate) can be determined by assessing the variable level of skewness and kurtosis. A skewness value above 3 and kurtosis value above 10 are indicative that depart from normality (Kline, 1998). Curran *et al.* (1996) recommend concern if skewness > 2 and kurtosis >7. Hair *et al.* (2006) and Harlow (1985) recommend if variables have univariate skewnesses and kurtoses in the range of -0.5 < skewness < +0.5 and -1.0 < kurtosis < 8.0 can be attributed to normality. In AMOS (SEM software), only Mardia's coefficient of multivariate kurtosis and its critical ratio are available (Gao *et al.*, 2008). From the AMOS output, the Mardia coefficient of multivariate kurtosis indicated that the SEM models in this research did not deviate from multivariate normality values below the critical value of ± 1.96. Factor analysis is steadily related to the assumptions of normality. However, if variables are normally distributed, the solution is enhanced afterward (Coakes *et al.*, 2009).

Outliers are cases that have out-of-range values compared to the majority of other cases. A presence of outliers in the data may distort the statistical test results (Tabachnick and Fidell, 2007). Furthermore outliers can be detected from the the distribution of standardized residuals.. According to Hair *et al*. (2006), cases with standardized residuals of greater than $\left|2.58\right|$ are considered as outliers. Typically, standardized residuals less than $\left|2.58\right|$ do not suggest a problem. Standardized residuals between $\left|2.58\right|$ and $\left|4.0\right|$ deserve some attention, but may not suggest any changes to the model if no other problems are associated

with observed covariance terms and fitted covariance terms. However, a few outliers in large samples are common and most of the time, taking any action is not necessary.

Another important assumption is that a relationship between independent and dependent variables is linear and should exhibit homoscedasticity. The violation of these assumptions will underestimate the extent of the correlation between these two variables and this will result a degradation of analysis (Tabachnick and Fidell, 2007). Linearity is assumed when the residuals have a straight-line relationship with the dependent variable scores, and the homoscedasticity exists when the presence of dots is dispersed throughout the scatter plots. Hetercedasticity, the opposite of homoscedasticity will exist if the dispersion is unequal whereby the dots are widespread across the graph. The examination of these assumptions can be performed by conducting partial regression plots and regression standardized residuals (Hair *et al*, 2006).

b. Assessing Multicollinearity

Multicollinearity refers to high intercorrelations among the independent variables. In assessing the relationships between independent and dependent variables, the presence of multicollinearity can cause several problems including inaccurate results of regression coefficient estimation (Tabachnick and Fidell, 2007; De Vaus, 2002). According to Gujarati and Porter (2009) and Hair *et al.* (2006), the Tolerance and *Variance Inflation Factor* (VIF) refers to the indicators of *multicollinearity*. Tolerance is a value that measures the degree of the independent variable's variability that is not explained by the other independent in the model and it is computed by using the formula $1\text{-}R^2$ for each variable. VIF is the inverse of tolerance and calculated simply by inversing the tolerance value (1 divided by tolerance). The rule of thumb is when the value of tolerance is less than 0.10 and VIF of a variable

exceeds 10, that variable is considered to be highly collinear (an indication of multicollinearity).

3. Assessment of Measurement Model Fit

One hundred and thirty one (131) questionnaire items of TQM implementation in the oil and gas industry represented ten latent constructs for this study. After adjusting some reversed scores, items representing the constructs and dimensions were subjected to reliability and validity tests.

a. Reliability of Measures

Reliability is an assessment of the consistency degree in multiple measurements of a variable (Hair *et al*., 1998). Cronbach's alpha coefficients were computed to estimate 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, they could be retained if these eliminated items would result in lower Cronbach's alpha coefficient of the related scale (Hair *et al*., 1998).

b. Validity of measures

After the scales had reached the necessary levels of reliability, the scales were assessed for validity by using confirmatory factor analysis, 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). For this reason, it provided an evidence of convergent validity. This study also assessed the discriminant validity of the latent constructs that 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, it becomes the evidence of discriminant validity for the two constructs.

c. 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 a greater confidence that the individual indicators consistently measure the same measurements. The threshold value for acceptable reliability is 0.70 (Hair *et al*., 1998).

d. Fixing the Error Terms and the Lambdas

Several single indicators measured some 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 that 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 of 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 the standard deviation into each variable. Using standardized variables eliminates the effects due to the scale differences (Hair *et al*., 1998).

e. An Assessment of Non Response Bias

It was made by using an extrapolation approach recommended by Armstrong (1979). Each individual questionnaire type (high, middle, and low level managers) was categorized by the time the completed questionnaire was received.

4. Factor Analysis (FA)

It refers to a data reduction technique that uses correlations among data variables (Jöreskog, 1979; Antony *et al*., 2002). The underlying assumption of FA is that a number of factors exist to explain the correlations or inter-relationships among observed variables (Antony *et al.*, 2002). The general purpose of factor analysis is to find a way in condensing or summarizing the information into a smaller set of new composite dimensions (factors) with a minimum loss of information (Antony *et al*., 2002, Hair *et al*., 1996 in Chowdhury *et al*., 2007). There are two techniques of factor analysis, namely, EFA and CFA which are described as follows (Coakes *et al.*, 2006).

4.a Exploratory Factor Analysis (EFA)

EFA with varimax rotation was performed on QMPs and WCC to extract the dimensions underlying the constructs. Factor analysis is used as an exploratory technique when a researcher wishes to summarize the structure of a set of variables. EFA is also used to asses both convergent and discriminant construct validity. Prior to performingthe factor analyses, the suitability of the data for factor analysis was assessed, and the data were found to meet the fundamental requirements for the factor analysis (Hair *et al*., 1998, Demirbag *et al.*, 2006).

The results reported here were obtained by using the principal components analysis as a means of extraction and *varimax* as a rotation method. There are two basic models for EFA—PCA and PFA. PCA, the most common from of factor analysis, is used for summarizing most of the original information (variance) in a minimum number of factors for prediction purpose. In contrast, PFA is used primarily to identify underlying factors or dimensions that reflect what the variables share in common (Chowdhury *et al.*, 2007). For this research EFA was performed using PCA model for identifying QMPs and WCC constructs. According to Hair *et al*. (1998), factor loading greater than 0.30 are considered to meet the minimal level; loading of 0.40 are considered more important; if the loading are 0.50 or greater, they are considered to be very significant. In this research, a factor loading of 0.50 was used as the cut-off point. Hair *et al*. (1998) describe three techniques for factor extraction, namely latent root criterion or eigenvalue; variance percentage and screen test. Factors having eigenvalue greater than one are considered significant and all other factors with eigenvalue less than one are considered to be insignificant or disregarded.

4.b Confirmatory Factor Analysis (CFA)

Itis a technique of factor analysis for testing a theory about the structure of a particular domain. Scale purification was conducted with the first dataset through CFA. Upon developing one-dimensional scales through CFA, reliability and validity (convergent and discriminant) were assessed. For the study, CFA is used to test the measurement models for WCC (a second-order CFA), and OE, CNFP, and CFP (a first-order CFA).

The CFA consists of two models: a first-order factor model and a second-order factor model. Both CFA models must account for relationships among constructs. A first-order factor model means the covariances between measured items that are explained with a

single latent factor layer (one level of latent construct). A first-order measurement model accounts for these relationships simply by directly estimating each through free elements in a construct covariance/correlation matrix (two-headed arrows). In contrast, a second-order factor model accounts for covariation among constructs by specifying another higher-order factor or factors that cause the first-order factors. In other words, the first-order factors now act as indicators of the second-order factor (Hair *et al*., 2006).

5. Structural Relations Analysis

It is used to analyze the effect of QMPs on company performance and to investigate the interrelationships among QMPs, WCC, OE, and company performance (CNFP and CFP). According to Hair *et al*. (2006) the technique of structural relations analysis is basically concerned with the estimation of the linkage magnitude among variables (the observed and unobserved variables) and using these estimates to provide information about the underlying causal processes (a recursive model) within the context of SEM (including the decomposition of effect in path analysis). It also enables one to measure the direct and indirect effects that one variable has been on another and to decompose the correlation between any two variables into a sum of simple and compound paths; some of which may be meaningful and others which may not. With these advantages, structural relations analyses and the decomposition of effect in path analysis refer to techniques used in this study to explore the hypothesized relations among the ten constructs.

5.a Structural Equation Modeling (SEM)

An extension of several multivariate techniques, most notably multiple regression and factor analysis is employed to deal with the relationships of the constructs in the proposed model. The attractiveness of SEM stems from the followings:

1. It provides a straightforward method dealing with multiple relationships simultaneously while providing statistical efficiency.
2. It has an ability to assess the relationships among latent variables
3. It has an ability to comprehensively assess the relations and provides a transition from exploratory to confirmatory analysis (Curkovic *et al*., 2000).

SEM is as selected the most appropriate one for this study due to its purposes. The purposes of this study are to offer new empirical evidence on the form and strength of the relations among the research constructs of comprehensive TQM implementation model (the proposed structural relations model). In empirically assessing the extent to which the structural relations model, it is important to recognize that the researcher has evaluated a series of relations between manifest variables and latent variables (as represented by the proposed structural relations model in Figure 3.4). This mapping also extends to relations between latent variables and higher-order factor referred to QMPs. The analysis of this structure is best accomplished by SEM. More important, in studying this structure, the researcher must realize that the researcher is studying a process by which comprehensive TQM implementation in oil and gas industry model is achieved. Again, the process is best handled by SEM because it allows the researcher to examine the multiple relationships simultaneously with statistical efficiency and an incorporating measurement error into the estimation process (Anderson and Gerbing, 1988; Curkovic *et al*., 2000).

In general, the researcher follows a two-stage process of SEM (Hair *et al*., 1998). Here, the measurement model is firstly estimated using factor analyses (EFA and CFA) to obtain a factor score for each research construct. In the second stage, the measurement model is fixed when the structure model was estimated. As Hair *et al.* noted, “The rationale of this

approach is that accurate representation of the reliability of the indicators is best accomplished into stages to avoid the interaction of measurement and structural models." If a single-stage analysis with simultaneous estimation of both the measurement and structural models has been done, the model's specification and interpretability will be more complex. Adopting the two-stage modeling approach then facilitates the researcher to maintain the comprehensive TQM implementation model (Wilson and Collier, 2000).

In addition, a set of acceptable parameter level for goodness-of-fit statistics test is very useful to compare the fit between the hypothesized model and the perfect fit (Byrne, 2001).

5.b Decomposition of Effect in Path Analysis

A structural relations model with a hypothesized mediating effect can produce direct and direct effects—decomposition effects in path analysis (Alwin and Hauser, 1975). **Direct effects** are a relationship linking two constructs with a single arrow (e.g. a direct effect of QMP_{1-6} and CFP would include a single arrow). **Indirect effects** are the relationships that involve a sequence of relationships with at least one intervening (mediating) construct. Thus, an indirect effect is a sequence of two or more direct effects and is represented visually by multiple arrows. Indirect effects are consistent with mediation (Hair *et al*., 2006). To test H4a-f and H5a-f, the researcher uses the path coefficients to examine the total effect of QMP_{1-6} on CFP through WCC or OE and CNFP and then compares them with the direct effect of QMP_{1-6} on CFP. The indirect effect is calculated by multiplying the contributing path coefficients. For illustrations purpose, the breakdowns of the direct and indirect (mediated) relationships are shown in Table 3.5 and Table 3.6.

Table 3.5
Decomposition of Effects in Path QMP_{1-6} → WCC → CNFP → CFP

Decomposition of Effects	Path Analysis	Regression Coefficient
Direct:	QMP_{1-6} → CFP	β_1
Indirect:	QMP_{1-6} → WCC → CFP	$\beta_2 \times \beta_8$
Indirect:	QMP_{1-6} → CNFP → CFP	$\beta_6 \times \beta_7$
Indirect:	QMP_{1-6} → WCC → CNFP → CFP	$\beta_2 \times \beta_4 \times \beta_7$
Total:	$\Sigma = \beta_1 + (\beta_2 \times \beta_8) + (\beta_6 \times \beta_7) + (\beta_2 \times \beta_4 \times \beta_7)$	

Table 3.6
Decomposition of Effects in Path QMP_{1-6} → OE → CNFP → CFP

Decomposition of Effects	Path Analysis	Regression Coefficient
Direct:	QMP_{1-6} → CFP	β_1
Indirect:	QMP_{1-6} → OE → CFP	$\beta_3 \times \beta_9$
Indirect:	QMP_{1-6} → CNFP → CFP	$\beta_6 \times \beta_7$
Indirect:	QMP1-6 → OE → CNFP → CFP	$\beta_3 \times \beta_5 \times \beta_7$
Total:	$\Sigma = \beta_1 + (\beta_3 \times \beta_9) + (\beta_6 \times \beta_7) + (\beta_3 \times \beta_5 \times \beta_7)$	

3.12 Summary of Research Methodology

To test six hypotheses of the study, the researcher performed an empirical study in oil and gas industry in Indonesia. Here, the explanatory research design (the Quantitative-Qualitative linkages approach) is developed. The extent of the structural relations of TQM implementation in oil and gas industry in Indonesia and in the level of company performance on both non financial and financial performance measures were determined by using judgmental measures based on managers' perceptions for the performance of the SBU on each constituent item.

The next chapter (Chapter IV) presents data analyses of the study of the data collected from the structured questionnaire and qualitative research interviews. It involves three major steps, namely *the data reduction process*; *quantitative data analyses* (*the structural relations and mediation analyses)* using SEM.