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ABSTRACT

Business Excellence in a
U.S. Gulf Coast Oil Refinery:
A Process for Measuring Managerial Accountability

by

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MBA, Louisiana State University, 2001
BSEE, Louisiana Tech University, 1987
MA, Louisiana Tech University, 1979
BMEd, Louisiana State University, 1978

Dissertation Submitted in Partial Fulfillment
of the Requirements for the Degree of
Doctor of Philosophy
Engineering Management

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ABSTRACT

Although there has been considerable research on management accountability, there is still a lack of clarity on the systems that produce unanticipated events impacting worker safety. The purpose of this research was to evaluate the effectiveness of managers at one U.S. Gulf Coast oil refinery to create an environment of business excellence and worker safety. Three organizational theories used for this research were Jacques's requisite organizational structures, Kanji's quality management business excellence model, and Reason's prevention of human error. Two survey instruments addressed strength of leadership, focus on people management, and external customer satisfaction. A quantitative analysis was performed utilizing a partial least squares (PLS) regression methodology. A surprising result was that strong leadership behavior and high external customer satisfaction did not necessarily drive internal business excellence. One of the lowest mean scores, 5.1 on a 10-point scale, showed that people management systems were only partially effective in helping to achieve internal excellence. Specifically, stakeholders did not perceive that employees were matched to the right jobs or that they had clear accountability to sustain critical work processes. In this case, refinery managers must take immediate action to clarify work processes, establish clear accountability, and ensure employee competency to sustain safety, quality, reliability, and business excellence. From a societal perspective, the study demonstrated the potential benefits of using these surveys and the 3 comprehensive business theories to analyze the operations of an organization and to highlight where improved accountability and focus on internal excellence can yield improved organizational performance and safety.

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DEDICATION

For my loving and supportive wife Gail, and

my understanding children, Travis, Sydnee, and Tyler,

4 years of support. Thank you.

ACKNOWLEDGMENTS

I owe a great debt of gratitude to the leadership team and employees of the refinery that willingly participated in the survey. Not only did the leadership sponsor the research, they also sponsored my doctoral studies. Unfortunately, because of confidentiality issues, I cannot reveal their names, but without their support, this work would not have been possible. Through the years, I have had the pleasure and honor of working with many outstanding scholar-practitioners who were totally dedicated to understanding how the system creates its own reality. Each of my colleagues always encouraged my exploration into human systems as well as equipment failures that developed into the themes used in this paper.

To my parents, Edmund and Faith Winston, both professional educators, I thank you for teaching me never to stop learning and instilling in me a dedication toward achieving a goal. To professor Gopal Kanji, thank you for your gracious help, the theory, the software, and the many conversations to enlighten my perspectives. To my committee chair, Dr. Thomas Spencer, thank you for your continuing and wise counsel. To Dr. Bill Steeves, thank you for your encouragement and leadership guidance for several years. To Dr. Ruth Maurer, thank you for your numerous detailed edits, practical coaching, and unfailing confidence in this work. Finally, this paper would not have been readable without the assistance of my editor, Barb Elwert. Thank you for your patience, humor, encouragement, and dedication over many long months.

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CHAPTER 1: INTRODUCTION TO THE STUDY

Introduction

The oil-refining industry seeks to produce quality fuel products through sustained business excellence in financial, safety, environmental, reliability, and quality performance. Producing low-cost, high-quality fuel safely under an intense global market of margin pressures requires competitive, effective, and efficient leadership that gives purpose and direction to the business. The focus of this research was a refinery on the U.S. Gulf Coast with throughput capacity of approximately 250,000 barrels per day, 500 employees, and annual revenues of $250 to $400 million from 2003 to 2005. Of the 500 employees, approximately half are hourly employees in operations, maintenance, or administrative; the other half are salaried in various technical support or managerial functions.

Managers are accountable for setting and continuously improving safety, reliability, and quality of production (Reason, 1990); workers are accountable for following the procedures and executing the expected tasks to the best of their ability (Reason). Jaques (1989) defined management accountability as being held responsible for the output of subordinate performance. Managers have a responsibility for setting the organizational conditions for acceptable performance. In this research, accountability and responsibility were differentiated in that accountability for an individual's or a subordinate's actions cannot be shared. Responsibility on the other hand, implies a sense of duty or ownership that can be shared between two or more people working toward a

common cause. In other words, joint responsibility or unique accountability was used throughout this study.

Unanticipated incidents or accidents can be avoided by proactively creating barriers and enforcing structures within safety systems. Safety can be improved by defining clear personal accountability within job roles at every level of the organization (Reason, 1990). In a manufacturing facility, quality, reliability, and safety processes are difficult to improve upon in the absence of clear accountabilities; however, many people can have responsibility for working toward a safe or a reliable operation. In a broader sense, individual managers are accountable for setting and achieving the expectations, targets, and results of an organization, a group, or a person. Effectively reducing human error is both an expectation and an accountability of managers, and workers share an equal burden to follow procedures and perform their tasks to the best of their ability (Reason). Human error is a normal phenomenon that can never be completely eliminated; however, the probability of occurrence can be lowered through a commitment to understanding from past failures, developing safety systems, taking personal responsibility for decision making and awareness, and by intentionally designing barriers (Reason).

Statement of the Problem

What are the conditions that create or detract from business excellence within an oil refinery? Although there has been considerable research on management accountability, there remains a lack of clarity on the system that produces unanticipated

events impacting product quality, reliable equipment performance, sustainable work processes, and worker safety. By knowing the strengths and weaknesses of the business systems within the organization, recommendations can be made to focus prioritized improvement action plans. Business excellence is dependent on the performance of internal systems as well as internal and external stakeholder expectations (Kanji, 2002). This research utilized business system concepts from total quality management (TQM) and Kanji's business excellence model (KBEM), as well as the theories of Jaques (1989) and Reason (1990), to define business excellence in an oil refinery.

Customer expectations must be measured and analyzed for understanding where to focus resources. Because refinery managers have a responsibility to create the conditions for improved results, they will benefit by learning which critical success factors (CSFs) are in need of the greatest improvement based on valid data. Furthermore, without reliable data to explain the impact of current strategies, goals, and actions, management accountabilities for improvement are hard to quantify. The critical variables of Leadership, Continuous Performance Improvement, People Management, Managing by Fact, Work Processes, Teamwork, Measurements, Prevention, and Customer Satisfaction, as well as their interrelationships, must be measured simultaneously so that corrective actions can be planned in a prioritized manner.

Nature of the Study

This quantitative study explored three theories of quality and management accountability, from which selected constructs were incorporated into a testable

questionnaire comprised of two surveys: Part A, the Business Excellence in Refining Survey (BERS), and Part B, Kanji's Business Excellence Scorecard (KBES). The findings derived from the BERS yielded valuable information for supporting change and action planning. This method of combining real data and validated theories will inform managers of complex industrial manufacturing environments how to prevent or reduce unanticipated incidents by managing human error and identifying areas where accountability is lacking. The essential element in this research was the survey, whose development was based on Kanji's (2002) KBEM. The KBEM is based on a partial least squares regression (PLS) methodology and provides a reliable set of data needed to understand the relationship between internal employees and the business performance perceived by stakeholders.

Research Questions

1. What is the numerical strength of the relationship between the KBEM's CSFs and managerial accountability in the oil refinery under study?
2. How effective is the oil refinery under study in achieving customer satisfaction through various levels of stakeholders, employees, managers, and suppliers?
3. To what extent does the leadership create distinguished safety, reliability, quality, and financial performance?
4. How do customers perceive the ability of the organizational culture in the oil refinery to improve its products, price, and quality?

5. How well are leaders and employees aligned on the purpose, goals, missions, and strategies of the oil refinery under study?

6. To what extent are the employees' capabilities, competencies, and knowledge matched to the right roles within the oil refinery?

Purpose of the Study

The purpose of this study was to assess management's effectiveness in creating business excellence and worker safety in manufacturing. An oil refinery was used as a proxy for a complex organization to synthesize the three theories of this research. The recommended focus improvement efforts were a specific application of the assessment findings. Critical to this process was the utilization of the Pareto effect, that is, 20% of the effort produces 80% of the desired results from valid data. An evaluation of the data will inform management of areas within the organization where accountability is weak. The longer term implication is that management may use the findings to self-diagnosis, evaluate, and understand gaps and improvement efforts over time. Actions may then be developed to create a sustainable, globally competitive refining manufacturing model well into the 21st century.

TQM Principles

Kanji (2002) defined TQM as a management philosophy that fosters an organizational culture committed to customer satisfaction through continuous improvement. This study was not about the application of a TQM program; rather, the focus of the study was the measurement of the concepts and principles of existing

practices of managerial accountability within the framework of TQM and the KBEM. TQM provided the variables of Delighting the Customer, Commitment to Supplier Relations, People-Based Management Systems, Team Work, Management by Fact, Process Management, Information Management, Prevention, Continuous Improvement, and Culture of Continuous Improvement. Customer satisfaction is only part of what makes an oil refinery safe, reliable, and environmentally successful. The integration of TQM, KBEM, managerial responsibility, and organizational learning creates the technical and social underpinnings that lead to business excellence. In addition, leadership has a responsibility to create a shared vision, structured systems, and work processes so that all employees can be safe and effective at all levels of the organization (Reason, 1990).

However, the output of the vision, safety system, work processes, and decisions results in the accountability of a person within a management position in the hierarchy of a requisite organization (Jaques, 1989). "It is well known that in general, about 85 percent of the common problems of manufacturing and service industries are related to the management and system, and only 15 percent are specific to the operation and connected technology" (Kanji, 2002, pp. 2-3).

In a similar vein, after studying multiple major incidents in oil refineries and other complex industries, Reason (1990) concluded that up to 85% of unanticipated incidents attributed to human error are the consequence of unclear organizational accountabilities, inadequate defenses, improper equipment designs, underdeveloped learning and training

programs, nonexistent or unclear procedures, and dysfunctional work processes. Creating the conditions for people to work in effective systems, processes, and productive working relationships is the responsibility of managerial leaders (Jaques & Clement, 2000). Managers of complex industrial manufacturing organizations who do not seek to understand and improve operating performance by delineating clear directions, purposes, and accountabilities may place the business in an unnecessary crisis situation (Deming, 1982/2000). Johnson and Gustafsson (2000) found that quality improvements require a system of performance management.

TQM frames the concepts and principles of accountability and assessment in CSFs. Kanji (2002) stated that business excellence in an industrial manufacturing organization may be measured and improved by focusing on fundamental CSFs. As part of this research, the KBEM (Kanji) was applied to an oil-refining environment to clarify and measure an oil refinery's performance using 14 CSFs, which are discussed in more detail in the Theoretical Framework section.

Business excellence in complex organizations can be measured by assessing the satisfaction responses of customers, stakeholders, employees, and employers simultaneously (Kanji, 2002). The KBEM calculates the Business Excellence Index (BEI) based on the principles of TQM, defined by Grandzol and Gershon (1997) as an organizational approach to enable people, structures, and processes to attain quality products and services as a holistic system. Although management and leadership philosophies for complex manufacturing businesses abound, TQM-enhanced

management accountability links business excellence to safety, reliability, quality, financial and customer satisfaction, stakeholder relationships, people systems, operational utilization, and legal environments. At the same time, management's task is to develop all levels of the system to mitigate unanticipated incidents through organizational learning (Reason, 1990). The goal is to provide managers with a set of reliable data to define, measure, clarify, and utilize resources, products, and services so that they understand their responsibility to drive business excellence.

Three major theories were discussed in this study: Jaques's (1989) requisite organization theory, Kanji's (2002) business excellence model (KBEM), and (c) Reason's (1990) human error theory. Separately, each theory offers a limited perspective of organizational accountability and responsibility; together, they provide a structure that identifies, evaluates, and builds understanding of the importance of the gaps or strengths in organizations. This process of discovery will allow organizations to use their resources more effectively and focus on improvement areas. With that information clearly validated, corrective action plans will improve levels of superior service and avoid unanticipated incidents or accidents.

BERS Survey Test Instrument

The researcher's self-developed Business Excellence in Refining Survey (BERS; see Appendix A), which is framed upon the KBEM (Kanji, 2002), was used to measure the effectiveness of managerial accountability, as perceived by the internal customers. The BERS was the Part A survey. According to Kanji, effectiveness may be measured by

performance on leadership, continuous improvement, people-based management, prevention, and management by fact.

> The Business Excellence Index (BEI) is a means of measuring customers', employees' and shareholders' (all the stakeholders) satisfaction simultaneously within an organisation in order to obtain a comprehensive evaluation of the organisational performance. Kanji's Business Excellence Model (KBEM) can be used to measure Business Excellence Index (BEI) in order to show how well different areas of the organisation, i.e., leadership, continuous improvement and other TQM principles, are performing. It has been constructed in such a way so as to allow direct comparison across each area while at the same time being able to compare the same business in different geographical areas. The Business Excellence Index also allows a particular business to be measured over time. The **Business Excellence Index** is therefore a measurement of the complex interaction between total quality management principles and Business Excellence of the organisation at a certain point. (Kanji Quality Culture, 2006, Kanji's Business Excellence Index section)

The researcher's BERS identified the manifest variables that represent management accountability (i.e., roles, relationships, processes, structures, and systems) and then integrated them into the BERS for evaluation (see Figure 1).

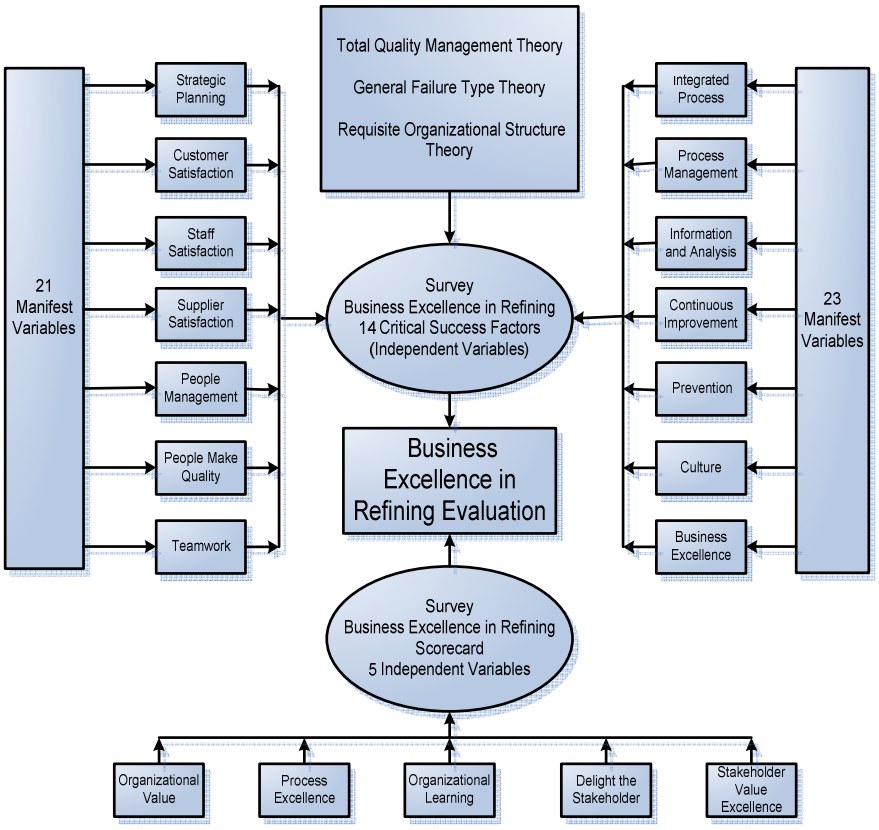

Figure 1. The researcher's BERS as an adaptation of Kanji's (2002) KBEM.

The BERS was designed so that areas where management accountability is not clear may be more readily identified so that resulting actions may be taken to reduce unanticipated incidents or unexpected results. The BERS utilized a PLS methodology to determine weights for all business excellence constructs and identify cause-and-effect factors. This model takes the observed values of the manifest variables and manipulates them in a certain way to come up with calculated valuables for latent variables. With the relationships identified and the strength of the relationships given as numerical gaps, improvements may be undertaken to reduce the incidence of unanticipated incidents or events. As part of the practical application of this work, financial performance, reliability

and quality of operations, safety, environmental compliance, and reputation were built into the questionnaire. Managers may then use the data to evaluate the overall health and relationship clarity of organizational structures.

The second survey, Part B, namely, Kanji's Business Excellence Scorecard (KBES; see Appendix B) was conducted external to the refinery to collect data from key stakeholders, suppliers, and customers. This scorecard was needed to facilitate a comprehensive review of the perceptions of organizational performance from external stakeholders. Questions on the scorecard survey are similar in nature to the original KBEM survey. As explained in Appendix C, the symbol ξ stands for the prime exogenous variable; the η symbol stands for endogenous latent variables, which are indirectly measured; and the y symbol stands for manifest indicators, which are directly measured.

The BERS and the KBES were integrated into the BEI, and the outcome of the BEI was used in the final calculations, which ranged from 0% to 100%. The scorecard and the BERS provided a balanced approach to evaluating the whole business position, as perceived by all of the internal and external stakeholders (Kanji, 2002). A balanced scorecard is essential for a business to create sustainable growth holistically (Kaplan & Norton, 1996). The primary themes measured in the KBES are shown in Figure 2.

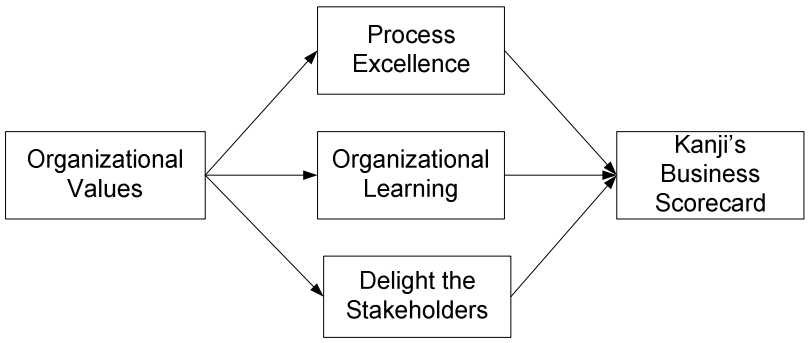

Figure 2. Kanji's Business Scorecard

Figure 2. Kanji's (2002) Business Excellence Scorecard.

The arrows indicate a cause-and-effect relationship as described by the direction that was used in the PLS structural equation modeling for the current research.

In this study, the external customers and suppliers were measured utilizing the following constructs from the KBES:

- Organizational Values - an organization is committed to its values and aligns its strategies to its mission and vision.
- Process Excellence - captures the concepts of the refinery's use and effectiveness of key work processes and linked relationships.
- Organizational Learning - tests the organization's commitment to continuous improvement and learning.
- Delight the Stakeholders - measures how well the organization communicates honestly and reliably to the stakeholders.
- KBES, or Stakeholders' Value Excellence - a combination of the image, reputation, and financial performance of the business.

Combining the KBEM and the KBES criteria from the aforementioned TQM concepts may provide key insights for a manager to build commonly shared strategy and tactics. Although the business concepts are easily understood, there has been little systemic effort into measuring these business excellence concepts from a stakeholder perspective toward oil refineries.

Theoretical Framework

Theories of Managerial Accountability

Reason

In Reason's (1990) theory of human error, specific factors and methods measure what is needed in order to reduce slips, trips, mistakes, and judgment errors. These are the typical constructs that result in general failure types. Included in the model are such variables as hardware, design, maintenance management, procedures, error-enforcing conditions, housekeeping, incompatible goals, communications, organizational alignment, training, and defenses.

Jaques

In Jaques's (1989) theory of requisite organizations, the structure and foundations of leadership accountability are established for the sustainability of the performance of the work. The following elements are part of the major accountabilities for managers: (a) Managers must establish the organization's goals, visions, effective organizational structure, and authorities at appropriate levels; (b) managers at a functional level must ensure that essential business functions and processes operate effectively. To ensure that

the processes function effectively, managers must match complexity of tasks to the appropriate level; (c) managers provide for systematic planning, standards, control, and maintenance so that operations will deliver quality and reliable products to the customers; (d) managers are accountable for ensuring that mentoring, coaching, or advising on the nature of tasks and role clarity is provided to all personnel; and (e) managers are accountable for providing differential pay for appropriate work responsibilities and accurate subordinate appraisals (Jaques, 2002).

Kanji

Measuring business excellence is based on 14 well-understood TQM principles known as CSFs (Kanji, 2002). In the KBEM, each of the CSFs is a latent variable. Latent variables are not directly observable; rather, they are the effects of the manifest variables. The manifest variables were tested by the questions on the survey. *Leadership* is the prime CSF component for all businesses (Kanji). As the prime exogenous variable, leadership is linked to the 4 major principles of Delight the Customer, Management by Fact, People-Based Management, and Continuous Improvement. Each of the 4 major principles is described by 2 latent variables known as core concepts:

Delight the Customer - described by *customer satisfaction* and *internal customers are real*.

Management by Fact - described by *all work is process* and *measurement*.

People-Based Management - described by *teamwork* and *people make quality*.

Continuous Improvement - described by *continuous improvement cycle* and *prevention*.

As seen in Figure 3, each of the 4management principles has 2 associated core concepts. In total, there are 8 core concepts describing Business Excellence, which is the output or response variable based upon the relationships of the core concept latent variables. All 14 CSFs and their relationship are shown in Figure 3. Each of the variables was scored on a scale of 0 to 100 points. The final element, the BEI, was a weighted mathematical analysis to yield an overall score.

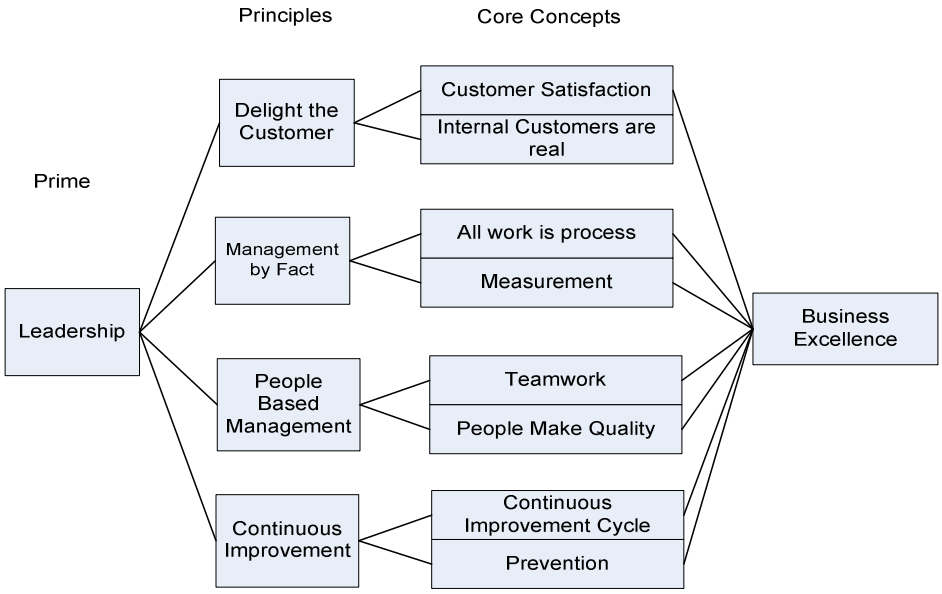

Figure 3. The CSFs of Kanji's (2002) KBEM.

Definitions of Terms

Human Error: A concept that relates the conditions and form of a human error in three major elements: "the nature of the task and its environmental circumstances, the mechanisms governing performance and the nature of the individual" (Reason, 1990,

p. 4). In a general sense, "error" is a generic term that describes the condition whereby certain intentions, actions, and consequences did not proceed as planned to achieve a desired outcome.

Requisite Organization: "Doing business with efficiency and competitiveness, and the release of human imagination, trust, and satisfaction in work. These conditions are essential for the effective managerial leadership systems in any decent free-enterprise democratic society" (Jaques, 1989, p. 3). Specifically for use in this research, Jaques's theory suggests the existence of a universally applicable organizational structure of layers that is designed with accountability and authority in lateral and vertical working relationships. Working relationships are based on clarity of accountability, as mandated by the organization's needs and the criteria of time, resources, and capability expectations. To match organizational accountability with the right levels of management, people's mental capabilities should be assessed and matched to a time horizon for task completion. A requisite organization is an organization with patterns of connected roles that operate efficiently and effectively (Jaques, 1989).

Assumptions, Limitations, and Delimitations of the Study

Assumptions

The researcher corroborated that the data from the CSFs representing TQM are applicable to oil refineries. The following are the specific assumptions that were applied to this study:

1. A formal TQM process per se was not necessary to utilize the KBEM questionnaires. If a TQM process was not necessary, the respondents should certainly be aware of the organization's reliability, safety, and quality efforts as a routine part of their work.

2. Specificity of accountability will be improved through the application of the original KBEM to the oil-refining industry. Manufacturing in general probably does not pay enough attention to customer satisfaction, whereas the KBEM expends considerable emphasis on delighting the customer. Because the workers in refineries do not experience external customer relationships as a part of their normal working day, the customers were from internal group-to-group interactions. It was assumed that the major overlaps of customer satisfaction in a refinery are in the systems and the processes necessary to produce people management, quality, reliability, fact-based decision making, learning, and continuous improvement.

3. The fundamental TQM principles (Kanji, 2002); human error theory (Reason, 1990); and requisite organizational theory (Jaques, 1989) may be used in complex and highly technical industries requiring standardized procedures. This assumption was based on the belief that validation and reliability of the KBEM instrument can be transferred to the BERS because of the common approach using the CSFs.

4. The 10-point Likert scale used on the survey yielded data consistent with the KBEM's variables because they are both based on the same CSFs. If the answers to the

BERS yielded extremely low correlations, the question may have been dropped from the survey results.

Limitations

The focus of this study was on one refinery on the U.S. Gulf Coast. The study did not include multiple corporations or multiple refineries within one corporation for comparison. The output of the survey evaluation may not be generalizable to the specific weaknesses or strengths of other refineries or industrial organizations. Employees within the refinery were solicited to participate on a voluntary basis. The views expressed in this study were not necessarily those of the organization, the managers, the stakeholders, or the owners. The questionnaire responses were reflective of the perceptions of employees, suppliers, customers, and supporting organizations, but not necessarily all stakeholders. Frontline customers at gasoline stations were not solicited because they were not the immediate customers of the oil refinery in this study. General survey limitations such as truthfulness, misunderstanding, inaccuracy of memories, instability of current attitudes, reactions, and thinking were potential threats to this study (Singleton & Straits, 2005).

Another limitation of the survey was that employees could have presented a bias of opinion represented by those participants who may have wanted to use the Part A survey to make a statement either strongly positive or negative about a particular manager, coworker, company policy, topic, or perceived condition. This bias could have been manifested in either consistently high or low scores, regardless of the topic.

Delimitations

Topics not considered for inclusion in the analysis and results of this study included the following:

1. Customer satisfaction with the cost or the quality of gasoline at service stations. The specification of gasoline is rigidly maintained by national standards; therefore, gasoline quality is appropriate for assessing refinery quality.

2. Evaluation based on the effectiveness of implementing only TQM principles in an oil refinery. TQM principles were measured as part of the KBEM processes, but neither the BERS nor the KBES was utilized to prove the advantages or disadvantages of the TQM process. Instead, this research presented the data indicating how the facility is performing in the areas identified as the key areas of management accountability, effective organizational structure, control of human error, and delivery of business excellence. Without these key components of refinery management, the result could be business losses or potential fatalities.

3. The data may not be applicable to other refining corporations because causal conditions may be different based on the application of TQM within the site.

4. Stratification of the refinery population was not attempted prior to the distribution of the surveys. In this case, a voluntary census was used on the workforce.

5. Surveys were not followed up with interviews to verify or validate the respondents' understanding.

Significance of the Study

This study is significant because it is the first time the KBEM's measurement of TQM concepts collectively has been used within the context of managerial accountability in an oil refinery. Because this study was broadly based in TQM, leadership, and human error theory, it can be relevant to refineries of various sizes and in various countries. By measuring the specific variables listed previously, this work might fill a critical knowledge gap in achieving business excellence across many manufacturing industries that are similar to oil refining.

This research was based on one oil refinery on the U.S. Gulf Coast. The oil-refining industry is a mature business that obtains maximum utilization of its assets while controlling fixed and variable operating costs. In this study, management teams had the opportunity to monitor the long-term effectiveness of their accountability as managers. Next, the surveys provided a holistic framework for assessing the level of stakeholder satisfaction. Because the surveys yielded perceptions at a particular point in time, a longitudinal study could be used to determine what is changing in the organization and how well the organization is learning from these changes. The BERS and the KBES provided a way of preserving valuable knowledge for future generations of managers.

The social implication of this work will be based upon the outcomes of the changes made by the employees within the organization after having completed the application of the output. Organizations are collections of people acting together to create valuable products. As a social entity, employees within a refinery gain a sense of

accomplishment and purpose to achieve business excellence. An oil refinery organization requires a collective effort by all of its employees to understand and prevent unintended consequences in daily activities and systems. The risk of unanticipated events and the potential damage to equipment and personnel precipitated by human error can be reduced through improved leadership and increased through more efficacious decision making, organizational design, processes, and safety systems as the result of the application of business excellence in refining.

Organization of the Study

Chapter 1 provided an overview of the concepts and theoretical contexts for the assessment, definitions, limitations, significance of the study, and relevant conclusions. The problem statement, nature of the study, as well as specific research questions and objectives were clarified. The CSF variables of the KBEM, which became the framework for the study, were briefly introduced and described, as were three theories of managerial accountability.

Chapter 2 begins with an introduction and an explanation of the literature and the theories related to quality, leadership, organizational learning, managerial accountability, organizational structure, prevention of human error, and business excellence concepts. The implication is that once these theories are exposed and integrated, management's accountability may be defined, and leaders will know what to focus on to improve organizational performance. These concepts provided the framework for the development of the survey questionnaire. The most significant aspects of each theory were integrated

through comparisons and contrasts based on the theorists' perspectives. Each variable that was tested was defined and explored in a discussion of the major topics in the BERS.

Chapter 3 describes the methodology of the research and the analysis of the data. A graphical representation is presented to illustrate the variables and their interrelationships. The survey instruments, as well as detailed analyses of the processes and calculations used in the assessment of the instrument, are defined. Chapter 4 begins with a poststratification analysis of the survey returns based on the demographics of the study sample. The outputs of the PLS regression are then described with mean scores and numerical coefficients representing the strengths of relationships between each of the latent and manifest variables. The research questions provide a framework to understand business excellence performance within the refinery. Chapter 5 continues with specific recommendations based on the results of the analysis from chapter 4. Chapter 5 provides answers to the research questions and recommends actions to improve business excellence performance and customer expectations. After several suggestions to extend and improve the research, a summary concludes the study and its potential implications for society.

CHAPTER 2: LITERATURE REVIEW

Introduction

Each theory mentioned in chapter 1 is explored in more detail in this chapter to provide synergistic relevance between management accountabilities in industrial manufacturing and business excellence concepts. The principal theories of managing a refining business are explained and linked to the fundamentals of knowledge learned from more than 100 years of experience of preventing and/or reducing unanticipated and unwanted incidents in oil refineries.

Oil-Refining Business Overview

In the 1970s, oil shortages of fuels and energy became a topic of widespread discussion. New environmental regulations and laws were enacted, and transportation systems underwent redesign to be more fuel efficient and environmentally friendly. All during this time, the oil-refining industry provided billions and billions of dollars in revenue and security of jobs to local and regional communities. America's refinery industry continues to contribute to the 21st century by investing in communities, paying taxes for schools and other programs, creating jobs, improving commerce, and developing innovative technology, all of which contribute to the world.

In all refineries, there are chemical and work processes involved in receiving crude oil as a raw material and then refining or distilling it into other products. These products must meet established, industry-wide specifications. Making the final products of kerosene, gasoline, diesel, aviation fuel, heating oil, coke, fuel oil, lubrication oils, or

blending products creates such by-products as hydrogen, sulfur, heat, steam, propane, butane, various grades of olefins, lubrication oils, and asphalt. Making these products 7 days a week, 24 hours a day, requires a complex structure that must run safely and at high utilization rates. Processes and management decisions must be made to develop and satisfy owners; capital investors; operational reliability; safety, quality, and environmental compliance; technology; maintenance; suppliers; and the community. For more than 100 years, refining has been a vital player in the economic structure of the world's development (Gary & Handwerk, 1994).

Oil is refined through a process involving high temperatures and high pressure in enclosed vessels, piping, and equipment, in combination with control technology, knowledge systems, procedures, standards of design, all of which require defined operator skills and competencies, professional support personnel, as well as supply and distribution chains (Gary & Handwerk, 1994). Catalysts and an external infrastructure are needed to complete the reactions necessary to make the products. Many energy oil companies have developed various initiatives to improve operational excellence, customer satisfaction, and owner equity while providing superior quality products at the lowest sustainable costs.

Because oil refineries operate equipment in hydrocarbon service in hazardous temperatures and pressures, human lives are at stake. Without accountability throughout the organization, it remains unclear who owns the output of the systems, structures, roles, and relationships that facilitate current performance and results. To improve company

performance and managerial accountability, the strengths and weaknesses that exist within a refinery must be identified and assessed. In short, management is responsible for creating and clarifying the conditions between and among all organizational interactions (Jaques, 2002).

Overview of Managerial Leadership Theories

As applied in this study, managerial leadership theory is based on the work of Jaques, Kotter, Deming, Kaplan and Norton, Crosby, Juran, and Kanji. Jaques's (1989) research was the foundation for understanding the accountability of leadership as a requirement for successful businesses. His concepts of managerial hierarchy, human capability, time span horizons, and task complexities were related directly to the parameters tested in Kanji's (2002) business excellence model (KBEM), although not specifically referenced to oil refineries.

The KBEM (2002) identifies the principles and core concepts necessary to run a complex industrial organization that can be measured to ensure quality and reliable performance. Kanji explained that successful industrial businesses have a balanced combination of the 14 critical success factors (CSFs) within the organizational structure and culture. The variables used to measure the principles and core concepts are built from generally accepted quality theories. Although the constructs are generic, the questions in the BERS were derived from a combination of the case study findings from root cause analyses (RCA) and the theories mentioned previously.

The business excellence scorecard (KBES) concept was introduced in chapter 1 as part of Kanji's (2002) KBEM, which includes such variables as Organizational Learning, Delighting the Customer, and Achieving Process Excellence. Improving organizational learning may be beneficial to leadership, teamwork, people make quality, and continuous improvement, as well as the prevention of unanticipated events. Achieving process excellence may be translated to all work in process and measurement because increasing revenue helps to fund learning. Maximizing stakeholder value brings investment, which directly increases business excellence, which enhances investments in learning (Kanji).

The key is to understand the strength of the linkages among the 14 CSFs because a business must continuously monitor movements and interrelationships so that actions may be taken to adapt organizational or business goals, department goals, or individual goals to address weaknesses. This is the role of managerial accountability.

Jaques's Theory of Requisite Organization and Leadership Accountability

Accountability and Authority

The problem statement in this study refers to the lack of clarity of managerial accountability as a contributing factor to the occurrence of unanticipated events. Jaques (2002) described managers as being accountable not only for their own effectiveness but also for the output of subordinates. Accountability means that people may receive recognition or discipline for their actions or for the actions of another person or group. In

addition, accountability carries with it the authorization and use of resources to perform the activities necessary to complete the assigned tasks (Jaques).

If accountability requires authority, then accountability and authority must be appropriately matched. Stated another way, there is no accountability for work when there is no authority; therefore, output cannot be expected. Without both accountability and authorization, the likelihood that output will be predictable and effective is low. This lack of clarity throughout an organization often may impact people, work groups, and the company's reputation. Thus, managers are accountable for matching employees' capability with their authority (Jaques & Clement, 2000).

Time Span Horizon

Managers are accountable for selecting employees capable of handling the complexities demanded of their roles and responsibilities. Managers have to provide the resources and training for people to get the work done. Selecting the right people means matching their mental processing with the time needed to complete the assigned tasks. Jaques (1989) referred to this determination as the time span horizon, which simply means how long the longest task takes to complete. A manager must be able to conceptualize and communicate the actions required for a job as a set of tasks with the output in mind before delegating to a subordinate.

A requisite structure exists when a manager is correctly placed in an organization when he or she can conceptualize and operationalize the role of a subordinate or a work group. The manager must be able to function at the next higher level of complexity and

time span horizon in order to delegate successfully for task completion. Assessing and selecting the right individual is a very humane activity because the right person is working effectively for the organization and is being rewarded adequately for doing the required work. A good match between job complexity and time horizon to a person's capabilities satisfies both the organization's and the employee's needs. Capability in this context is the ability to use discretion and judgment to solve problems effectively in working toward a mutual goal (Jaques & Cason, 1994). The manager should be able to understand the activities, measurements, behaviors, system inputs, and organizational barriers that will be encountered by the subordinate before delegating work so that the subordinate may successfully do the job.

Leadership can motivate employees by giving them fulfilling work, thus satisfying their basic need to belong to the organization and receive recognition for their contributions (Kotter, 1990). Successful organizations are often perceived as networks of informal relationships that are tightly linked so that functions and communication happen easily. In this case, leadership sets the direction and aligns the resources to get the work done, whereas management controls the budget and sets targets (Kotter).

How are time horizon and complexity related to accountability and authority to get the work done? Linking the two concepts together, the manager is accountable for to providing clarity on the expectations for resources and the authority necessary for a capable subordinate to complete the job effectively. The requisite hierarchical structure has as its fundamental requirement the need to match complexity and time requirements

of a task to the accountability and authority given to the person to complete the task (Jaques & Cason, 1994).

Roles

Management accountability creates clarity for the manager and the subordinate to understand the purpose and vision of the larger organization so that both can react effectively within their roles and make decisions based on the facts as they occur in real time. "A role is a position within a social network" (Jaques & Cason, 1994, p. 12). People work in role relationships. In the manager-subordinate role relationship, each individual must be able to rely on the other to behave within the role expectations to clearly delineate the specifications for the required task. The manager must be accountable to assign the task, and the subordinate must be responsible for carrying out the task (Jaques & Cason).

Oil-Refinery Roles

Operator. In an oil refinery, the operator role is the fundamental level, or stratum, of work. This stratum concept is a measure of how big the job is and refers to the match between a person's capabilities and the task requirements (Jaques, 1989). An effective time span of horizon for an operator could be identified as all of the tasks and interactions that occur during a routine shift that are essential to the optimal operation of the refinery. If correctly done, the operator has the accountability and authority to start, slow down, or stop all equipment, processes, and work as necessary. Support at the next level provides the resources to accomplish those tasks on his or her shift.

Operators must be able to understand how to communicate to operators on the next shift any ongoing problems so that they learn in real time. Operators are accountable for learning from past experience and communicating this knowledge when they believe a problem exists. It is the accountability of the management structure to support operators with training, knowledge, and structures to retain the body of knowledge for learning in the future. Frustration may occur when the job role expectations are not clearly understood by either employees or managers, thus compromising accountability (Jaques, 2002).

Operators must have the accountability to request and receive training, guidance, knowledge, or support to operate and maintain equipment (Jaques, 1989). A requisite structure assumes that the next higher level of management knows enough about the system so that operators receive support or know how that support will be given within their time horizon. This support may include training needs, equipment conditions, alarm conditions, set points, permits, maintenance activities, measuring devices, hand tools, technical support, skill development, competency assessment, procedures, and instructions. If a request is such that it exceeds an operator's time horizon or experience, the next higher manager must consider the appropriateness of the task, and then he or she is accountable to request assistance (Jaques & Clement, 2000).

Line management. The first-line manager must be able not only to understand the activities and duties of the operators on 12-hour shifts but also to prepare one week ahead as operators leave and then return to their next working shift. In other words, the first-line

manager must be able to communicate problems across weekly time spans so that the newly arriving operators can be successful at their tasks. The manager then can seek out advice, mentor, coach, guide, offer additional resources, or train if he or she believes that an operator needs assistance. To be effective, this organizational structure routinely communicates back to the operator on the progress at each level. This open communication helps to create the proper alignment throughout the organization. In this study, communication was tested in two surveys: Part A, the BERS, and Part B, the KBES.

Which option is more ineffective: The person who is overqualified for the job, or the person who is under qualified for the job? The result of improper employee-task matching is often boredom or frustration in the person, a sentiment that is reflected in the organization's inconsistent or unpredictable performance. When expectations are not being met because of a mismatch in capability, accountability, and authority, there is often an aspect of lowered morale. This can generally be tested by asking about the satisfaction level of employees or customers. This same line of reasoning flows vertically in an accountable management system (Jaques & Clement, 2000).

According to Jaques (1989), requisite managerial leadership must have a thorough knowledge of the role relationship among the work, the necessary governance structures, the defined time span horizon of the tasks, the knowledge of the complexity of interfaces, the barriers, and the freedom necessary for a person to take appropriate actions when expected. All work in this case is purposeful and goal driven. "A goal is what by when"

(Jaques, p. 19). In addition to the goal, other factors must be considered: What method will be used; what resources are required; and what limits of rules, polices, or practices must be in place for the work to be accomplished?

Taken collectively, these statements indicate that the manager must thoroughly understand what makes job success and then select the right person for the task. This aspect of people and resources is covered in the people management portion of the survey. As one rises within the managerial levels within the refinery, time span horizons and mental processing complexities increase. In the Part A survey, this relationship was addressed in the internal People Management Systems section and as part of the Internal Customer Focus section.

A lack of documentation describing job roles and responsibilities cannot adequately compensate for the reasoning and mental processing capability accountabilities within the organization (Jaques & Cason, 1994). Mental processing capabilities are defined in the next few sections. Using these theories of mental processing, it is possible to determine how people are selected for positions within the organization (Jaques & Cason). Managers are accountable for ensuring that subordinates are suited to their jobs and have the necessary documentation, technical support, equipment designs, and leadership support structures (Jaques & Clement, 2000). In addition, managers must provide the training and competency-building systems for employees to move to the next level as their mental processing changes over time (Jaques & Cason).

It is essential that managers have the capability to make effective assessments in the areas of delegation, appraisal, compensation, recognition, talent development, and pay. All of these issues are linked to an individual's potential capability, skills, values, and commitment (Jaques & Cason, 1994). There are very clear criteria for placing the right people in the right jobs. Although pay issues, appraisals, vacation, and compensation were not included in this study, these topics infer a perception of how people feel about the effectiveness of senior management and the organization. Leadership capabilities and accountability to set up the organization were part of the analysis. The next section describes how mental processing and time span horizon are integrated.

Complexity of Mental Processing in an Oil Refinery

Various levels of leadership are required each day to keep a business or a corporation healthy. These levels require various echelons of complexity of mental processing as they are applied in an oil refinery.

Declarative processing or practical judgment. A person gives one or more reasons why he or she has a position on a topic, yet the reasons are not linked sequentially to resolving the problem. In this case, the statements are broad, disjointed, and based on a practical judgment of that person's experience and values, although each reason could stand alone.

Cumulative processing or diagnostic accumulation. A person may connect various ideas to explain a position, none of which explains the conclusion by itself.

However, when viewed together, they do provide an explanation. The analysis of this perspective using the definition is that it does have a somewhat connected reasoning that is a diagnostic accumulation of observable data.

Serial processing or alternative paths. A person sequentially links one idea to the next, a process that leads to a conclusion. This type of reasoning tends to link various steps or conditions that must be met before a conclusion can be reached (Jaques & Cason, 1994).

Parallel processing. A person offers a position supported by a number of serial conditions. This reasoning holds several lines of serial processing in suspense while linking them together. The reasoning has a double conditioning attached to the scenarios that link to each other (Jaques & Cason, 1994).

Importance of mental processing. Different jobs in a multifaceted operating environment require different abilities in mental processing to handle information ambiguity. Job expectations and mental processing should be matched. Just as the longest time horizon helps to define the match, so, too, must the ability to use mental processing match appropriately to the problem at hand. One uses the appropriate processing for the appropriate problem. Obviously, not all problems need the same level of processing or data complexity. Jaques and Cason (1994) referred to five orders of increasing complexity of information: preverbal, concrete verbal, symbolic verbal, conceptual abstract, and universals. This study was concerned only with the symbolic verbal and

conceptual abstract because those orders of information cover the time span horizons of 1 day through 50 years.

Tables 1 and 2 show how strata, time horizons, mental complexity, job roles, and information processing relate to an oil refinery or any other complex industrial organization. To explain how Jaques's (1989) capability model of information processing fits into business excellence requires knowing how people's capabilities can be assessed and matched to the task.

Symbolic-verbal communication. In Strata I to IV, the time span is 1 day to 5 years. Symbolic-verbal communication is used when discussing or planning all of the day-to-day or year-to-year work that is required to run a refinery or any other complex industrial facility (Jaques & Cason, 1994). Common elements in this category include instructions, shipping, receiving, budgets, regulations, plans, designs, processes, people and management selections, purpose, vision, mission, customer satisfaction, financial results, information systems, and metrics. In Stratum I, operators and craftspeople use equipment, plans, procedures, permitting, instructions, and troubleshooting to make judgments appropriate to that time span. Managers in Strata II and III are accountable for setting the conditions for the operators and craftspeople to do their jobs effectively. Strata III and IV managers control the system resources or finances to have procedures, engineering, planning, or repairs done at the local refinery level. The resources or the work may be delegated to the appropriate stratum (see Table 1).

Table 1

Refinery Structure Based on Jaques's Requisite Organization (1 Day-5 Years)

Stratum IV	Senior Refinery & Corporate Leadership	2Y-5Y	Parallel Serial Cumulative Declarative	Symbolic Verbal
Stratum III	2nd Line Managers, Discipline Consultants	1Y-2Y	Parallel Serial Cumulative Declarative	
Stratum II	1st Line Managers, Staff Specialists	3M-1Y	Parallel Serial Cumulative Declarative	
Stratum I	Operators, Crafts, Engineers, Accountants	1D-3M	Parallel Serial Cumulative Declarative	

(Adapted from Jaques & Cason, 1994)

Abstract-conceptual communication. In Strata V to VII, the time span is 5 years through 50 years. Abstract-conceptual communication does not mean expounding on the merits of academic theories (Jaques & Cason, 1994); rather, it means using academic abstract concepts and applying mental processing to solve real problems. This is typically encountered at the corporate level of an oil-refining or a complex industrial business, where strategies and concepts to tackle more complex problems in terms of political, economies, competition, mergers and acquisitions, emerging technology, emerging nations, global regional issues, foreign laws, social polices, or raw material supplies for the next 50 years are considered. Here, a corporate or a senior leadership level group considers the information presented and takes action at an organizational level to meet the needs of the organization (see Table 2).

Table 2

Refinery Structure Based on Jaques's Requisite Organization (5 Years-50 Years)

Stratum	Job Roles	Time Horizon	Mental Processing	Complexity of Information
Stratum VII	CEO, Chair of the Board	20Y-50Y	Parallel	Conceptual Abstract
			Serial	
			Cumulative	
Stratum VI	Senior Executive Vice Presidents, COO, CIO	10Y-20Y	Parallel	
			Serial	
			Cumulative	
			Declarative	
Stratum V	Corporate Vice Presidents, Directors	5Y-10Y	Parallel	
			Serial	
			Cumulative	
			Declarative	

An organization following the basic premise of Jaques's (1989) model has clear accountabilities, role relationships, responsibilities, and task expectations. The effectiveness of the job role understanding was tested in the survey questions concerning the right person being in the right job. Within an oil refinery, multiple management systems operate to protect people, assets, equipment, and the environment, as well as maintain governmental regulations and specifications.

From Requisite Organization to TQM Principles

A requisite organization relates to TQM principles and the KBEM (Kanji, 2002) through a concept of preventive thinking as a principal element (Reason, 1990). Preventive thinking, maintenance, and processes are critical to preventing unanticipated events in an oil refinery. Equipment that is not maintained performs unpredictably because of wear, corrosion, erosion, heat, pressure, mechanical stress, or environmental

attack. People systems also need to have preventive plans in place to predict and eliminate problems. Preventive and proactive thinking requires a certain type of parallel mental processing. An organization needs a balance between the day-to-day fixers, who execute the work, and the proactive thinkers, who plan future activities. This issue was covered in the survey questions related to the people management system. Jaques (1989) developed a descriptive breakdown of the functions necessary for various levels of management that relate to preventive and proactive thinking (see Figure 4).

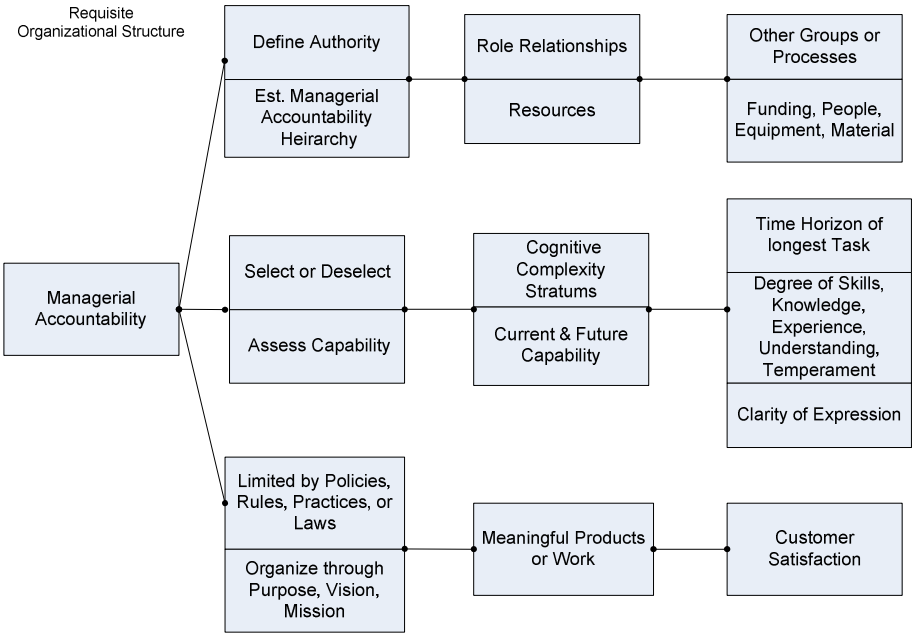

Figure 4. Requisite organization managerial hierarchy.
(Adapted from Jaques, 1989)

Jaques' (1989) model is supported and enhanced by the 11 general failure types in Reason's human error model (1990) that explain how structures and systems can control and reduce human errors in an oil refinery. The effectiveness of these applications was

tested in the BERS. Reason's theory and its components are explored in more detail in the next section.

Characteristics of Management Systems in Reason's Human Error Model

Managing Human Error

Reason (1990) stated that organizations must have defensive functions at all levels of the organization that are capable of preventing or preparing for hazards. Evaluation of that statement could lead to the conclusion that systems of comprehensive strategies, plans, or goals to prepare people within an organization to deal with potential hazards are not important because the statement focuses on defensive positioning. To understand this statement, one must consider that some plans, strategies, and actions are defensive in nature but others are procedural and must be practiced in real time.

In addition, Reason (1990) asserted that an organization with plans to grow must manage improvements in safety, quality, reliability, environmental, and knowledge systems. Leaders become accountable for the preparation of systemic plans, taking into account the latent failures in the system. Reason's assertion was similar to Jaques's (1989) findings from the perspective of accountability, albeit derived from a different perspective. Reason's findings resulted from investigations of unanticipated incidents, whereas Jaques's findings evolved from discoveries from direct interventions into organizations made from observations of multiple case studies with data supported from

his own psychological and medical expertise to explain his insights into organizational dysfunctions.

Reason (1990) asserted that unanticipated events often occur when human beings make errors because of ineffective management systems, defenses, designs, boredom, or complacence. Strauch (2004) argued that errors that may occur in a complex manufacturing industry are directly linked to incidents in complex systems. In contrast to Jaques's (1989) comments, Reason and Strauch identified a need for management systems to communicate and document a variety of standards, policies, guidance, documentation, and work processes to support work groups in their efforts to achieve results. This is a key leadership attribute that was tested in the BERS.

Management of Errors in an Oil Refinery

Often, people or group interfaces are undefined, leading to unanticipated events in oil refineries. Assumptions are made about who is to do a critical role. For example, contractors are hired to do specified work, but when the operator permitting the job makes assumptions about how much the contractors know about doing the work, mistakes may occur. The result could lead to an unanticipated event. Therefore, people must have the competency to ask questions in an effort to check their assumptions. They should not assume that people are trained to handle situations unless they have verified that information for themselves through direct observation. Successions of managers or operators assume competencies as people rotate through jobs. This topic is covered in the Management by Fact section of the BERS.

Reason (1990) argued that errors may be caused by skills-based slips and lapses. Errors may also be caused by mistakes. Skills-based slips and lapses are the result of attentional (i.e., not paying attention) slips of action or lapses of memory that must be managed through proper maintenance training and procedures (Reason & Hobbs, 2003). As defined earlier, human error is "the failure of planned actions to achieve their desired ends - without the intervention of some unforeseeable event" (Reason, p. 71). These are important aspects to understand, as defined in the systems necessary to achieve safe and successful refining operations. Reason created 11 major categories of general failure types to be easily understandable yet based on factual patterns of evidence across many industries (see Table 3).

Table 3

Reason's 11 General Failure Types within Industrial Facilities

General Failure Types	Description
Hardware	Quality and availability of tools and equipment. Policies and responsibilities for purchase, quality of stock, supply, compliance to specifications, age of equipment.
Design	When the failure comes directly from errors and violations, including a designer not providing guidance on equipment, how it functions internally, and no feedback to user.
Maintenance management	Having to do with maintenance execution, for example, in planning, hazards, and timing of activities.
Procedures	Quality, accuracy, relevance, availability, and workability of procedures.
Housekeeping	Problems present for a long time from various levels in an organization, but nothing is done to correct them. Often resulting from inadequate investment, insufficient personnel, poor incentives, poor definition of responsibility, or poor hardware.
Error-enforcing conditions	Two general conditions relating to either the workplace or the individual that can lead to unsafe acts but often influence error though errors or violations from other general failures.
Incompatible goals	Goal conflicts occurring at individual, group, or organizational level.
Communications	System failures where necessary channels do not exist, messages are not transmitted, or the right messages are misinterpreted or arrive too late.
Organizations	Three main failures concerning deficiencies in organizational structure, organizational responsibilities, and management of contractor safety.
Training	Problems in understanding the training requirements, downgrading of training relative to operations, insufficient assessment of results, poor mixes of experienced and inexperienced personnel, poor task analyses, inadequate definition of competence requirements, and so on.
Defenses	Failures in detection, warning, personnel protection, recovery, containment, escape, and rescue.

(Source: Reason, pp. 134-135)

Pattern behavior analysis of human error may be evaluated using chaos theory to create an effective understanding of the environment (Delgado-Lopereña, 2004). Delgado-Lopereña's research was based on observations of nuclear control board operators responding to a steam generator event simulation. Delgado-Lopereña defined

three major error types: (a) design errors associated with people making decisions on human interface to equipment and machinery through engineering or implementation; (b) system errors associated with the interrelationships of software or hardware designs; and (c) human-induced errors associated with the nature of the individual or the environment, either external or internal to the person.

Butikofer (1986) concluded that accidents in petrochemical and refineries are due to equipment and design failures (41%); personnel and maintenance failures (41%); inadequate procedures (11%); and inadequate inspection (5%, as cited in Embrey, 1994). Butikofer (as cited in Embrey, 1994) confirmed that Reason's (1990) general failure types consistently are due to personnel and maintenance practices that correlate to human error in design and maintenance management. The inadequate procedure type is a direct match to Reason's procedure failure type. Inadequate inspection may be considered a defense mechanism within Reason's general failure type description.

Embrey (1994) also identified the influence of classifications on human performance. Specifically, Embrey stated that the operating environment, task characteristics, operator characteristics, and organizational and social factors are general areas that must be addressed to prevent unsafe events. Each of these categories can be broken down into subcategories that can determine the probability of human error.

Based on these aforementioned theories, it becomes clear that management is accountable for implementing systems that minimize unsafe acts or failures; learn from accidents or unanticipated incidents; identify general failure types; develop guidelines,

designs, and standards and management systems to control operations; measure operating conditions and failure mechanisms; train and motivate personnel to eliminate hazards through equipment use and to perform safely; and inspect and improve conditions on a routine basis (Reason, 1990). These elements of a good refining management system are essential for carrying out work safely under hazardous conditions. In the BERS, the questions were placed in the general category of People Management Systems, which is directly linked to leadership's accountability to have systems in place or to create systems where people learn and continuously improve.

Leadership as a Prime Variable for an Organization

Leadership is the prime exogenous variable of Kanji's (2002) model. It is accountable for driving excellence in quality, reliability, safety, environment, people, systems, and the organization. Leadership drives other latent variables within the model. According to Kanji, the CSFs related to leadership excellence are:

> 1. The existence of strong and shared organizational values (which provide the foundation for the identity for the organization and are reflected in its mission, vision, strategy, and management practices).
> 2. The development and communication of an inspiring vision.
> 3. The definition of a mission that states what the organization stands for.
> 4. The development of a strategy aligned to the mission and a vision and ability to create a sustainable competitive advantage over the competitors.
> 5. The establishment of an organizational structure and operation mechanisms that facilitate the implementation of the mission, vision, and strategy. (p. 109)

At this point, it may be beneficial to discuss the research of other theorists who have contributed to the body of knowledge of managerial accountability and leadership. This discussion may help the reader to understand how these different theories and

theorists have influenced and been influenced by one another. To begin, Walton (1986) described Deming (1982/2000) as a recognized guru of quality who believed that leaders should help workers do the best job they can so that they can reach their full potential. This assertion concurs with Jaques's (2002) assessment of the power and accountability of an organization's chief executive officer (CEO). From the top and going down the organizational hierarchy, all lower level managers provide coaching, mentoring, and training (Jaques). Leadership needs to have the same strategic vision to give all employees a consistent set of behavioral expectations. This alignment on vision and behavior helps to ground the quality culture within an organization (Deming). Managers are then responsible for setting up and designing the strategic vision. Kotter (1990) stated that a leader's role is to (a) establish a sense of urgency, (b) create the guiding coalition, (c) develop a vision and strategy, (d) communicate the new vision, (e) empower broad-based action, (f) generate short-term gains, (g) consolidate gains and produce more change, and (h) anchor new approaches in the company culture.

In the KBEM, Kanji (2002) defined leadership as having the prime or primary role of defining the mission, vision, and the goals that promote a quality culture; establish a set of shared values; define a strategy; coordinate the use of resources to improve financial performance; establish goals and systems to enhance customer satisfaction; establish effective information systems and use objective data in the decision process; promote the development of human resources by investing in training and education and recognizing quality achievements; and communicate, define, and motive continuous

improvement. Leadership as a quality variable in Deming's (1982/2000) management method are explored and interpreted in detail in a later section.

Jaques (2002) believed that leaders are accountable for designing the organizational levels essential to helping workers do their best work and that all systems must be linked in such a way as to accomplish the assigned tasks. Jaques argued that time is wasted in developing visions and missions, as well as reengineering organizational learning, if the right person with the necessary capability is unaccountable. Therefore, the effectiveness of senior management depends on leadership capabilities that can communicate with all levels of the organization.

Correct or appropriate organizational structure is based on the business itself and the time horizon needed for the completion of a task. If the right stratum of complexity is defined and matched to a senior manager, the quality, reliability, safety, and environment will allow the business to formulate the appropriate goals and grow plans for the future. On the other hand, Jaques (1989) asserted that a lack of measurement of the accountabilities and authorities in cross-functional relationships is a constant source of stress in team-based work environments.

Leaders are accountable for organizing structures that are systematically designed in a hierarchy based on task complexity matched with the person's current capabilities (Jaques & Cason, 1994). Jaques would view this as releasing the human imagination to all kinds of industrial and commercial services, as well as other social services such as education, health, and defense (as cited in Jaques & Clement, 2000). He implied that in a

successful structure, each employee's tasks are matched to his or her capabilities, defined by one's mental processing in terms of time horizons, that is, how the employee logically puts events in series or parallel. Employees feel fulfilled because they are contributing to the company's strength and vibrancy.

Leaders, as explained by Greenleaf (1991), have to create a generative culture that shares responsibility, welcomes new ideas, understands failure mechanisms, and explores potentially far-reaching defenses within organizations. Both Greenleaf and Reason (1990) cited the importance of culture in precipitating or preventing unanticipated events. The following statements reflect the structured approach suggested by Reason:

1. Create understanding and awareness of local hazards
2. Guidance on how to operate safely
3. Provide alarms and warnings when danger is imminent
4. Restore a system to a safe state in an abnormal condition, state, or situation
5. Interpose barriers between the hazardous condition and further potential losses
6. Contain and eliminate hazards if they escape containment or barriers
7. Provide a means of escape from hazards if loss of containment occurs. (p. 7)

The effective use of communication in hazardous environments requires systems that function during normal and abnormal conditions with a common purpose that is simple to understand and use (Strauch, 2004). The characteristics of effective communication and behavior within an organization must be focused on balanced, clear targets (Kaplan, 2005). To achieve optimal employee participation and commitment, the challenge is for the leader to effectively communicate and demonstrate the relevancy of the business purpose to financial institutions, community, people, and the environment (Kaplan). Employees create wealth for the organization through their behavior; at the same time, they experience frustration with and arising from organizational dysfunction

(Jaques, 1989). Kaplan suggested that for a business to achieve excellence, it is the leader's accountability to provide a balanced set of targets directly tied to daily operations and to receive feedback from employees so that issues are resolved in a collective and an open approach.

Mintzberg (1975) commented that a manager plays several roles: monitoring subordinates for unsolicited feedback, systematically disseminating information to subordinates who otherwise have no direct means of access, and representing the unit or division to external audiences or stakeholders. Often, the biggest challenge to managerial effectiveness is having insight into one's own work accountabilities to link information and authority to the technology and the findings of that particular manager's analysis about what the organization needs (Mintzberg). Here the concept of personal effectiveness is connected to leadership as a topic important in creating affective leadership at all levels of the organization. This is very similar to Jaques's (1989) requisite hierarchical managerial structure.

The three theories are clear that management should regularly communicate on quality, reliability, safety, financial condition, regulatory issues, political, human resource, investments, customer issues, training, stakeholder expectations, and health issues for the oil refinery. In addition, ongoing solutions to system problems, along with approximate completion dates, should be communicated. These topics were included in several areas of the BERS. Management systems must be adaptable enough so that corrective actions can be taken when needed when systems are either breaking down or

not functioning as anticipated (Kotter, 1990). The accountability of the leaders or managers is to set up systems so that teams can make equipment design decisions that address and eliminate latent defects.

All of the basic quality tools suggested by Crosby (1990), Juran (1995), and Kanji (2001), as well as many others, focus on the same foundational elements of product and service quality. The cost of quality is free when compared to the costs of nonconformance to product quality, customer satisfaction, and the bottom line (Crosby). Even the methods to measure important costs and process variables fit into the KBEM (Kanji, 2002).

Deming

In the late 1940s and early 1950s, there was a dramatic move to rebuild the infrastructure and economy of Japan after World War II. An American business consultant named W. E. Deming was brought to Japan. He introduced the Shewhart statistical tools and quality concepts to Japanese businesses through the Japanese Union of Science and Engineering (as cited in Walton, 1986). After Deming provided extensive training to Japanese employees and managers on the quality tools and concepts, they began to master the techniques and greatly improve their businesses and the economy. In part because of Asian society, managers and employees quickly accepted the concepts of measurements to improve production and performance. Japanese business leaders realized that they needed to improve the quality of their products while maintaining a competitive cost position if they wanted to become leaders in the global economy.

As the result of Deming's (1982/2000) efforts, prizes named in his honor were instituted. The awards recognized individuals or companies that practiced the principles and methods of total quality control. From the 1960s to the 1980s, the benefits of a quality control process were quickly realized in such major Japanese businesses as Sony, Honda, Toyota, Yamaha, and many others. These companies rose to global power during those years in large part because of the work of Deming and others.

Other countries quickly followed Japan's lead in recognizing quality. In America, the Malcolm Baldrige National Quality Award (MBNQA) became the standard of excellence. It is covered in more detail later in this study. In Europe, the quality prize was known as the European Foundation for Quality Management Excellence Model. These awards were meant to encourage and recognize the ongoing work of organizations to achieve customer and stakeholder satisfaction while increasing performance and long-term success (Kanji, 2002).

Crosby

Crosby (1990) stated that to change an organization to a quality orientation requires conviction, commitment, and conversion by all managers because managers effect as part of the company culture through their authority and responsibilities. The major components of quality management principles and responsibilities include customer focus, continual improvement, establishment of mutually beneficial supplier relationships, involvement of people, factual approach, system approach, process

approach, and leadership. Crosby argued that the organization must have a consistent and understandable reason for being or doing what is needed for their customers.

Likewise, Deming (1982/2000) stated that customer satisfaction and the creation of value for customers is the major purpose of a business. It is critically important for a business to provide meaningful jobs to all employees. This purpose does not include giving in to what the customer wants; rather, it focuses on providing each employee with the ability to contribute to the manufacture of the highest quality products at a reasonable cost. Profit is not the reason for existence, but it is recognized as foundational to organizational growth so that more customers may be satisfied.

Crosby (1990) also observed that leaders are key to establishing this purpose and direction for an organization. Leaders are responsible for enabling all employees to fully participate in creating value for customers (Hoyle, 2004). To inform leaders about quality, Crosby defined four absolutes:

1. Quality is defined by conformance to requirements, not goodness.
2. Quality is achieved through prevention, not appraisal.
3. The quality performance standard is zero defects, not acceptable quality levels.
4. Quality is measured by the price of nonconformance, not indexes. (p. 50)

Note that there is no ambiguity about what it takes to achieve quality through conformance, prevention of defects, and measurements.

Juran

Another quality practitioner and leader known for his organizational quality work from the 1960s to the 1980s was Juran. He worked intently on developing processes to

study and analyze problems and then create the necessary measurements and monitoring methods to resolve issues. Juran's (1995) research evolved into the field of Statistical Process Control. In addition, he established a large following of students and practitioners who had received their formalized training and accreditation at the Juran Institute. Juran's methods also are the fundamental building blocks of Six Sigma (Pande, Neuman, & Cavanagh, 2000).

In Juran's (1995) work, key process variables were first selected on the basis of what is important for assuring quality. The data were collected, tracked, and monitored on a routine basis. Upper and lower limits for acceptable performance were established using standard formulas that need some interpretation for acceptable performance. Companies using these methods established quality teams made up of a combination of experienced employees and experts both hourly and salary. These teams used Juran's techniques to attack problems that are not easily resolved and are often complex because of the number of variables involved. These types of problems are difficult to see without deeper analysis.

In comparison, Juran (1995) and Deming (1982/2000) contributed foundational elements to help operators and key stakeholders of the process understand the variations in manufacturing that cause unexpected failures. They both utilized the statistical methods of Shewhart, as well as other team-based techniques of brainstorming, fishbone analysis, benchmarking, and other statistical tools, to discern patterns from the data. The basic approaches were the same; however, the major difference was in the method to

create systemic changes. Deming collected data analyses to identify key areas to focus and improve, whereas Juran enhanced teamwork through extensive upfront design work in the development of sponsorship, quality champions, team charters, specified deliverables, and recognition of quality teams.

As Six Sigma continued to evolve, Juran (1995) asserted that these types of large projects can be handled using the Six Sigma approach (Pande et al., 2000). Six Sigma uses a multiple-step process with details using the Design Measure Analyze Improve and Control tools mentioned early to break the project into achievable goals. For example, questions are used to eliminate team frustration at the beginning. The Six Sigma methodology currently in use has been acclaimed for its dramatic turnarounds and resulting business success. This topic is explored in more depth in the following sections.

TQM principles. As stated in the introduction of this study, Gopal Kanji (2002), a leading global quality practitioner-scholar, offered the following definition: "Total Quality Management is a *management philosophy* that fosters an organizational *culture* committed to *customer satisfaction* through *continuous improvement*" (p. 2). The concept means that business is becoming part of a larger context where people, processes, products, services, and support are part of the strategic fabric of the business environment. Kanji and Jaques (1989) agreed that managers are accountable for the systems that drive their work processes. Schoderbek et al. defined systems as "a set of objects together with relationships between the objects and between their attributes related to each other and to their environment so as to form a whole" (as cited in Kanji,

p. 10).

Continuously learning about quality is a prerequisite to staying competitive in an ever-changing global context (Campenella, 1999). TQM is more of a combination of concepts and principles that have evolved from past research. The principles vary among organizations and countries, but certain "…essential principles can be implemented to secure greater market share, increase profits and reduce costs" (Kristensen, Kanji, & Dahlgaard, 1993, p. 17). A leading contributor to organizational learning was Peter Senge.

Senge

Another knowledge innovation that complements the quality movement is systems learning and organizational learning. Senge (1990) contributed to the concept of developing a systems learning perspective of organizations. This concept models the concept of learning about oneself and the organization through careful observation of the interactions and relationships in the organization (Senge, Kleiner, Roberts, Ross, & Smith, 1994). The connection with quality is the continual process of knowledge improvement, along with an analysis of the interrelationships among different parts of the system. The other important connection in the quality area is paying attention to the systems of behavior within the organization. The importance of teamwork and the establishment of organizational designs that allow people to work without organizational silos is a concept that enhances quality. Working in a trusting and open environment is a certain aspect of learning within the organization. This combination of organizational

learning and a systems approach to organizations is key to improving products and services.

Senge (1990) noted that "the dynamics of managing quality and capacity do not differ fundamentally in a wide variety of service businesses" (p. 332). Organizational learning is a place "where people continually expand their capacity to create the results they truly desire" (Senge, p. 1). Achieving quality in terms of consistency of expectations for products or services also links in to people's desire to do good work. It is easy to see how one can equate quality in products; however, it is more difficult to measure the variability of services produced within organizations because quality is judged by human interactions when services are exchanged. Managing transactions between people is challenging because it has to do with the perceptions and expectations of the customer. Most TQM principles classify quality improvement through Plan, Do, Check, Act (PDCA) learning cycles (Deming, 1982/2000).

Kanji's (2002) leadership model is drawn from a consistent approach to the major quality leadership models. For example, Dahlgaard, Kristensen, and Kanji (1998) suggested that leadership should be responsible for customer satisfaction: the delivery of products and services; the processes, services, and measurement systems to deliver the products; the education and training of the employees; and the well-being of customer and employee relationships.

KBEM and the BERS

Although each theory has validity, it is impossible to include all aspects of each in one questionnaire. The overall variables constituting the framework of the BERS came from the CSFs. Using the KBEM (Kanji, 2002) with the information provided earlier, the following points, which were related directly to leadership responsibility, were tested:

1. Enabling people, reliability, quality, safety, environmental, and investment growth plans.
2. Using balanced metrics to drive improvement strategies and tactics.
3. Leading; participating; and supporting quality, reliability, safety, environmental, and learning performance.
4. Linking individual and department goals to long-term quality and reliability improvement goals.
5. Communicating through various mediums to demonstrate commitment and accountability.
6. Modeling respect, integrity, care, and honesty in routine communications.
7. Opening channels of communication to all levels of the organization.

Deming (1982/2000) developed specific guides or practices that summarized his points for management quality. Although each of Deming's 14 points is not specifically addressed in the three major theories discussed in this study, they are the basis for much of the TQM work developed over the last half of the 20th century. As such, they were the foundation for the definition of leadership in the KBEM (Kanji). The next sections define

the key latent endogenous variables in the KBEM, with comparison and contrast statements from the three major theorists (see Table 4).

Table 4

Managerial Accountability Constructs

KBEM CSF Constructs	Requisite Organization	Management of Human Error	Synthesis of Constructs
Leadership (prime)	Org. values, results-based managerial accountable hierarchies	Identifying hazards, defenses, and losses	Vision, goals, commitment, structure, strategies, processes to manage the culture
Delight the Customer (principle)	CEO accountability	Commercial and Operational pressures	Building expectations and feedback in business plans
Customer Satisfaction	1) Providing goods and services that community seeks, (2) reasonable costs, price, and quality improvement	Error making & decision processes and third-party suppliers.	Products specifications, processes, and procedures to produce customer expectations
Internal Customers are Real	Employment contracts of clear accountability throughout	Components of a safety culture (p. 195)	Open communications, learning oriented
Management by Fact	Systems drive behavior	Management tools for error management and decision making	Information is integrated systems & processes, and fact-based analysis
All Work Is Process	Ownership, accountability, and authority for all processes	Managing 11 general failure type mechanisms	Functions, role relationships, teams assigned, design, communications
Measurement	Time span of control and task complexity	Error reduction/containment measures	Measurement to increase or reduce exposure or to create optimal conditions, time based, matched to capability
People-Based Management	Individual Development & recognition - coaching, counseling, mentoring, teaching, training	Culture of reporting and learning	Identifying the skills, rule, knowledge- basis for safe effective and productive work

Table 4 (cont'd)

Teamwork	Identify type and needs of project teams, colleague, subordinates, & mixed teams	Awareness of intention, actions and consequences	Solving real problems with intention and clarity of relationships
People Make Quality	Task initiating role relationships with specifications for authority and accountability	Quality assurance & control	Cross-functional design teams clarified with role relationships, authority, and accountability
Continuous Improvement	Accountable managerial owner of the processes	Investigations, sharing, and learning through awareness of latent conditions/factors	Formal and informal structures for learning and feedback within system
Continuous Improvement Cycle	Managerial accountability within time span of complexity	Broader personal factors, engineering human-machine interface, and organizational systemic factors	PDCA cycles impacting quality, reliability, and safety
Prevention	N/A	Defenses are maintained in all aspects of the organization	Organizational preventive maintenance system
Business Excellence	Organizational value for employees, stakeholders, society, government, and community	Creating results-oriented culture for safety, reliability, quality, and profitability for stakeholders and the community	Employee relations, stakeholder value, corporate citizenship

Delight the Customer

Kanji (2002) contended that customer expectations have to be completely satisfied in order for an organization not to switch to alternative suppliers. Customers are satisfied when what they asked for is available on a consistent basis. This attitude is created by experiences with the products or services. An emotional affinity is created for customer loyalty. Delighting the customer as a means of performing business may result in less money being spent on recovering or attracting new customers.

Jaques (1989) did not address customer satisfaction from an external perspective; however, from an internal customer view, a requisite organization is structured to ensure that employees and managers alike are highly satisfied because of the clarity of work tasks specifically matched to the employees' capabilities. It is the CEO's accountability to ensure that services and products provide customer satisfaction and that the organization provides meaningful for work for all employees (Jaques, 2002). Jaques (2002) believed that three or four goals should be set for each manager. These goals should specify manufacturing accountability, role relationships, product/service accountability, and development of customer/supplier networks. Reason (1990) also did not specifically cover customers; however, like Jaques (2002), he believed that communication is essential to delighting the internal customer.

People-Based Management

To Kanji (2002), people-based management means having an organization in which employees are equipped to do their jobs in terms of knowledge, skills, and competencies. This requires a system of communication that tells employees how well they are doing their assigned tasks. This openness builds encouragement, commitment, and responsibility among employees. The concept continues by expanding commitment into customer satisfaction as part of a quality organization. Jaques (2002) was aligned with this theory of an organization, but he also defined the roles and responsibilities as prime objectives for managers and subordinates. The standard relationships should be defined in terms of particular authorities and responsibilities according to the tasks

needed to be performed, which he called task-initiating role relationships, which are the responsibility of management (Jaques, 1989).

Jaques (2002) defined the management of people's capabilities as individual development. Jaques and Clement (2000) defined the keys to developing people as coaching, counseling, mentoring, teaching, and training. Coaching sessions are regular discussions that happen between managers and subordinates to increase the skills of the subordinates to handle increasingly difficult work. Counseling is about helping individuals sort out difficult problems. Mentoring is about managers' development of specific plans for improvement to help subordinates reach their highest potential growth within the organization. Teaching is more about helping others through lectures or didactic methods. Formal and informal training is intended to help individuals enhance their skills and knowledge through on-the-job courses (Jaques, 1989). Here, emotional intelligence builds knowledge, and it is just as important as skills and experience (Goldman, Boyatzis, & McKee, 2002).

Quality management theory (Deming, 1982/2000) posits that internal interactions within the organization always have a customer-supplier relationship. The output of one group should meet the standards and specifications of the downstream customer, and visa versa. Managing these relationships is an essential part of interconnecting people and their relationships, which creates effective work. Internal customer-supplier relationships were tested as part of the BERS.

Continuous Improvement

Continuous improvement is an organizational commitment to advance all processes and the work that drives customer satisfaction. Testing, monitoring, and changing are practiced consistently. These processes are important because no matter how good a company is, a competitor is always working to improve or exceed current expectations. This process should happen in all key activities of the organization.

In quality management, the key to continuous improvement is driven by the PDCA learning cycle. According to Dahlgaard et al. (1998), managers at the senior and middle levels should develop plans for improvement in:

1. Customer satisfaction.
2. Employee satisfaction.
3. Products and services.
4. Processes (systems and technology).
5. People (education/training).
6. Customer relationships.
7. Supplier relationships.
8. Measurement systems.

To transfer theoretical constructs into meaningful actions on the shop floor, the organization must have the ability to learn from unanticipated events, problems, or failures. Learning starts with a thorough and rigorous investigation that must be able to link equipment failures to the human and management systems that created them. The

challenge often lies in stating the findings and causes in a way that personnel removed from the failure believe the facts so that they will embrace and commit to change.

The TQM theorists in this study stressed that learning can be derived from investigations. The language of TQM often is theoretical with regard to learning, and converting quality language into easily understood words and concepts is not straightforward. To help with that task is Reason's (1990) work on managing maintenance actions and error, which evolved from years of inquiry into major, global, industrial incidents. His structured approach was derived from his findings based on his investigations and research.

Management by Fact

Knowing the facts about the current performance at all levels of a company is essential for facilitating the decision-making process. Without facts, decisions have to be based on opinions, assumptions, or subjective data whose accuracy may result in new and unintended problems. An important part of a routine management process is having a systematic approach to gathering, evaluating, and acting on the facts (Kanji, 2001). Data quality appears at many different levels, and each type of data quality has a different application based upon the need for the timeliness of the decision. Data that are not as rigorous usually take less time to gather, thus facilitating expeditious decisions.

Internal Customer Satisfaction

Internal customer satisfaction refers to a structured approach to processes and relationships that collaborate to produce the product or service for the external customer.

Each group depends on the other for quality outputs to achieve customer satisfaction. Effectively managing these relationships is key to an organization's performance and results. This concept links very well into the systems, specifications, processes, and guidance documents described by both Jaques (1989) and Reason (1990).

External Customer Satisfaction

From a quality perspective, customer satisfaction entails self-evaluation (Kristensen et al., 1993). An outward-looking company demonstrates this concept by measuring the expectations and success criteria of its customers and then setting these as internal goals and targets. According to Kristensen et al., customer satisfaction may be linked to company earnings, as measured by the optimized allocation of individual resources, loyalty of staff, and customers, in comparison to the competition. This work can be done through surveys, length of average service, suggestion schemes, complaints received, and other analyses. This concept ties into all TQM principles as well as most organizations, particularly service businesses.

Because a manufacturing environment is less focused on marketing, the quality management approach is perhaps less relevant to the manufacturing arm of an organization. This is not to say that the business as a whole should not expend considerable effort on marketing, advertising, brand equity development, new products, growth strategies, and supply chains, but it does indicate that the BERS should be more focused on the measurements closest to the control of customers and suppliers within or directly connected to manufacturing. In other words, the concepts are the same, but the

customers are generally at a wholesale level for a large manufacturer such as an oil refinery.

All Work is Process

Process has an input, a sequence of steps, and an output, the delivery of a product or a service combined with feedback back to the input. Various methods, functions, specifications, guidelines, standards, resources, equipment, metrics, and expertise are required to complete a process in the refining organization. The mark of a quality organization is a constant focus on reducing variations in its processes (Kanji, 2002) by paying attention to the special causes or by understanding and repairing the common causes. This concept of creating value for customers was also supported by Michael Hammer, noted business organizational consultant. In 1996, Hammer noted, "Customer value is created through processes, business success results from superior processes performance, superior process performance is achieved by having: superior process design, the right people, and the right environment" (p. 105). Hammer argued that for a business to succeed, it must be customer driven and process focused on management structure and strategies. Several methods can be used to study and analyze processes, including statistical analysis, histograms, control charts, scatter diagrams, for example. Information technology processes are needed to connect relationships in the entire organization among the functions of supply, production, people or staff needs, order fulfillment, customer satisfaction, and stakeholder expectations.

Measurement

Measurements track organizational performance related to customer satisfaction and financial health. Numerical targets and qualitative targets require tools and methods to collect and communicate data. Multiple methods can be used: surveys, questionnaires, focus groups, market trends, interviews, computer database sorts, benchmarking, or other means. The point is that the combination of methods used must be routinely and analyzed to determine if the results (metrics) are moving in the right direction. This seems like a common-sense approach, but if not applied in a disciplined approach, it can yield unanticipated or unpredictable results. Jaques (1989) stated that roles can be confused and communication can be hampered because the organization and its managers are unsure what to communicate or what their accountability is to communicate. People become afraid of being blamed for bad news.

Kanji's (2001) KBEM concepts supported the development of the surveys used in this research. The intent was to test the CSFs on a routine basis and inform management of particular areas that merit a focus of resources.

Teamwork

Teamwork is defined as people working together to achieve a common purpose. In many cases, people working in teams may develop a different perspective about the organization. With teamwork, different groups and individuals may communicate about the need for quality outputs to complete their work. Teams also may help to create the conditions for eliminating barriers between groups. Teams are an essential part of a

complex organization because no one person has all the answers or can solve all the problems.

The way in which maintenance and operations personnel work together in teams to keep equipment functioning at an optimal level is key to continuous improvement in the organization. When repairs are needed, they are handled efficiently and effectively. Creating emotional empathy between these two teams is essential for a healthy and productive environment, which builds top performance (Goldman et al., 2002). Effective teams know which roles and processes are needed for them to be effective. Tools are used effectively in team data collection processes, analysis, planning, decision making, execution, learning, giving of constructive feedback, and improvements in projects or solving problems (Scholtes, Joiner, & Streibel, 2003).

People Make Quality

Systems often get in the way of people trying to do a good job (Jaques & Clement, 2000). People, not systems, resolve problems and bring others to a higher performance level. In resolving the circumstances that prevent success, real problems need to be addressed by immediate supervisors. In this case, managers are responsible for removing the barriers for people, thus ensuring quality.

Jaques (1989), Kanji (2002), and Reason (1990) stressed that people need to be equipped with the knowledge, skills, rules, and systems to do their jobs. They all agreed that people need to be kept informed of how well they are doing. Once these conditions are met, people are then accountable and responsible for performing their assigned tasks.

"TQM recognizes that systems, standards and technology themselves will not ensure quality" (Lawler, 1994, as cited in Kanji & Tambi, 2002, p. 101). The people who do the jobs construct the quality. Therefore, to improve quality, employees who do the work must participate in improvement efforts.

Managers are accountable for empowering people to make changes to the process. Draman (2004) focused on a three-entity integration of a living business systems approach to organizational management. The premise of the model is that three entities are required for a living business system: functions and activities, inputs, and organizational knowledge. The premise is that individuals subordinate their performance for the benefit of the whole. In living systems, attention must be focused on generating new knowledge (Senge, 1990). The process of learning within living systems is often termed the continuous improvement cycle.

Continuous Improvement Cycle

Continuous improvement is a way to establish customer expectations and requirements, and to ensure that they are met successfully. A continuous improvement cycle continually verifies that the customers' input is acknowledged and given due consideration and that goals are set according to the customers' needs. Marketing research can help an organization assess customer data through statistical analysis; however, it is the manager's accountability to seek ways to make long-term improvements to the system of production (Dahlgaard et al., 1998). Although the TQM strategy of improvement does not end with one change, the major belief is that deeper

understanding, statistical methods, and proper analysis are necessary parts of any organizational improvement effort.

Prevention

Prevention in TQM means eliminating the causes of problems before they occur. This concept works in tandem with continuous improvement processes to seek out, identify, and drive failures out of the system. In this methodology, the design of the process is reviewed for flaws or wastes. The next step is to focus on the production process itself. Using a statistical reasoning package, these failures can be addressed before they become repeat failures. Root cause analysis (RCA) is an example of a primary investigation tool or a structured approach to examining system failures. Completion of the analysis provides a clear sign of where to focus attention and corrections (Kanji, 2002).

Setting and holding people accountable to maintain general housekeeping expectations and standards is another prevention strategy. The purpose is twofold in that (a) maintaining a clean working area creates ownership and the mindset of a professional approach and (b) good housekeeping creates a safer working environment by taking proactive steps to prevent slips, trips, and falls due to cluttered and unclean conditions. The theory follows from Reason (1990) that a clean working environment creates efficiency of work task completion, thereby facilitating the proper interactions.

Kanji's Perception of Business Excellence

In the concept of business excellence, as explained by Kanji (2002), a measure can be taken simultaneously to ascertain the health of customer satisfaction, stakeholder satisfaction, and employer satisfaction. This simultaneous evaluation becomes the core of the focus areas for concern. The BERS along with the KBES provided a BEI that condenses the CSFs into internal and external scores as well as an overall index score.

Stakeholders

There are two different classes of stakeholders: internal and external. Internal stakeholders are part of the organization's interworking fabric or environment. The individual managers are responsible for these duties. The external stakeholders are in the peripheral environment, but they still impact or effect great change in the organization. External stakeholders include unions, suppliers, competitors, customers, and government agencies. To bridge the concepts of producer of goods and supplier of services, the concept of stakeholder was developed by Crosby (1990). In the case of service businesses, the concept of stakeholder is perhaps a fitting connection to the customer concept. Almost all quality processes are targeting true change in the way people think and act as identified as part of their culture or behavioral norms. The global stakeholders in this case are the owners, customers, employees, community members, government agencies, suppliers, consumers, and other interested parties. With a broader understanding of stakeholders, expectations for quality relationships between sales and services may be quantified or qualified for testing and measurement.

Supply Chain Management

Additional research by Kanji and Wong (1999) focused on relationships between supply chain management (SCM) and TQM using the Kanji's (2002) KBEM. The researchers developed a new SCM model that incorporates TQM principles to better utilize supply chains to achieve business excellence. Kanji and Wong tested the hypothesis that leadership leads to customer focus, cooperative relationship, management by fact, and continuous improvement, factors that help companies to achieve business excellence. After reviewing TQM principles and the SCM model, Kanji and Wong concluded that the original SCM missed some of the key concepts in supplier relationships, such as the leader's role in establishing supplier relationships. The new SCM model included six variables: leadership, customer focus, cooperative relationship, management by fact, continuous improvement, and business excellence.

Of 1,050 surveys mailed out, 145 were returned, and 134 were completely filled out and used in the statistical analysis. The respondents included senior and middle managers. The sampling design included a query of Federation of Hong Kong Industries of 1997. The selected companies made significant purchases including manufacturers, wholesalers, and importers. Respondents answered the questionnaires on a 5-point Likert scale. Cronbach's alpha was measured at .7, or above, indicating good internal consistency or reliability of the answers. The new SCM was found to be a suitable fit in the chi-squared results of 5.627 ($df = 1$) and a comparative fit index of 0.93 and a normal fit index of 0.991 (Kanji & Wong, 1999).

The results revealed that leadership in an organization builds strong supplier partnership relationships, which translate into stronger business performance for both partners through teamwork and customer satisfaction (Kanji & Wong, 1999). The significance of this research was its assertion that simply focusing on the supply chain is not sufficient to build quality supplier and buyer relationships for the long term. The surprising finding is that the well-known original model of SCM had deficiencies that were addressed by the new SCM (Kanji & Wong), which was founded on Kanji's KBEM (2002). In addition, the KBEM is adaptable to testing the supply chain management, not just companies involved in TQM as part of the stakeholder survey. A refinery does not have to be engaged in TQM to obtain a meaningful measure of the business excellence constructs because the topics are fundamental to all manufacturing business. Kanji and Wallace (2000) described the effect of customer satisfaction on business excellence in terms of customer expectations, perceived quality, perceived value, customer satisfaction, customer complaints, and customer loyalty.

Root Cause Analysis Data

The KBEM (Kanji, 2002) uses the variable "prevention" to describe and measure an RCA approach (Kanji). All causes have two important aspects: an action and a condition (Gano, 1999). A cause can be the same as an effect. This means that in one sequence, an effect is the cause of the next effect, or the effect of one sequence is the cause of the next. In quality processes, once the problem has been identified, the next step is to understand the cause of the problem and then find an effective solution.

RCA is a description that has been used in industry for different reasons. The degree to which one drives down taking baby steps is a function of investigation time and expertise. For example, one can explore all possible categories of cause, mechanisms of cause, mode of failure, sufficiency and necessity of causes, reasonableness, logical, and so on. At some level, causes may be common and those assumptions of common cause stated in a positive construct build the KBEM (Kanji, 2002) for refining.

In quality management, several tools can be used in the category of RCA, including fishbone analysis, event tree analysis, cause and effect diagrams, failure mode and effect analysis, loop diagrams, and many others. Recognized as one of the most rigorous methods of analyzing a problem, RCA was developed in an attempt to resolve complex exploration, manufacturing, production, distribution, and marketing problems at a fundamental level. The RCA method is a structured, fact-based approach to understanding discovery, learning, and actions.

Management has the accountability to understand and resolve the causes of problems that impact business excellence. Drucker (2002) explained that instead of identifying most probable causes in a complex system, it may be necessary to identify which factors are sufficient or essential for a system breakdown. Often this requires system-human interaction. Drucker stated that human errors occur often because of "interactions between human behavior and features and vulnerabilities of their operating worlds" (p. 38). Often there are common themes of causal factors both at a system level and at a human factor level in complex manufacturing industries (Reason, 1990).

Summary

This work is new because it combines three significant theories and applies them to a highly complex operating environment, connecting them into business excellence managerial accountability. The theories and components explored earlier can be synthesized for the purpose of measuring the fundamentals of business excellence. By comparing the KBEM (Kanji, 2002); requisite organizational structures (Jaques, 1989); and managing human error (Reason, 1990) theories, all of the basic aspects of refining can be measured and tested in one questionnaire. In chapter 3, the research design operationalizes the constructs of each of these theories.

CHAPTER 3: METHODOLOGY

Introduction

This chapter provides detailed information about the research design, target population and study sample, survey instrumentation, statistical methodology, data analysis, and measures to protect the participants' rights. The methodology describes the construct, content, and criterion validity tests. It also includes a detailed explanation of the administration of the BERS and the KBES.

Research Design

This quantitative study utilized Kanji's statistically validated assessment tool based on several other applications of the KBEM in higher education, banking, health care, and other manufacturing industries around the world (Kanji, 2002). Because this study is an extension of the KBEM, the BERS and the KBES indices can be compared with the results of other industry business excellence studies. The researcher utilized the 14 critical success factors (CSFs) from the KBEM as the framework for the development of the Business Excellence in Refining Survey (BERS)-Part A. The Kanji Business Excellence Scorecard (KBES)-Part B was derived from Kanji's 5 CSFs framework suggested for external stakeholders. The CSFs for the oil-refining industry were defined, compared, and contrasted to Jaques's (1989) management system theory, the KBEM, and Reason's (1990) human error theory. Recall that the purpose of the study was to conduct a survey that measured in a simple, valid, and robust way the managerial accountability in an oil refinery from the perspective of its customers, suppliers, employees, owners, and

external agencies. The perceptions of the stakeholders were measured in variables linked to the CSFs via the BERS and the KBES.

An alternative method to develop the theory was to perform a qualitative research with focus groups and direct observations. The disadvantage to this approach was that the interview data would be focused on a phenomenon within one refinery on the U.S. Gulf Coast. The intent of this work was to derive a research method that could be easily applied to measurable business performance quality variables at any oil refinery. The weakness of using a survey method to study an issue is potentially a low response rate of 10% to 20%. To encourage participation on the BERS and the KBES, it was hoped that senior level backing and commitment to making positive change based on the survey results would improve return response rates to between 30% and 50%.

A third option to obtaining the data was to use historical trends from existing records. This approach was not taken because of the potential bias that would be introduced into the analysis either because the researcher injected his own opinion or the questions that were relevant over time may be taken out of context.

This empirical study was designed to test the relationships in an oil refinery's managerial accountability based on the 14 CSFs identified in the KBEM (Kanji, 2002). This quantitative approach was selected for four reasons:

1. There is no application of the KBEM in an oil refinery. This work will help to assess the effectiveness and reliability of the model.

2. There is a need to build clarity on the importance of relationships between management accountability to the variables of customer satisfaction, quality, safety, reliability, financial, organizational learning, and environmental performance for all industries (Jaques, 1989).

3. This quantitative study described perceptions about the health of the organizational systems and the processes that create or infer the cause and effect of current operating conditions, performance, and results of a particular refinery on the BERS.

4. This study provided a one-time simultaneous cross-sectional overall view of the strengths and weaknesses of an oil refinery, as perceived by stakeholders, suppliers, internal employees, managers, and owners. The findings will add to the body of knowledge of business excellence.

Although this study could have been undertaken as longitudinal research to establish trend data on refinery performance, the researcher declined the opportunity because that was not the focus of this study. Creswell (2003) noted that one of the difficulties of using a quantitative design in a cross-sectional survey lies in trying to disentangle changes in the general population over time so that individual management and employee changes may not be discernable. Limitations that influenced the research methodology were the time and resources needed to prepare and contrast the data. Other methods of field research designs were considered, but they also were eliminated for a variety of reasons. The limitation of an observer interacting with a large study sample

would make it difficult to replicate, compare, or generalize the findings. There is the possibility that if one were interviewing on the shop floor, group dynamics could bias responses. Individual, confidential, and private responses on a written survey addressed that issue.

Grounded theory is more typically and appropriately used in discovery, but the maturity of the oil-refining business does not need to be investigated. The rules, laws, regulations, and business constraints of grounded theory are well understood (Creswell, 2003). Experimental or quasi-experimental designs were considered but ruled out because they are more appropriate in a laboratory environment, where artificial conditions can control and test a theory. A case study method would not have provided the appropriate connections to various types of stakeholders.

The components that were analyzed as part of the regression are known as latent vectors or latent variables. Latent variables were chosen to provide maximum correlation with the dependent variables (DVs). In the case of the BERS, Kanji's CSFs were the underlying latent variables that accounted for variations in the responses of the manifest variables.

The BERS measures the relationships between latent variables corresponding to the KBEM concepts. The latent variables are an operationalization of the theoretical constructs of TQM. The variable of leadership and the core concepts mentioned in chapter 1 are latent variables because they cannot be directly measured, but are represented by the manifest variables instead (Kanji, 2002).

The manifest variables in the model are represented by the directly observable values indicated by the answers to the questions. These observations are made by a person who establishes a value according to his or her perception. Multiple manifest variables link to one latent variable. By combining several manifest variables into one latent variable, the overall representation is strengthened through correlation weights (Singleton & Straits, 2005).

PLS regression analysis was used in the BERS to calculate the scores of the various parameters. These scores were analyzed for each construct and linked to the manifest variables in the model. Together, these scores showed which measurements need to be increased. A reliability analysis was based on mathematical tests using Cronbach's alpha and chi-square test results.

Implementation Plan

The implementation of this study includes an explanation of the data collection, survey development, data analysis, sensitivity analysis, and summarization. This plan is a customization of the concepts in the KBEM (Kanji, 2002). Figure 5, a graphical model of the methodology for BERS, reflects the steps of each phase of the development of the study. Each step in the process is explained in detail.

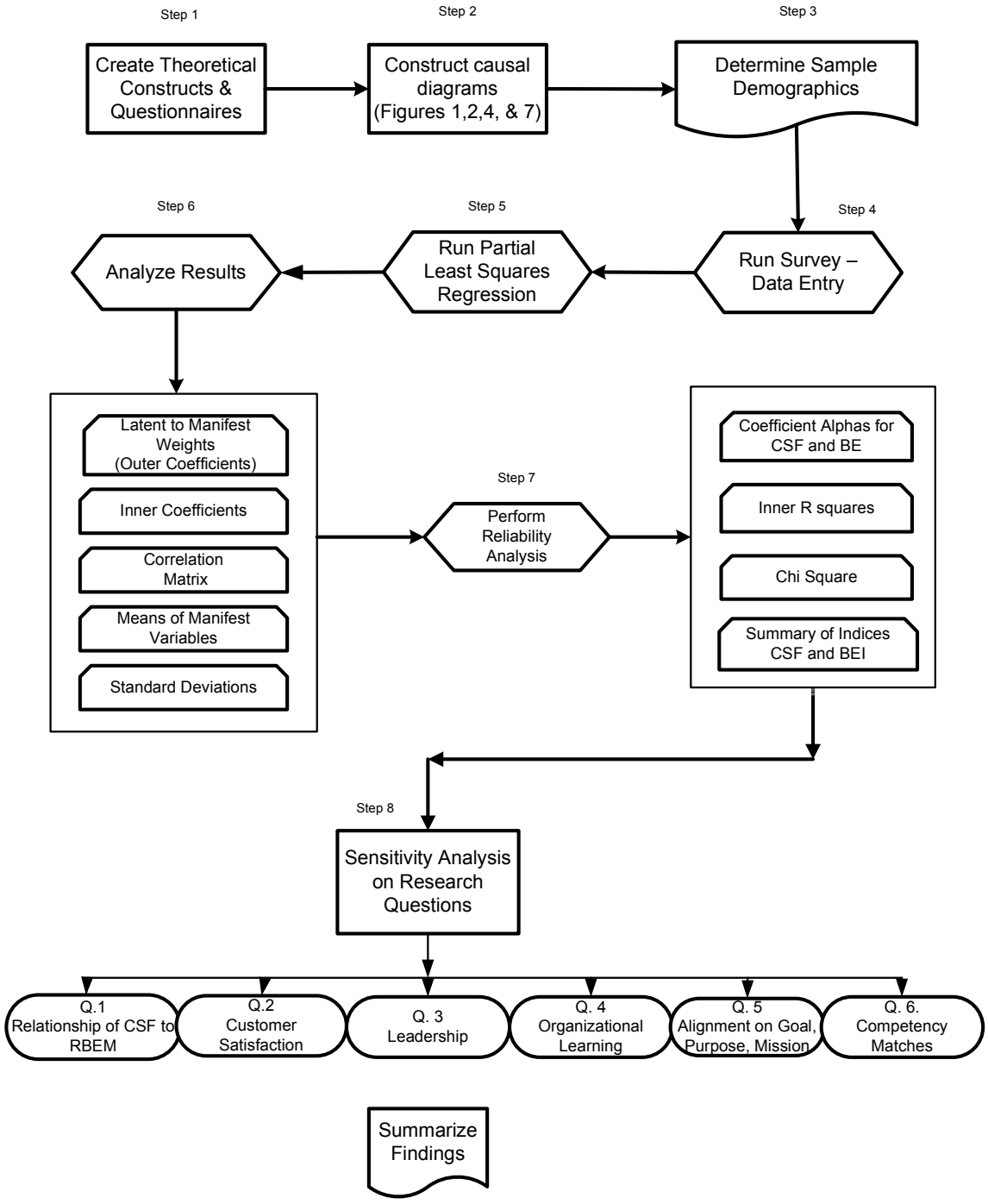

Figure 5. Methodology for the BERS. (This model demonstrates the approach used in this study to build the theoretical constructs, collect data, build the model, make comparisons, and draw conclusions about the research questions).

Step 1. Explanation of the Model

Development of the theoretical model was based on a structural equation with strong theoretical foundations. The KBEM (Kanji, 2002) was the foundational framework for the development of the BERS. The KBEM has a predetermined set of CSFs that has been proven reliable from quality management.

Using the theories developed from literature and extensive quality management programs, the KBEM structural model was developed to represent the major aspects of an organization (Kanji, 2002). Variables in a structural model are categorized as latent or manifest. Latent variables are both endogenous and exogenous, and they share the common definition that they cannot be explicitly tested. Latent variables are causal to manifest variables, which are assumed parameters that can be tested for accuracy, validity, influence, and reliability, as representing the constructs of the model.

In defining the structural method used in this research, Kanji (2002) explained that cause-and-effect relationships within a structural model are expressed as functional relations in a structural model that can exist between the effects on one or more causes. An example in the KBEM is that leadership (an exogenous latent prime variable) affects the CSFs (endogenous latent variables). Exogenous indicators and constructs are assumed to be determined by sources outside the model. "An exogenous variable by definition is never assumed to be caused by any other construct" (Nunnally & Bernstein, 1994, p. 578). Conversely, endogenous indicators may be influenced by, or caused by, other constructs within the model (Nunnally & Bernstein). Endogenous variables or indicators

can be influenced by other endogenous or exogenous indicators. Influences between variables may be called cause-and-effect relations, and the relative strength can be measured between one or more endogenous latent variables and with manifest variables. Each of these functional relations within the structural model is stated using equations (Kanji, 2002).

Confirming an analysis requires that the manifest variables reflect the latent variables, a process that utilizes a set of predictions among the manifest variables. Correlations were made between the consistencies of the manifest variable predictions and the observations and the magnitude of their differences using variances and covariance matrices. The strengths of these relationships were denoted as structural weights. Their disturbances are defined in the next step.

Step 2. Construction of the Diagrams

Model configuration. Inner coefficients are known as the endogenous latent variables, or the independent variables (IVs). These parameters cannot be compared across groups, nor can those that are produced by the same population over time. The amount of change represented on each effect variable is reflected in the causal strength of the relationship to the preceding endogenous or exogenous variable. Appendix C shows the naming convention and endogenous-to-exogenous relationships to each question. The standard deviation is the standard error of the sample estimate of the equation. It provides information on the spread of the means.

The direction of the inward or outward directions of the latent variables was built into the program. A latent variable is inward if the information is entering into the model structure; it is outward if it is leaving the structure. Business excellence is the only outward variable. The model iterates the outer coefficients from estimates of the relationships. Outer coefficients are the unstandardized structural weights of manifest indicator variables. The structural weights are used to reflect the number of changes in an effect variable resulting from a unit of change in a cause variable. The effect variables are endogenous; the cause variables can be endogenous or exogenous. All other causes of that effect are held constant. Diagrams are used for depicting the connections that represent predictive relationships to the constructs that correspond to the KBEM's (Kanji, 2002) CSFs (see Figure 6). The diagram gives an indication of the flow of information and assumed relationships. In some cases, these relationships can loosely be considered causal, but in this research, it is not considered a fact of causality.

Figure 6, a graphical representation of the BERS, matches the paths and interrelationships to the variables. In this step, a model was used to establish the set of structural and measurement elements that link the diagram to the constructs of the theory. Structural equations were used to link the constructs. Variables were assigned to the specific constructs showing which variables measure which constructs. A set of matrices was used to indicate the hypothesized constructs from the factors of the CSFs to the constructs or variables. The BERS was designed to identify the manifest variables to the latent variable constructs.

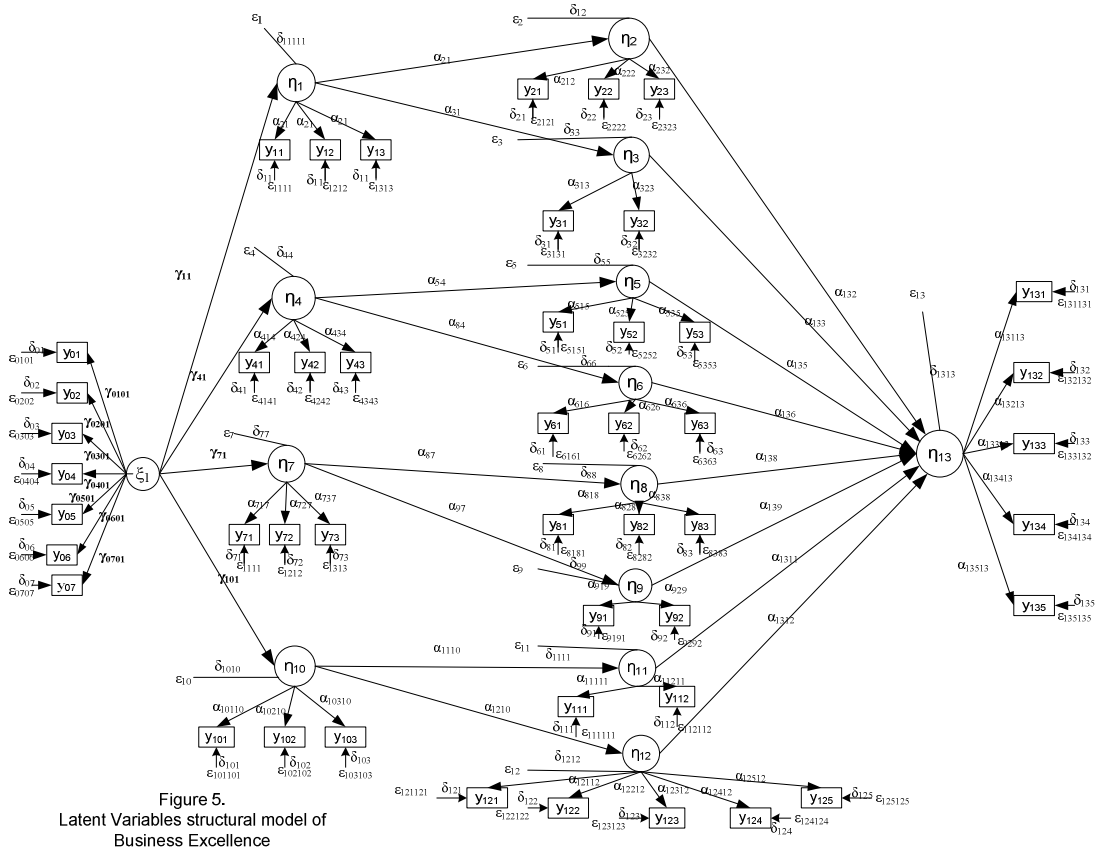

Figure 6. Latent variables structural model of business excellence.
(Based on the latent variable structural model, Kanji, 2002, p. 133)

Figure 6 of the BERS shows all the values of the endogenous variables change as a result of the exogenous variable or the preceding endogenous variable. The disturbance terms between the endogenous variables of the model are measured by ε_{ji}. Disturbance terms indicate the variations of the endogenous variable that are not attributable to other endogenous variables (Kanji, 2002). The parts of the model that are sources of variation are:

> (a) random shocks and/or unmeasured or omitted causes, (b) random measurement errors in the effect the causes, where the primary concern is error in one or more of the causes, and (c) non-random measurement such as bias in scales of measurement and method variance. (Kanji, p. 134)

The method used was patterned after the business excellence in higher education model (Kanji & Tambi, 2002). Responders to the BERS included corporate manager groups and owners (stakeholders) randomly selected from the refinery e-mail distribution lists. It is intended that the results will be available within one month of the completion of the survey. Various lists of the data results, along with interpretations and recommendations, will be made to management.

Measurement of the elements. The measurement of the elements was based on the Analysis of Covariance Structures (ACS; Nunnally & Bernstein, 1994). The model used matrix notation in a statistical package to set up the simultaneous equations. The exogenous variable in the KBEM (Kanji, 2002) is leadership, which is represented in the model as ξ_1. The other latent variables are denoted by $\eta_{i,}$ with subscripts where i = 2,…14 (see Appendices B and C for variable symbology). These latent variables cannot be directly observed, but they are defined by the manifest variables, which are labeled y_i. Each manifest variable is an endogenous variable. Structural parameters that associate the strength of each connecting line of directional causation are designated as γ_{ji}, α_{ji}, δ_{ji}. The structural variable connecting the exogenous variable to the endogenous variables is designed by the symbol γ_{ji}, where the j subscript indicates the number of the endogenous variable and the i subscript indicates the number of the exogenous variable connected by the arrow. The structural variable used to indicate the cause and effect relationship is

denoted by α_{ji} where the subscript *j* is the endogenous variable that is the effect while the *i* is the endogenous variable that is the cause.

Step 3. Determine Sample Demographics

Selecting the sample size and administering the BERS allowed the results to be correlated to the measurement items from a cross-section of customers, suppliers, managers, and owners. According to Creswell (2003), mail surveys run the risk of nonresponse for a number of reasons: The respondents may feel that they are too busy to take another survey, they may not believe that the survey is credible or will do any good, they may not understand the questions, or they may not trust the researcher's claim of data confidentiality. A return rate of 20% to 30% is considered acceptable for mailed surveys (Cooper & Schindler, 1998). Because the BERS was given by an employee within the company, the expectation for the response rate to a mail-in survey was 30% or higher. If a sample size return rate of responses had been less than 100, or 30%, then a cross-section of the oil refinery's employees and stakeholders by percentage or proportion of the segmented groups of operators, managers, technical support, owners, and suppliers was considered in a poststratification and reweighting.

The BERS and KBES population was defined as approximately 554 people for the oil refinery studied. The 554 total included 454 internal customers and 100 external suppliers. The sample design was to survey everyone on site within a 1-week time period. Because of shift work, vacations, training, or other absences it was assumed that approximately 70% or 318 people would be on site for the BERS. Using the same 70% as

a sample size design for external customers, 70 surveys were mailed out to external suppliers for the KBES. The external suppliers and vendors selected for the KBES were picked because of their volume of business with the refinery over the last year. The distribution of the 454 internal refinery stakeholders included hourly or classified employees; engineering or professional support employees; administrative, financial, or clerical employees; and managers working on site.

The confidence intervals were determined through the application of tables (Anton & Perkins, 1997). For the sample size, a plus or minus error of 3% and a confidence level between 90% and 95% is acceptable (Anton & Perkins). Marcoulides and Saunders (2006) suggested that error rates are greatly improved as the sample size increases. Larger sizes (e.g., $N = 100$ to 250) help to ensure that PLS estimation errors are acceptable (Marcoulides & Sanders). A sample of 388 BERS and KBES surveys were sent out with hopes of obtaining a return rate of between 100 and 150 completed surveys. Because this is a single organizational assessment within one refinery, no gender, age, race, or ethnic data were collected. However, demographics in terms of the role or position of the respondents within the refinery were collected such that a comparison was made to proportional information of the sample to the proportions of the refinery population.

Step 4. Run Survey and Data Entry

Data were entered manually into an Excel spreadsheet to check for accuracy. The estimated data that were inputted into the software came from Kanji and Tambi's (2002)

study in higher education and Kanji and Lan's (2003) study on business excellence in banking. Running computer-based PLS model equations, developed by Kanji, determined the path coefficients and the factor indices. Kanji's software was used, with permission, to compute the results of the survey.

The BERS uses a PLS calculation methodology that contains one latent exogenous variable, leadership, and 9 latent endogenous variables known as CSFs. The BERS contained 47 questions, and the KBES contained 16 questions that corresponded to the CSFs for each stakeholder group.

Step 5. Run PLS Regression

The PLS regression calculation used for this study was embedded in the customized software provided by Professor Kanji (see Appendix D). PLS regression is a method for constructing predictive models whereby a relatively large number of descriptor factors (manifest variables) can be transitioned to a smaller number of highly collinear orthogonal factors known as latent variables (Tobias, 1997). Although the PLS method was developed by an econometrician named Herman Wold in 1966, it has been used in many social sciences, business, chemometrics, and many other field soft both experimental and non-experimental data (Abdi, 2003). In general, the method takes *I* observations described by *K* DVs and stores them in an *I x K* matrix denoted as **Y**. The *J* predictors values are then stored in *I x J* matrix **X**. "The objective of PLS is to predict **Y** from **X** and to describe their common structure" (Abdi, p. 1). By performing a

simultaneous decomposition of the IVs **X** and **Y,** the components explain the covariance between **X** and **Y** (Abdi).

Step 6. Analyze Results for Goodness of Fit

This implies that the strength of the IVs and DVs can be explained. Once the method of input was determined, the PLS calculated all variables simultaneously. Once the BERS was developed, the questionnaires were modeled on MathCad software. The software required MS Windows 2000 or XP or MS Excel from Office 2000 or XP. The program is menu driven, so once the data were entered, the program provided an analysis and reports based on PLS methodology. The weights of the path coefficients represent the strength of the relationships among the different variables. This structural equation model uses inner and outer coefficients that were estimated as part of the iterative method (Kanji, 2002). The inner coefficients reflect the intensity or strength of the causal relationships to the latent variables. Each is expected to have a positive effect on all CSFs, thus indicating the influence on each other. "The outer coefficients correspond to the weights of the manifest variables. The higher they are, the more relevant they become in explaining the correspondent manifest variable" (Kanji, p. 221).

The following descriptions offer an explanation on what outputs and reporting mechanisms are available from the PLS-executed program.

> Vector N
> This vector is the number of indicators for each latent variable in the order as they appear.
> Vector IR
> This vector indicates what variables are involved as dependent and independent variables in each inner relation.

Vector IRN
This vector determines how many variables there are in each inner relation. ”
Vector IO
This vector indicates whether the outer indicators go in (1 is assigned) or out (0 is assigned) for each variable in the inner relations.
Size
This is the sample size of input data.
Maxnoit
This is the maximum number of iterations for the PLS procedure, MAXNOIT is given as 100 for all data sets.
Criterio
This is the converge criterion which is given a value of 0. 000001. Iteration stops when all coefficient estimates converge within CRITERIO.
Program Output
PLS. SAS generates several types of outputs:
Outer coefficients (γ, a)
Inner coefficients (γ, a)
Pearson correlation coefficient square (inner r^2)
Pearson correlation coefficient (inner r)
Cronbach coefficient (α; Kanji, 2002, pp. 136-137)

Step 7. Perform Reliability Analysis

An analysis was carefully done on the results. The model was then judged on goodness of fit using a chi-square test. Cronbach's alpha was used to measure the reliability of the model. The $\mathbf{r}^2$ was analyzed to assess the power of the explanation of each measurement scale and the structure of the BERS. Coefficient of determination r^2 is an indicator of randomness within the model between variation due to cause variables and variation due to randomness. If the values differ from zero significantly, it may be concluded that causal connections exist.

A Cronbach alpha (coefficient α) was calculated. It is a general method that was used to determine the internal consistency of the items that belong to the same dimension in the measurement instrument (Kanji & Tambi, 2002). Cronbach coefficient α is an

indicator of internal consistency of latent variables that are being empirically reflected by manifest variables. It is calculated using variance of individual questions and covariance between items. The formula is:

$$\alpha = \frac{k}{k\text{-}1} \left\{ 1 - \frac{\Sigma\sigma_i^2}{\Sigma\sigma_i^2 + 2\Sigma\ \Sigma\sigma_{ij}^2} \right\}$$

where k = the number of items in the scale, σ_i^2 = the variance of item *i*, and σ_{ij} = the covariance of the items i and j. Computing alpha divides total variance into signal and noise components. In other words, the total variance that is equal to the signal is equal to alpha. The second term in brackets represents the noise in the model (DeVellis, 2003). A coefficient α value of more than 0.7 indicated the consistency of the questions as appropriate to the reliability of the measurement scale.

Step 8. Conduct Sensitivity Analysis on Research Questions

After the internal validity constructs and reliability assessments were satisfied, the final step is to interpret the BERS and the KBES research questions. This required a careful review of the results and possible elimination of the offending constructs. To be able to apply the research questions asked in chapter 1 required that the strengths and weaknesses between the inner and outer coefficient were significant (> .01). If the strength of the correlations indicated that the questions were not significant, then one or more questions had to be explained for management. The assumption was that the questions not addressed from this particular survey instrument were important for a refinery but not understood by the respondents. An explanation was offered based on the

analysis of the data and the construction of the question. Conversely, questions that had strongly correlated data within the BERS were determined to be significant indicators. Conclusions and recommendations to address weaknesses and strengths were based on the research questions.

Construct Validity

Content Validity

Content validity of the test instrument depends on how well the researcher has created the specified domain to cover the content of variables under study (Nunnally & Bernstein, 1994). The content validity of the BERS and the KBES are based on how adequately the samples tested the breadth of the concepts representing business excellence. The BERS contained the 14 latent variables, and the KBES contained the 5 latent variables from the KBEM (Kanji, 2002), a validated model.

Construct validity can be established by how well the questionnaires capture the meaning of the concepts being measured. (Nunnally & Bernstein). Sixty-three unique manifest variables represented the domain of the corresponding latent variables. The meaning of each manifest variable was measured by its mean score.

Criterion-Related Validity

Criterion validity can be defined as how well the criterion in the test instrument corresponds to what is intended to be measured (Carmines & Zeller, 1979). To claim that criterion-related validity exists for the model, the CSFs, as determined from the TQM principles, had to be collectively highly and positively correlated to organizational

performance (Kanji & Tambi, 2002). The CSFs used in this instrument were evaluated by the strength of the weights of the relationships between the variables.

Protection of Participants' Rights

These data identified categories of employees, not individuals, so completing the survey questionnaire is a low-risk task in terms of exposing personal information. Completing the BERS and KBES was strictly a voluntary activity. It was given only to healthy adults working at one oil refinery on the U.S. Gulf Coast. To safeguard the information and the privacy of the participants, all data were handled only by the researcher in strict confidence. The distribution of the BERS went out over the internal mail system to all employees and through the postal system to owners, external vendors, and suppliers to ensure confidentiality. A letter of introduction and an invitation to participate in the study (see Appendix E) was drafted and signed by the researcher. It guaranteed the participants' confidentiality and anonymity (see Appendix F). Participation in the study was voluntary, but consent (see Appendix G) gave implied permission to use the data. No aspects of this survey were used to make any personal connection. The survey data will be kept in the research files for 5 years, after which time the researcher will shred the documents. This study was an exploratory, organizational survey whose output will be shared with local management; once all names or any other identifiers are removed, the results will be published in the dissertation. The Institutional Review Board (IRB) forms was submitted and approved prior to the distribution of any surveys.

Summary

The results of the analysis addressed the six research questions. Although each concept was explained in detail from a theoretical perspective and through the corresponding equations, the conclusions were based on quantitative results and explained in a table of weighted values. Although managers cannot run a business on concepts alone, the relationship to the CSFs and the cause of each perceptional construct are distinct enough to focus action plans. The BEI and the measurement concepts give sufficient information to managers to take appropriate actions to create business excellence within the organization. Although many concepts, theories, models, or ideas about leadership and management exist, concepts and the CSFs applied in the BERS are specific and have been extensively proven to apply to real organizations based on the research of Kanji (2002), Jaques (1989), and Reason (1990).

The threat to the BERS is that it was based on the responses from employees at only one oil refinery. However, the concepts of the KBEM (Kanji, 2002) have been proven valid and reliable in many previous organizational applications, and so this threat was minimal to the validity of this study. This study proposed a theory of treating a business as a living system using inputs, functions and activities, and knowledge to achieve goals. The three theories are plausible, but they do not give evidence of their preferred efficacy. The theories provide interconnections directly into the major concepts of managerial accountability.

CHAPTER 4: RESULTS

Introduction

The responses to the research questions are addressed in this chapter, and survey demographics, data collection, statistical analysis, and findings are discussed. This chapter also describes the results of the data collection from the two surveys: Part A, the Business Excellence Refinery Survey (BERS), and Part B, Kanji's Business Excellence Scorecard (KBES) based on partial least squares (PLS) software. Sample response rates and refinery populations were used in a poststratification process. Mean scores, indices, outer coefficients, inner coefficients, and reliability of the survey instrument are analyzed. The conclusion ties the three theories presented in chapters 1 to 3 to the results presented. The survey questions provided insights to managerial accountability through the analysis and interpretation of the results.

The overall Business Excellence Index (BEI), which combined the results from the two surveys, was 71.3% in the oil refinery studied. This score was an indicator of business excellence and illustrated how well the facility is managed. This information helped to answer the first research question: What is the numerical strength of the relationship between the KBEM's critical success factors (CSFs) and managerial accountability in the oil refinery under study? The relationship values between each CSF and the numerical strengths and weakness of the relationships are explained in this chapter.

Data Collection

This section identifies the survey response rates by demographic variable and analyzes the returns compared to the population studied. As stated in chapter 1, the BERS was the Part A survey that was mailed to employees and owners of the U.S. Gulf Coast oil refinery under study. The Part B survey, the KBES, was mailed to recent suppliers of that refinery. Because both surveys were mailed out during the same time frame, simultaneous feedback and analysis from both internal and external stakeholders presented an accurate assessment of business excellence. The Part A survey asked 47 questions, and the Part B survey asked 16 questions. Both surveys utilized a 10-point Likert scale ranging between 1 (*not effective*) and 10 (*highly effective*) to rate each manifest variable. Three incomplete surveys were returned, so they were not included in the total. The refinery population size was approximately 554 people, which included 454 internal stakeholders and 100 external stakeholders. Generally, during any given week of activity, 318 people are available on site; shift schedules, vacations, training, travel, or other absentees account for the other 136 individuals of the 454 refinery total. The sample design attempted to include approximately two thirds of the refinery population, with representation from each refinery work group. Three hundred and eighty-eight represented 70% of the total refinery population of 554. In total, 92 surveys were returned. Of the 92 surveys returned, 80 were the BERS-Part A surveys from the internal customers and 12 were the KBES-Part B surveys from the external suppliers. The

expected response rate was between 20% and 30%, as stated in chapter 3. Ninety-two returned surveys out of 388 yielded a 24% response rate.

Poststratification techniques were applied to evaluate the sample. The sample proportion is the ratio of the sample size in each group compared to the refinery population demographics. The sample size of the refinery internal stakeholders for the Part A survey was 318. Operator proportions as a group revealed 255 out of 554, or 46% of the population. The returned operator surveys were 42 out of 92 of the total returns, or 46%. The operator category represented 170 out of 318, or 53%. For the Part A survey, the returned operator surveys were 42 out of 80, or 52.5%. In general, the response rates matched the population demographics within 3 to 6 percentage points. Table 5 shows how evenly the survey returns matched the sample demographics.

Table 5

Comparison of Population Percentages versus Survey Returns

	(A) Population	(B) Sample Size by Group	(C) Survey Returns Part A	(D) Survey Returns Part B	(E) Sample (col A/554) Part A & B	(F) Returns as % (col C/80) Part A	(H) Returns as % (Col D/70) Part B
Operators	255	170	42		46%	53%	
Day Staff	20	15	9		4%	11%	
Support Staff	100	66	14		18%	18%	
Leadership	40	40	8		7%	10%	
Senior Leader	1	1	1		0.2%	1%	
Owners	3	3	1		1%	1%	
Maintenance	35	23	5		6%	6%	
External Suppliers	100	70		12	17%		17%
Totals	554	388	80	12	100%	100%	17%

It can be seen in Table 5 that the two largest differences were in operators and day staff. Day staff were support personnel who represent 4% of the population, yet the response rate was 11% of the sample in Part A. In the refinery under study, day support personnel were formerly operators selected from hourly operators to become salaried staff. Therefore, day support observations and experiences were a combination of hourly and salary perspectives, depending on how long they were in the positions. Day support positions are filled from internal hiring programs. These people must have the capability to deal with the needs of hourly staff, upper management, work processes, and standards, and compliance with environmental, safety, quality, reliability, and profitability targets. The difference from the original sample design to 7 percentage points higher may have been attributable to their desire to want to have their opinions heard.

In chapter 2, an application of Jaques's (1989) theory suggested that the time horizons and capability assessments for day support jobs is Stratum II. The day support personnel have a significant influence on daily operations and how the facility performs its business on the shop floor as they try to ensure that daily targets are met while ensuring compliance with the safety, quality, reliability, and production work processes. Personnel in this position should be matched with the capability to identify, analyze, and resolve problems that cross shifts and require up to 18 months to resolve.

Also from Table 5, the response rate for Part B was 17%. Creswell (2003) suggested that 10% is often used as an expected return rate of mailed surveys. Several of the participants in Part B wrote by hand on their survey that they did not know enough

about the refinery's operations to give accurate assessments, although they did give answers. Using that statement as a basis could indicate that the questions on Part B were not easily understood or interpreted and should have been modified to what suppliers look for in support from a refinery. Perhaps a presurvey focus group may have improved the wording in the questionnaires and the response rates.

CSF Scores

The relationships between the manifest variables and the performance, or business excellence indices, are addressed next. The research questions asked are shown with the appropriate latent variables in Tables 7 and 8 for the Part A and Part B surveys. Table 7 indicates the total number of latent variables related to specific research questions within the survey. Research Question (RQ) 3 regarding leadership had the highest number of raw questions at 17, followed by RQ2 with 15, RQ4 with 13, RQ5 with 10, and RQ6 with 9. RQ1 was more relevant to the fit of the applicability of the KBEM to the oil-refining business. RQ1, which is addressed with the data and evidence, requires a more qualitative assessment. Each of the research questions has a calculated average score based on the number and corresponding scores of the question locations in the surveys based on Table 6. In addition, frequency of response and percentage of scores are discussed.

Table 6

Research Questions associated with CSFs for Part A

Research Question	Label	CSFs (Latent Variables)
5. How well are leaders and employees aligned on purpose, goals, missions, and strategies of the oil refinery under study?	F1	LEADERSHIP: Strategic Planning
2. How effective is the oil refinery leadership under study in achieving customer satisfaction through various levels of stakeholders, employees, managers, and suppliers?	F2	DELIGHT THE CUSTOMER: Commitment to Customer Satisfaction
3. To what extent does the leadership create distinguished safety, reliability, quality, and financial targets established as part of the business plan?	F3	Customer Focus: Commitment to Staff Satisfaction
2. How effective is the oil refinery under study in achieving customer satisfaction through various levels of stakeholders, employees, managers, and suppliers?	F4	Customer Focus: Commitment to Supplier Relations satisfaction
6. To what extent are the employees' capabilities, competencies, and knowledge matched to the right roles within the oil refinery?	F5	PEOPLE-BASED MANAGEMENT
6. To what extent are the employees' capabilities, competencies, and knowledge matched to the right roles within the oil refinery?	F6	People-Based Management: People Make Quality
6. To what extent are the employees' capabilities, competencies, and knowledge matched to the right roles within the oil refinery?	F7	People-Based Management: Teamwork in cross functional teams
6. To what extent are the employees' capabilities, competencies, and knowledge matched to the right roles within the oil refinery?	F8	MANAGEMENT BY FACT: Integrated Process
2. How effective is the oil refinery leadership under study in achieving customer satisfaction through various levels of stakeholders, employees, managers, and suppliers?	F9	Management by Fact: Process Management
4. How do customers perceive the ability of the organizational culture in the oil refinery to improve its products, price, and quality?	F10	Management by Fact: Information Management & Analysis
4. How do customers perceive the ability of the organizational culture in the oil refinery to improve its products, price, and quality?	F11	CONTINUOUS IMPROVEMENT

Table 6 (cont'd)

4. How do customers perceive the ability of the organizational culture in the oil refinery to improve its products, price, and quality?	F12	Continuous Improvement: Prevention
4. How do customers perceive the ability of the organizational culture in the oil refinery to improve its products, price, and quality?	F13	Continuous Improvement: Culture of Continuous Improvement
1. What is the numerical strength of the relationship between the KBEM's CSFs and managerial accountability in the oil refinery under study?	PEA	BUSINESS EXCELLENCE: Deliver Customer Value

Table 7 shows how the research questions were related to the CSFs for the external suppliers.

Table 7

Relationship of Research Question to PART B External Suppliers (Latent Variables)

Research Question	Label	CSFs (latent variables)
5. How well are leaders and employees aligned on the purpose, goals, missions, and strategies of the oil refinery under study?	OV	Organizational Value
3. To what extent does the leadership create distinguished safety, reliability, quality, and financial targets established as part of the business plan?	PE	Process Excellence
4. How do customers perceive the ability of the organizational culture in the oil refinery to improve its products, price, and quality?	OL	Organizational Learning
2. How effective is the oil refinery under study in achieving customer satisfaction through various levels of stakeholders, employees, managers, and suppliers?	DS	Delight the Stakeholders
2. How effective is the oil refinery under study in achieving customer satisfaction through various levels of stakeholders, employees, managers, and suppliers?	PEB	Stakeholders' Value Excellence

In Table 7 above, Part B is related to the latent variables used in the BERS. The nomenclature used in Tables 6 and 7 are used to identify each variable explanation in

later sections of this research. Table 8 shows the total survey questions for each research question and the link to the latent and manifest variables.

Table 8

Research Questions Related to the Number of Latent and Manifest Variables for Parts A and B

Research Questions	Latent Variables	Total Questions	Manifest Variable Label
1. What is the numerical strength of the relationship between the KBEM's CSFs and managerial accountability in the oil refinery under study?	PEA, PEB	2	Performance Excellence Part A & B
2. How effective is the oil refinery under study in achieving customer satisfaction through various levels of stakeholders, employees, managers, and suppliers?	F2, F3, F4, DS, SV	15	A8, A9, A10, A11, A12, A13, A14, A15, B11, B12, B13, B14, B15, B16, B17
3. To what extent does the leadership create distinguished safety, reliability, quality, and financial targets established as part of the business plan?	F8, F9, PE	17	A25, A26, A27, A28, A29, A30, A,31, A32, A43, A44, A45, A46, A47, B4, B5, B6, B7
4. How do customers perceive the ability of the organizational culture in the oil refinery to improve its products, price, and quality?	F10, F11, F12, F13, OL	13	A33, A34, A35, A36, A37, A38, A39, A40, A41, A42, B8, B9, B10,
5. How well are leaders and employees aligned on the purpose, goals, missions, and strategies of the oil refinery under study?	F1, OV	10	A1, A2, A3, A4, A5, A6, A7, B1, B2, B3
6. To what extent are the employees' capabilities, competencies, and knowledge matched to the right roles within the oil refinery?	F5, F6, F7	8	A16, A17, A18, A19, A20, A21, A22, A23

From Table 8, it can be seen that RQ1 gave an overall view of business excellence in the refinery. RQ1 addressed business excellence indices from Parts A and B. RQ2 on effective customer satisfaction was addressed in a total of 15 questions in Parts A and B.

RQ3 dealt with the issue of leadership directly in terms of setting up the organization to produce performance. The leadership concepts explained in chapter 3 were specifically addressed through 17 questions. RQ4 judged the organization's ability to learn and was addressed in 13 various locations in Parts A and B. RQ5, with alignment of purpose, visions, goals, missions, and strategies, was addressed in 10 locations throughout Parts A and B. RQ6 questioned how well the organization matches people and competencies to the right job, and it was addressed in 8 locations in Part A. RQ6 was really intended to be answered by internal stakeholders and their perceptions of the organization; therefore it was not addressed in Part B, which is for external suppliers.

Data Description

This section explains the outputs from Parts A and B. It also identifies the strength of the relationships among the endogenous variables. The research questions are addressed in the next section. The results of the PLS regression were applied to both test instruments for Part A (internal customers) and Part B (external suppliers). The Part A survey contained 47 questions; the Part B survey contained 16 questions. For ease of reporting symbols, the CSFs were noted as F1 to F14 in the internal stakeholder survey, Part A. The symbols A1 to A47 represented the manifest variables questions in Part A. In Part B, the manifest variables were listed as B1 to B16. The symbols used in this chapter are based on the output of the KBEM software.

Coefficient of Determination, r^2

To address variations between IV and DV responses, an r^2 was used. This is a measure of the proportion of the total of a DV, which is explained by the IV, or cause, variations. Kanji (2002) stated that the strength of the relationships is a proportion of the regression sum of squares corresponding to latent variables. "The coefficient of determination can also be used to evaluate the accuracy of a structural model." (Kanji & Tambi, 2002, p. 130). The higher the value of the r^2, the better the model fits the data. The values for r^2 resulted in a low of 0.077 to a high of 0.6466 (see Table 9). This provided an indication of how well the KBEM can be explained by the latent variables observed by the manifest variables.

Table 9

Coefficient of Determination, r^2, for Part A Latent Variables

Latent Variables	r^2
Leadership	0.1795
Delight the Customers	0.0777
Internal Customer/ Staff Satisfaction	0.1244
External Customer Satisfaction	0.5329
People-Based Management	0.6083
People Make Quality	0.3133
Teamwork	0.5156
Management by Fact	0.5076
All work is Process	0.3690
Measurement	0.5543
Continuous Improvement	0.2467
Prevention	0.2366
Continuous Improvement Cycle	0.6466

Table 9 indicates the values for the coefficient of determination for the paths leading up to business excellence. The values of coefficient of determination can also be

thought of as a numerical percentage for each variable. For example, leadership has an r^2 = 0.1795, or 18%, as related to business excellence. From this same example, 82% of business excellence was explained by other variables. The latent variable Delight the Customer at 0.0777 indicated that less than 8% of the results were explained by Delight the Customer, In other words, 92% were unexplained by this topic alone. Because this was the lowest score, it could also mean that the questions related to Delight the Customer may not have been understood by the respondents.

High values of r^2 for this site were Continuous Improvement Cycle and People-Based Management, stressing the importance of learning work processes and people management systems as key to this particular an oil refinery. The minimum value of at least 0.65 was considered a reasonably high indication of model accuracy. In this case, none of the r^2 values was higher than the cutoff value of 0.65, meaning that the variations in the model's IVs explained less than 65% of the variance of DVs. However, given the positive scores of the model, several good correlations could be deduced from the data results.

The values of r^2 from the Part B survey are shown in Table 10. Note that each value was positive ordered by OV, DS, OL, and PE as weighted to explaining the model score on business excellence in the Part B survey.

Table 10

Coefficient of Determination, r^2, for Part B Latent Variables

Latent Variables	r^2
OV	0.6693
PE	0.2788
OL	0.3254
DS	0.5743

Reliability of Measurement Scales

In addition to the coefficient of determination, a Cronbach alpha provided an indicator of internal consistency of the latent variables used in the BERS, which was the Part A survey. As explained in chapters 1 and 3, the latent variables were the constructs, and the manifest variables were the measured observations. Alphas less than 0.7 could have been an indication that the manifest variables either were inconsistent in explaining the latent variables or that the questions were not well understood by the respondents. In Table 11, the measurements that were assured as reliable by the 0.7 criteria were People-Based Management, People Make Quality, All Work Is Process, and Measurement. The other topics at 0.6 or above included External Satisfaction; Prevention; and the index of business excellence, which is labeled PEA.

Table 11

Reliability Alphas for Part A

KBEM - PART A (Internal)	
Latent Variables	*Alphas
Leadership	0.5904
Delight the Customers	0.4546
Internal Customer/ Staff Satisfaction	0.2482
External Customer Satisfaction	0.6060
People-Based Management	0.7333
People Make Quality	0.7058
Teamwork	0.4602
Management by facts	0.4912
All work is process	0.7633
Measurement	0.7132
Continuous Improvement	0.0605
Prevention	0.6913
Continuous Improvement cycle	0.0015
Performance Excellence A	0.6217

Note. Cronbach alphas used in this study were a measure of latent variable reliability and were not intended to represent a significance level used in other statistical texts.

In Table 11, the Cronbach alpha is close to zero only in the Continuous Improvement cycle, indicating that there is a potential misunderstanding on the continuous improvement cycle as applied at the site or the continuous improvement cycle is not well applied at the site. The continuous improvement cycle is referenced in the Deming (1982/2000) PDCA learning methodology.

The alpha scores for the latent variables of Delight the Customer, Internal Customer/Staff Satisfaction, Teamwork, and Management by Fact were related to how people work together to achieve expectations on satisfaction, work in teams, and use facts in decision making. The structural model indicators of alpha were greater than 0.2 but less than 0.5, indicating some variation in the responses to the same questions. All

respondents may not have interpreted the question in a similar vein or, in fact, were observing greater differences in day-to-day working relationships. Responses may not be repeatable over time within the model. In the PLS regression analysis, the causal relationships of the manifest variables to the latent variables were examined within the context of the research questions and measured by the mean scores and internal and outer coefficients. These explanations are given in the next section.

The alphas for the Part B survey, the KBES, are explained in Table 12. Note that OV and Performance Excellence Part B (PEB) are greater than 0.7, whereas PE, OL, and DS are less than 0.7. This means that each latent variable did fit the model as a positive indicator, yet there was variation among the respondents. In the case of OL with a 0.1373, there may have been a data entry problem or the raw data were skewed with one or two values. As mentioned previously, this could have indicated a problem with the external suppliers not understanding the questions associated with DS.

Table 12

Reliability Alphas for Part B

Latent Variables	Alphas
OV	0.7580
PE	0.5492
OL	0.1373
DS	0.4347
PEB	0.8225

Inner Coefficients

The inner coefficients reflect the strengths of the relationships between the structural parameters. Structural values must have values significantly different from zero for confirmation or nonconfirmation of the model. PLS estimates the relationship between the latent variables (outer coefficients) and the manifest variables (inner coefficients). The coefficients are determined simultaneously by analyzing the mean scores of the CSFs and BE (Kanji, 2002). These relationships are assumed reflective of the strengths of the causal relationships. A causal relationship is assumed because the amount of change in an effect DV (endogenous variable) is the result of a unit of change in a cause variable. Cause variables can either be an exogenous variable or from preceding endogenous variables, with all other variables being held constant.

Figure 7 shows the inner coefficient weights of the relationships. If the numbers are different from zero, there is an indication that the strength of the causal relationships among the latent variables is strong. Each coefficient represents the amount of change that results from a unit of change in a cause variable. From the leadership prime DV to Delight the Customer, People-Based Management, Management by Fact, and Continuous Improvement, the inner coefficient scores are 0.4237, 0.7181, 0.7300, and 0.7445, respectively, and are all strongly linked. The other relationships shown in Figure 7 are positive and strongly weighted. The only weakly related variables are shown between the core concepts of External Customer Satisfaction and Business Excellence. A negative

number indicates there may be a need for further attention. For example, Measurement is negatively weighted to Business Excellence.

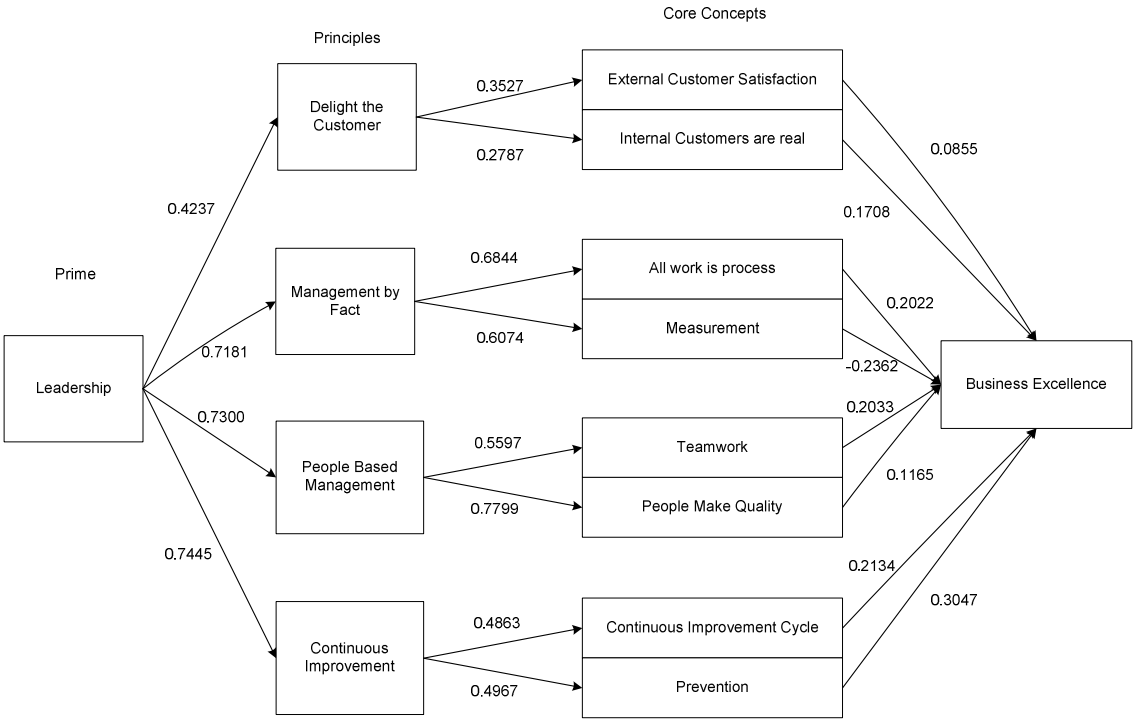

Figure 7. Inner coefficient weightings through the latent variables for each cause-and-effect link.

Figure 7 shows that all of the inner coefficient variations are significantly greater than zero. The relationships and their associated weightings are shown for all paths through the model. The linkages from the prime variable of leadership, to the core concepts, to the main DV of Business Excellence are shown. Using Figure 7 to view the last links to business excellence, one can see that External Customer Satisfaction, Internal Customers Are Real, All Work Is Process, Measurement, Teamwork, People Make Quality, Continuous Improvement Cycle, and Prevention ranged between

-0.2362 and .3047. The particular areas of concern to refinery managers were the -0.2362 for Measurement and the low scores of External Customer Satisfaction at 0.0856 and Internal Customers Are Real at 0.1708. The low scores could be the result of misunderstanding the questions, or it could be that job roles in these categories were not clear to the participants. These topics were explored further in the examination of causal connections of the outer coefficients and indices shown in the next sections.

For the purposes of demonstrating the inner coefficients of the major cause-and-effect variables, Table 13 is another view of Figure 7 that specifically examines the relationships between the prime to the principles to the core concepts of the KBEM. Each of the Leadership paths is strongly connected in Figure 7, as indicated by scores greater than 0.7. The path to Delight the Customers was lower at 0.4237. Delight the Customer to External Customer Satisfaction and Internal Customers Are Real were rated at 0.3587 and 0.2787, respectively. This indicated either a weakness in the model or a lack of clarity on how the management system addresses these topics. People-Based Management affected People Make Quality and Teamwork, and both of these topics were strongly weighted in the structural model, with scores of 0.7799 and 0.5599, respectively. The CSF principle of Management by Fact was related to the All Work Is Process and Measurement scores of 0.7125 and 0.6074, respectively. This indicated that both topics were influenced by the perceptions in these categories, with All Work Is Process being the stronger driver.

Following the Continuous Improvement path shown in Figure 7 above and Table 13 below, both the Continuous Improvement Cycle, with a score of 0.4863, as well as Prevention, with a score of 0.4967, were very similar in terms of impacts from the CSF principle of Continuous Improvement. Therefore, they were adequately addressed by the model.

Table 13

Inner Coefficients Results from the Major Paths through the BERS

Leadership	Inner Coefficients
Leadership - Delight the Customers	0.4237
Leadership - People-Based Management	0.7300
Leadership - Management by Facts	0.7181
Leadership - Continuous Improvement	0.7445
Delight the Customers	
Delight the Customers - Internal Customer/Staff Satisfaction	0.2787
Delight the Customers - External Customer Satisfaction	0.3527
People-Based Management	
People-Based Management - People Make Quality	0.7799
People-Based Management – Teamwork	0.5597
Management by Fact	
Management by Fact - All Work is Process	0.7125
Management by Fact - Measurement	0.6074
Continuous Improvement	
Continuous Improvement - Prevention	0.4967
Continuous Improvement - Continuous Improvement Cycle	0.4864

From Table 13, the inner coefficient score from People-Based Management to People Make Quality was 0.7799 and 0.5597 for People-Based Management-Teamwork. The cause-and-effect strengths between these latent variables and the model were quite strong, as indicted by the inner coefficients. The path of Leadership to People-Based Management down to People Make Quality revealed scores of 0.7300 and 0.7799,

respectively. These scores were an indication of the cause-and-effect relationships that influenced the BEI in Part A. Based on the information in Table 13 and Figure 7, the following observations can be drawn from the inner coefficients: (a) All of the inner coefficients are nonzero, and (b) the values of the inner coefficients are much larger from the prime principles-core concepts when compared to the significantly smaller coefficients, ranging from core concepts to business excellence.

Manifest Variables, Averages, and Outer Coefficients

PLS regression calculated the BEI for both Part A and Part B surveys and averaged those scores to yield one BEI. Assuming that business excellence is the prime accountability of management of a refinery, the numerical business excellence average from both Part A and Part B was 71.25%. The BEI of 71.25% was unique to the refinery studied and answered RQ1: What is the numerical strength of the relationship between the KBEM's CSFs and managerial accountability in the oil refinery under study?

Next, each of the 14 CSFs in Part A, designated as F1 to F14, was given an index of 0% to 100%. Figure 8 shows the indices for Part A.

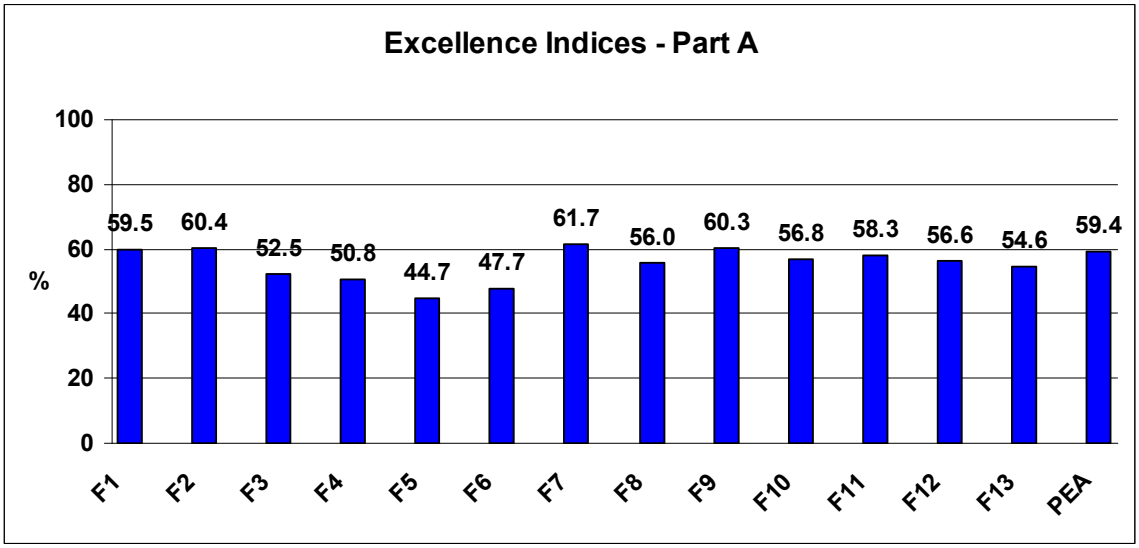

Figure 8. Business excellence CSF indices in percentages for Part A.

From Figure 8, one may discern that the PEA variable was 59.4%. PEA, or Performance Excellence for Part A, was the overall score for the facility from the internal customer perspective. There was a 17-point difference, from a low score of 44.7% on F5 to a high score of 61.7% on F7.

Figure 9 shows the Part B indices from each of the CSFs designated as OV, PE, OL, DS, and PEB. These were the combined scores from the external suppliers. In general, the Part A PEA index and the Part B PEB index differed by nearly 23 points. This was not necessarily an inconsistency, but rather a difference of perspective between internal and external customers. In this study, the answers to RQs1 to 6 were drawn from a combination of internal and external perspectives.

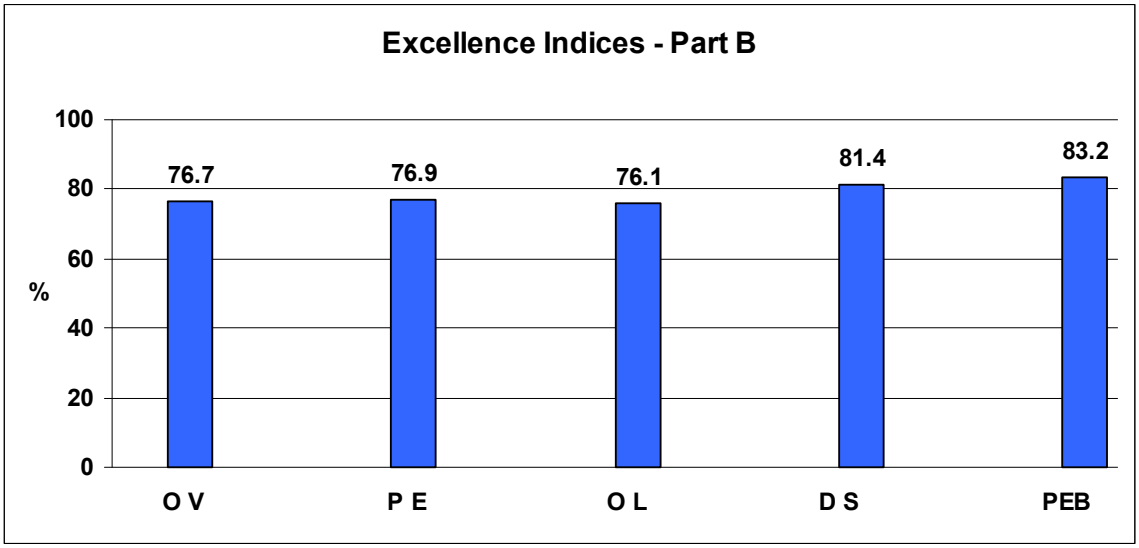

Figure 9. Business excellence CSF indices in percentages for Part B.

The indices for Part B in Figure 9 showed that the PEB was 83.2%. The indices for each latent variable ranged from 76.1% to 83.2%. The index for PEB indicated that the external suppliers considered that the refinery organization is performing at a high level. The average of the Part A and Part B indices, as stated earlier, was 71.3%. The overall combination of indices for Part A and Part B is shown in Figure 10, which addresses RQ1.

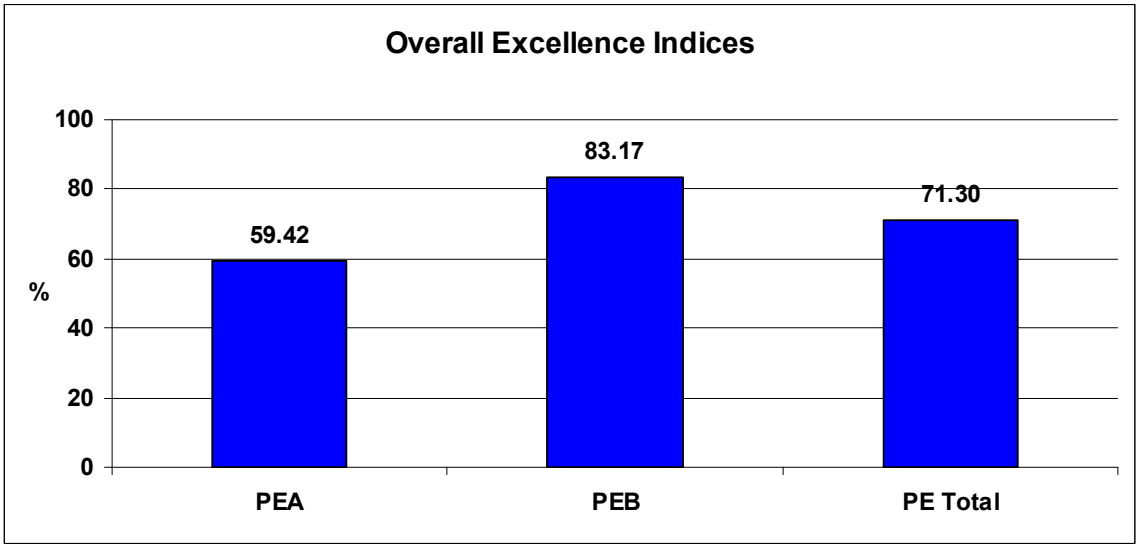

Figure 10. Overall business excellence indices in percentages for Parts A and B.

The next section explores the latent variable indices and the manifest variable mean scores. Outer coefficients, which are indications of cause-and-effect relationships, are presented in context to the research questions. "Outer coefficients correspond to the weights of the manifest variables. The higher they are, the more relevant they are in explaining the corresponding manifest variable" (Kanji, 2002, p. 221). A brief summary of the strengths and weaknesses of each area of managerial accountability is given for each RQ.

Manifest variables from the Part A survey (A1-A47) and the Part B survey (B1-B16) were rated by the respondents on a Likert scale of 1 (*least effective*) to 10 (*most effective performance*). The averages of those responses were calculated and analyzed in combination with the outer coefficient ratings as part of the PLS regression program supplied by Kanji (2002). As described in chapter 3, outer coefficients were used to

calculate indices for each latent variable, which culminated in the final score of Business Excellence for the refinery studied in this research. RQs2 to 5 are discussed next.

2. How effective is the oil refinery under study in achieving customer satisfaction through various levels of stakeholders, employees, managers, and suppliers?

Referring to Table 8 presented earlier in chapter 4, the CSFs and their indices corresponding to RQ2 were taken from Part A, Delight the Customer: Commitment to External Customer Satisfaction, with an index of 60.4%; Customer Focus: Commitment to staff satisfaction, with an index of 52.54%; and Customer Focus: Commitment to Supplier Relations, with an index of 50.7%. From Part B, the corresponding questions were DS, with an index of 81.4%, and PEB, with an index of 83.2%.

Delight the Customer

Table 14 gives the three relationship scores for Delight the Customer. The average scores were 6.55, 6.38, and 6.54, with respective outer coefficients of 0.5477, 0.6254 and -0.0764, respectively. The strongest impact on Delight the Customer from a manifest variable were A9 and A8, indicating a perception that the refinery engages in joint customer strategy activities and consistently delivers products and services meeting or exceeding customer expectations. The concern here was the negative outer coefficient on consistently delivering on-time and on-spec product. This could be an area of focus for the refinery managers at this facility.

Table 14

Delight the Customer

Manifest Variable	Label	Average Score	Outer Coefficient
Refinery consistently delivers products and services meeting or exceeding customer expectations	A8	6.55	0.5477
Refinery engages in joint customer strategy setting activities to anticipate and supply the needs of customers.	A9	6.36	0.6254
Refinery consistently focuses on delivering customer satisfaction with on-time and on-spec products	A10	6.54	-0.0764

Customer Focus: Commitment to Staff Satisfaction

Employees are typically internal customers working on products, specifications, work processes, and standard procedures to enable safe conditions and prevent incidents (Reason, 1990). The manifest variables A11, A12, and A13 were used in Part A. The results, as shown in Table 15, indicated that the weakest mean score was received on A12 as 5.56, but with a very high outer coefficient of 0.8986. This is definitely an area of concern for refinery managers because the observed behavior is how management optimizes people, money, equipment, and time so that employees can perform their jobs and get the work done. The next lowest score was received by employees' feeling that customers are satisfied during abnormal times. The mean score of A13 was 6.37, with a fairly low outer coefficient of 0.1554. This low coefficient could mean there was not agreement among those responding, but it remains an area of concern for refinery managers. In contrast to abnormal times, people believed that the refinery is a good place to work, with a high score with a score of 6.65 on A11. The correlation to the impact on

the model was very low at 0.0543, indicating that not everybody considers the refinery a good place to work.

Table 15

Results for Commitment to Staff Satisfaction, Internal Customers are Real

Manifest Variable	Label	Average Score	Outer Coefficient
Our refinery is a good place to work	A11	6.65	0.0543
Refinery management optimizes the allocation of resources (people, money, equipment, time) to enable people to perform their job	A12	5.56	0.8986
Refinery management and staff satisfy needs of the customers during abnormal times	A13	6.37	0.1554

From Table 15, A12 (management accountability for internal customer satisfaction) was an improvement area, especially in the area of optimizing resources to help people perform their jobs.

Customer Focus: Commitment to Supplier Relations

Table 16 shows the results of Customer Focus, as defined by the manifest variables A14 and A15. Assessing the effectiveness of A14, how well the refinery is committed to developing good suppliers rather than focusing only on bottom-line cost, received a fairly low rating of 5.4, with a high outer coefficient weighting of 0.7830. Because the correlation is high, the low is a concern. Management needs to assume accountability for improving the sense of commitment to supplier long-term success, not just on bottom-line impact. In A15, the manifest variable was used to assess the eagerness of the refinery managers to build longer term relationships with outside suppliers. The

score of 6.02, with an outer coefficient of 0.2896, indicated a good correlation between longer terms relationships and employees' perception that management pays attention to this part of the business. As Table 16 shows, this was probably not the most important area of focus for the management at this facility, but it showed the need to establish longer term, high-quality relationships.

Table 16

Results for Customer Focus: Commitment to Supplier Relations Satisfaction

Manifest Variable	Label	Average Score	Outer Coefficient
The refinery is committed to developing good suppliers rather than focusing only on bottom-line cost	A14	5.40	0.7830
The refinery is eager to build-long term relationships with suppliers of outside products, materials, equipment, and services	A15	6.02	0.2896

In the Part B survey, RQ2 was addressed to the external suppliers' rating of the refinery's leaders on their image, care, financial, reputation for quality, reliability, environmental, and safety performance.

The suppliers who responded to B14 through B17 in the Part B survey scored the refinery overall from 8.37 to 8.62, with very similar weighting (see Table 17). The concern was that the ratings were not as strong as some of the internal customer ratings. There are no weak areas in this category from the perspective of external suppliers. Stakeholder value in this case represented the refinery leaders having a good overall image, care of stakeholders, strong financial performance, and a good reputation.

Table 17

Results for Stakeholder Value Excellence - Part B

5. Stakeholders Value Excellence	Label	Average Score	Outer coefficient
The refinery and its leaders have a good overall image.	B14	8.44	0.2564
The refinery cares about its stakeholders.	B15	8.37	0.2629
The refinery has a strong financial performance.	B16	8.50	0.2583
The refinery has a good reputation for quality, reliability, environmental, and safety.	B17	8.62	0.2550

RQ2 asked, "How effective is the oil refinery under study in achieving customer satisfaction through various levels of stakeholders, employees, managers, and suppliers?" Internal customer satisfaction weaknesses were identified in A14 and A12. Longer term relationships need to be established. This weakness was also revealed in the latent variable index of 50.7, Customer Focus: Commitment to Supplier Relations. At the same time, external customers' perceptions, as observed from the manifest variables B14 to B17, did not identify negative issues for management, with an index of 83.2. From the Part A survey, the internal stakeholders gave their highest scores to manifest variable A11: The Refinery Is a Good Place to Work. The effect of this rating can be seen in the index for Customer Focus: Commitment to Staff Satisfaction at 52.54%. The highest result from external customers was on the manifest variable B17, with an 8.62, acknowledging the refinery's reputation to deliver on quality and reliability results. There were no weaknesses in this category. Action plans for improving internal customers weaknesses are given in chapter 5.

3. To what extent does the leadership create distinguished safety, reliability, quality, and financial performance?

The CSFs attributed to RQ3 explained maturity in work process leadership and management systems. The portions of the survey specifically related to process management are F8, F9, and PE, or Management by Fact: Integrated Process; Management by Fact: Process Management; and Process Excellence, respectively.

Management by Fact: Integrated Process

Management by Fact: Integrated Process is an indication of how well the refinery has integrated its major work processes. The overall index was 55.9. The manifest variable A25 had a fairly strong perception from customers, with an average score of 6.36. However, A25 was not a significant contributor to the model at -0.0160. This was a concern because A25 addresses critical infrastructure improvements, and one interpretation of the negative outer coefficient is that respondents did not sense that this is consistently applied to the facility. Infrastructure can be overlooked, but it is still a necessary item to keep a facility safe and reliable. The average score on A26 was 6.33. This was an indication that refinery management integrates operations, maintenance, reliability, safety, and quality through its work processes. This was not a contradiction to A25 because A26 addressed infrastructure and resource commitments, whereas A26 addressed the work processes to help people perform their work. The outer coefficient of A26 was strong at 0.5591, so this can be considered an effective part of the management accountability.

Table 18 shows another strong contributor in A27, which received a fairly low mean score at 5.77, and an outer coefficient score of 0.5997. The concern here was that people are not seen as an integrated web of people and processes acting together but as individuals operating in silos. Reason (1990) stressed the importance of maintaining alignment among people and processes.

Table 18

Results for Management by Fact: Integrated Process

Manifest Variable	Label	Average Score	Outer Coefficient
The refinery prioritizes critical infrastructure improvement needs, considering all the facts about resource commitments.	A25	6.36	-0.0160
Refinery management integrates operations, maintenance reliability, safety, and quality through work processes.	A26	6.33	0.5591
Our refinery can be visualized as a web of people, equipment, facilities, and work processes linked together as a system.	A27	5.77	0.5997

Management by Fact: Process Management

The Process Management latent variable, F9, index was 60.3. The manifest variables related to this score were A28, A29, and A30. These topics addressed decision making through managing by facts as a part of process management. These variables are addressing RQ3 as management's accountability to create safety, reliability, quality, and financial performance. The results of A28 on the use of fact based data, metrics, and risk assessment to drive decisions and processes has both a high average score of 6.40 and a strong outer coefficient of 0.4851. This indicates the refinery does use data appropriately to make decisions and act. A29 asks specially about fact based risk assessment decision

making. A29 received a score of 6.85 with an outer coefficient is a 0.3789. This indicated that there was a strong perception that risk assessment is used in decision processes. There does not seem to be a weakness in this area.

The lowest rating in Process Management was indicated on how well understood the metrics effectively drive and improve performance. The score for A30 was 5.98, with an outer coefficient of 0.3361. In general, as seen in Table 19, Management by Fact: Process Management was perceived as a strong area of accountability for the management team at this oil refinery. TQM requires the successful control of decision making, metrics, and the appropriate use of data (Kanji, 2002).

Table 19

Results for Management by Fact: Process Management

Manifest Variable	Label	Average Score	Outer Coefficient
Refinery uses data appropriately to make decisions and act when flaws are discovered in key work processes.	A28	6.40	0.4851
Refinery management uses fact-based risk assessment in decision processes.	A29	6.85	0.3789
Refinery has well-understood metrics to effectively drive and improve performance.	A30	5.98	0.3351

Process Excellence - Part B

Process Excellence as the overriding latent variable had an index of 76.9, as measured by external suppliers in the Part B survey. As can be seen from the average scores in Table 20, the manifest variables in B4 through B7 ranged from 7.81 to 8.12. The two highest outer coefficient contributors were from B6 and B7, at 0.3466 and 0.3255, respectively. This would indicate that the refinery compares its processes with its

competitors' processes. The refinery uses process measurements to drive relationships, accountabilities, and ownership. In addition, B5 has an outer coefficient rating of 0.2980, which is less than B7 and B6 but still contributes to the scoring of business excellence. B4 is not seen as an important contributor to the model because of its low outer coefficient of 0.0948.

Table 20

Results for Process Excellence - Part B

Manifest Variable	Label	Average Score	Outer Coefficient
The refinery has mature key processes, process owners, and individuals knowledgeable of the roles and responsibilities necessary to deliver results.	B4	8.12	0.0948
The refinery collects and disseminates a wide range of complete and accurate performance indicators.	B5	7.87	0.2980
The refinery compares its process performance with that of its best competitors.	B6	7.81	0.3466
The refinery uses key process measurements to drive relationships, accountabilities, and ownership.	B7	8.0	0.3255

To conclude, the results for RQ3 were strong. The question was: To what extent does the leadership create distinguished safety, reliability, quality, and financial targets established as part of the business plan? Overall, for Part A manifest variables, the highest average score with a high correlation was A28, with scores of 6.40 and 0.4851, respectively. The scores for A28 indicated that the refinery uses data appropriately to make decisions and acts when flaws are discovered in key work processes. The weakest area from Part A was A27, at 5.766, with a weighting of 0.5997. A27 gives an indication about how the refinery can be viewed as a web of people, equipment, facilities, and work

processes linked together as a system needs to be addressed. The one concern is on A25, where a low outer coefficient of -0.0160 may indicate that critical infrastructure may not be managed as a priority.

4. How do customers perceive the ability of the organizational culture in the oil refinery to improve its products, price, and quality?

RQ4 was addressed by the CSFs of F10, F11, F12, and F13 from Part A and OL from Part B. In addressing RQ4, the indices for the latent variables were 56.8% for Management by Fact: Information Management and Analysis; 58.3% for Continuous Improvement: Prevention; 56.6% for Continuous Improvement: Culture of Continuous Improvement; and 76.1% for OL. The results of the manifest variables within these latent variable constructs were an indication of organizational system learning within the facility.

Management by Fact: Information Management and Analysis

Information management can be viewed as a tool for analysis as well as for learning and sharing. The highest average score for the refinery in the study was on A31, 6.16, and a fairly high outer coefficient of 0.3735, which was an indication that there are facilities that provide a wide range of complete, timely and accurate information to analyze the quality and reliability of equipment and people systems. The average score for A32 was 6.08, with a high outer coefficient of 0.7099. The importance here is that learning is taken seriously and is facilitated through sharing between employees and

technology to achieve reliability and quality outcomes. Table 21 gives the results for A31 and A32.

Table 21

Results for Management by Fact: Information Management and Analysis

Manifest Variable	Label	Average Score	Outer Coefficient
IT systems provide a wide range of complete, timely, and accurate information to analyze the quality and reliability of equipment and people systems.	A31	6.16	0.3735
The refinery facilitates learning & sharing between employees and technology groups to achieve reliability/quality outcomes.	A32	6.08	0.7099

Continuous Improvement Prevention

Table 22 shows the results of the manifest variables. Specifically addressing learning through prevention are A36 and A37. In this category, A37 scored 6.10 on average, with a high correlation at 0.6795. A36 scored 6.09, but it was not as significant a contributor at 0.4389. Similar to the categories above, there was clarity on accountability on the use of work processes and information technology combined with people systems that are designed to predict and prevent potential problems. Reason (1990) stated that this is an essential element to learn and prevent unanticipated events. This type of learning process is important to the refinery's continuous improvement prevention efforts.

Table 22

Results for Continuous Improvement Prevention Results

Manifest Variable	Label	Average Score	Outer Coefficient
Personnel utilize a preventive approach to identify, assess, and maintain equipment in good condition.	A36	6.09	0.4389
Work processes, IT, and people systems are designed to predict and prevent potential problems.	A37	6.10	0.6795

Continuous Improvement: Culture of Continuous Improvement

The manifest variables shown in Table 23 are the results from Part A on the Culture of Continuous Improvement. The mean score for A38 was 6.05, with a negative outer coefficient of -.03192. This was a concern because the question addressed the issue of review and correction of compliance to service and behavioral standards. Correction of noncompliant behavior is certainly an accountability of management. One potential reason for a negative outer coefficient was that the participants may not have understood the question. On the other hand, a wide spread in responses could cause an outer coefficient to be negative. Certainly, this is an area of concern for further analysis. A39 is another example of a fairly high score of 6.21, with a negative outer coefficient. It could be that there was some confusion in the way the question was asked. Another possible concern is that the management of change with proper documentation is not practiced before internal employees take action.

The average score for A40 was 5.53, with another negative outer coefficient of -0.2681. This negative outer coefficient, as well as the low average score, was an indication that it is not seen as a culture of speaking out honestly and to learn from

mistakes. The manifest A41 addressed long-term employees who support the learning culture within the facility. The score of 5.98 was a fairly high average score, but the outer coefficient score of 1.038 indicated that this is a factor in business excellence. This did not seem to be an issue in this refinery organization. The manifest variable addressing mentoring, coaching, training, and motivating personnel in A42 received an average score of 5.57, with an outer coefficient of 0.2855. This was a concern in that management must create the conditions for people to be coached, to mentor, or be mentored. Mentoring, coaching, and training are an essential managerial accountability for building a culture of continuous learning (Jaques, 1989).

Table 23

Culture of Continuous Improvement

Manifest Variable	Label	Average Score	Outer Coefficient
The refinery regularly reviews and corrects compliance to service/behavioral standards.	A38	6.05	-0.3192
The refinery routinely practices management of change in assessing decisions, assumptions, design, documentation, and procedures prior to taking actions.	A39	6.21	-0.1237
Refinery personnel are rewarded for learning and speaking honestly about mistakes or errors.	A40	5.53	-0.2681
The refinery has many long-service, high-caliber technical support staff.	A41	5.98	1.1038
Refinery management creates conditions for mentoring, coaching, training, and motivating personnel.	A42	5.57	0.2855

Organizational Learning, Part B

To address RQ4 about the refinery's ability to learn and improve to produce product improvements of price and quality, the manifest variables from the Part B survey were addressed by B8, B9, and B10. The average scores ranged from 7.8125 to 8.0. The

highest weighting given to the model was from B8, with a score 7.85 and an outer coefficient of 0.4402. In each case, as perceived by the suppliers, the refinery uses balanced performance indicators and other forms of feedback to drive continuous improvement and learning. Although B10 had a high rating, the contribution to the model was smaller at 0.2609. See Table 24 for the OL results, as viewed by suppliers. The significance of this category is that in general, the suppliers view the refinery as a learning organization. It is interesting to note the difference between internal customers and external suppliers on the issue of OL. The two perspectives appeared to disagree on the culture of learning at the refinery.

Table 24

Results for Organizational Learning, Part B

Manifest Variable	Label	Average Score	Outer Coefficient
The refinery uses balanced performance indicators and other forms of feedback to drive continuous improvement and learning.	B8	7.87	0.4402
The refinery leadership are accessible, actively listen, and respond to people with respect.	B9	7.81	0.3680
The refinery has a culture of continuous improvement.	B10	8.00	0.2609

To answer RQ4 required insights from both internal and external customers. Internal customers (employees) scored A37 at 6.17, with a weighting of 0.6795 regarding the IT tools needed to predict failures. Work processes, IT, and people systems should be designed to predict and prevent potential problems (Reason, 1990). Even though the index for the latent variable for Management by Fact: Information Management and Analysis was 58.28, the major area of concern was the culture inhibiting speaking

honestly about mistakes. Management must be aware of these weaknesses to facilitate improvements at the refinery.

From the external supplier perspective, the high average scores and the high index of 76.1 did not indicate a problem here or that they do not have information on this topic. The results of the manifest variables within these latent variable constructs indicated that learning is not a major area of concern for OL within the facility; however, the culture of openness was a concern.

5. How well are leaders and employees aligned on purpose, goals, missions, and strategies of the oil refinery under study?

To answer RQ5, the CSF results from Part A of Leadership, F1, and Part B, OV, were used. The CSFs related to RQ3 on leadership effectiveness were also part of leadership assessment, but the focus of this question was on the alignment on goals, strategies, and plans produced by management. According to Deming (1982/2000), leadership has to establish a clear and consistent purpose for organizational alignment. In Table 25, the mean scores from internal customers are all greater than 6.0 on the 10-point scale of effectiveness.

Leadership Part A

The index for the latent variable Leadership was 59.5%. The highest manifest variable average score on Leadership was A3, with a score of 6.68. A3 was defined by senior management's leading, participating, and supporting quality, reliability, safety, environmental performance. The negative to this rating was the outer coefficient

weighting of 0.0138. The inconsistency between the high score and the low outer coefficient could have been due to the fact that several topics were in the question. Internal customers may have been responding to any one of the categories and, therefore, gave a wide variety of answers. To address this problem, the survey question should have been limited to one topic. Another potential reason for the low outer coefficient is that there could have been an overlap with other questions related to leading or participating in quality, reliability, safety, environmental performance.

In Table 25, the next highest average scores was A5 at 6.53 mean score and -0.0644 outer coefficient. A5 had to do with how managers communicate their commitment and accountability for quality and reliability. Although the mean score was fairly high, the low outer coefficient indicated that management should pay attention to this topic to improve the impact of communication on their leadership.

Table 25

Results for Leadership: Strategic Planning

Manifest Variable	Label	Average Score	Outer Coefficient
Senior management sets comprehensive people, reliability, quality, safety, environmental, and investment growth plans.	A1	6.51	0.2856
Senior management uses balanced metrics to drive improvement strategies and tactics.	A2	6.42	0.1379
Senior management leads, participates, and supports quality, reliability, safety, environmental, and learning.	A3	6.68	0.0139
Senior management provides individual and department goals together for long-term quality and reliability improvement.	A4	6.37	0.2636
Senior management uses various communication mediums to demonstrate their commitment and accountability for refinery quality and reliability.	A5	6.53	-0.0644
Senior management acts with respect, integrity, care, and honesty in routine communication.	A6	6.42	0.2317
Senior management opens channels of communication to all levels of the organization.	A7	6.24	0.5156

Continuing the analysis of Leadership, A1 conveyed that leaders set comprehensive goals in reliability, safety, quality, environmental, and growth plans. A1 had a mean score of 6.51 and an outer coefficient of 0.2856. One of the leaders' roles to be effective is to establish common purpose, strategies, and goals to help the organization move forward (Deming, 1982/2000; Jaques, 1989; Kanji, 2002; Reason, 1990). Both the

average scores and the outer coefficients were high, indicating that managers do provide clarity for the organization.

In addition, A2 dealt with the use of metrics to drive improvement metrics and tactics. A2 scored 6.42 on average, with a 0.1379 outer coefficient. Also linked to goals for individuals and departments was A4, which received a 6.37 average score and an outer coefficient of 0.2636. Taken together, these three areas indicated that the leaders are meeting their accountability to set goals, targets, strategy, and tactics both individually and at the department level. Metrics are used to drive strategies and tactics in this refinery. The combination of each of these items, A1 to A7, indicated that on average, people perceived that Senior Management is aligned on goals, strategies, tactics, with supportive metrics to achieve results. This is a key managerial accountability that is a strong point for this facility.

Organizational Value, Part B

In the Part B survey, the index for OV was 76.7%, as viewed from the suppliers' perspectives. Table 26 shows the results of the manifest variables. It is significant to note that the average scores were in the range of 7.81 to 8.31, with the outer coefficient influence on the model ranging from 0.202 to 0.489. The topics in B1 to B3 were an indication of how external suppliers view refinery leadership and their ability to communicate what it stands for and alignment on strategy and values. At the same time, building a sense of community around its values and mission and vision statements was

rated at the high score of 8.31. From the suppliers' standpoint, OV is an area of strength for this facility because management exceeds supplier expectations.

Table 26

Results for Organizational Value

Manifest Variable	Label	Average Score	Outer Coefficient
The organization communicates what it stands for.	B1	7.81	0.2020
The organization develops strategy aligned with its values.	B2	7.81	0.4894
The organization builds a sense of community surrounding its values, mission, and vision.	B3	8.31	0.3525

To conclude, the answer to RQ5, both the indices for Leadership and OV latent variables and the manifest variables indicated that leaders and employees are effectively aligned on purpose, goals, missions, and strategies. Respondents had a strong perception of senior management. The weakest area in leadership was on communication at all levels. Leadership, as judged by the expectations for setting goals, strategies, and tactics, was not among the low indices or manifest variables in this study.

6. To what extent are employees' capabilities, competencies, and knowledge matched to the right roles within the oil refinery?

RQ6 was addressed by the results in CSFs People-Based Management; People-Based Management: People Make Quality; and People-Based Management: Teamwork in cross-functional teams, F5, F6, and F7, respectively, and each of the manifest variables, as shown in Table 27.

People-Based Management

The index for People-Based Management latent variable was 44.6%. The scores received in this section of the Part A survey were the lowest indices and average scores of the entire BERS. The lowest score received was A17 at 4.44 and an outer coefficient of 0.4995. This indicated a strong weakness in the effectiveness of human resource management efforts supporting quality objectives. There was also a low score, A16, with an average score of 5.33 and an outer coefficient of 0.4678. The specific weakness was in the amount of feedback given to employees through mentoring, coaching, advising, or regular conversations. A similar question was asked in the manifest variable A42, with a similar mean score result of 5.54. However, the question differed with respect to creating the conditions for mentoring, coaching, training, and motivation. Both of these findings were consistent and indicated a need to improve in this area of People Management.

The score for A18 was the highest score in this category, with a score of 5.72 and an outer coefficient of 0.2069. The average score for A18 was above the other scores in this CSF. The question was related to each employee having the ability to contribute to quality and reliability goals. A18 was neither a significant strength nor a weakness. However, when compared to the higher scores in other manifest variables, it was a concern.

Table 27

Results for People-Based Management

Manifest Variable	Label	Average Score	Outer Coefficient
Feedback through mentoring, coaching, or advising conversations is regularly provided to employees on their performance.	A16	5.33	0.4678
The refinery's overall human resource management efforts support quality objectives.	A17	4.44	0.4995
Means are available for all employees to participate in, and contribute effectively to, meeting the refinery's quality/reliability/safety objectives.	A18	5.72	0.2069

People-Based Management: People Make Quality

The index for People-Based Management: People Make Quality was 47.7%. Table 28 shows that the average scores on A19, A20, and A21 were fairly low, with average scores of 5.36, 5.46, and 5.14, respectively. A19 had an outer coefficient of 0.5645. A19 indicated that refinery management is ineffective in matching the right people's capabilities with the organizational needs to deliver quality products and be reliable. This part of refinery leadership is a weakness for the refinery.

A20, at 5.4 and an outer coefficient of 0.2066, indicated another weakness of how well refinery management provides guidance and skill training so that people can perform quality jobs. The manifest variable A21 mean score of 5.14 was low; in addition, there was a strong outer coefficient of 0.4100. This is a serious weakness for refinery management. It is the accountability of management to define the resources, authority, role documents and accountability for people to do their jobs effectively within the key

work processes (Jaques, 2002). Table 27 shows the data for People-Based Management: People Make Quality.

Table 28

Results for People-Based Management: People Make Quality

Manifest Variable	Label	Average Score	Outer Coefficient
Refinery management aligns the right people capabilities with organizational needs to deliver quality products and quality services.	A19	5.35	0.5645
Managers provide the guidance, skill training, and systems so that people ensure quality in every job.	A20	5.46	0.2066
Refinery management provides clarity on the resources, authority, role documents, accountability, and timing for effectively and efficiently performing key work processes.	A21	5.14	0.4100

It is significant that internal stakeholders observed manifest variable A21 as one of the lowest in score and influential in terms of the model. The areas of providing clarity on resources, authority, role documents, accountability, and timing performing key work processes were cited as weaknesses for this management team.

People-Based Management: Teamwork

The index for People-Based Management: Teamwork was 61.7%. The results of the teamwork questionnaires from Part A were the high average scores of the People-Based Management CSFs. Teamwork is an essential function within the TQM system (Kanji, 2002). A22 was one of the highest average scores of the Part A survey manifest variable mean scores at 6.98 and an outer coefficient of 0.2177. This indicated that the refinery management does sponsor teams to solve complex problems within the facility.

Personnel are encouraged to take initiative in forming effective informal work teams, as reported in A23, with a high score 6.45 and an outer coefficient of 0.7996. A24 had a high average score of 6.47 and a low outer coefficient score of 0.0803. These scores indicated little causal impact from the topic of flexible organization to support reliability/quality team-based approaches when needed. The low outer coefficient may have indicated that refinery management needs to offer more flexibility in people's normal work to participate on teams. Because A23 and A24 received high average scores, there was no disagreement on the value of teamwork, but some on the flexibility of the organization to support team participation, which could be a concern for refinery management. In Table 29, the average scores indicated that support for teams is a strength of the facility.

Table 29

Results for People-Based Management: Teamwork

Manifest Variable	Label	Average Score	Outer Coefficient
The refinery uses cross-functional team based approach to solve complex problems.	A22	6.98	0.2177
Personnel are encouraged to take initiative in forming effective informal work teams.	A23	6.45	0.7996
The refinery has a flexible organization to support reliability/quality team based approaches when needed.	A24	6.47	0.0803

In conclusion, to answer RQ6, the low indices of 44.6 and 47.7 showed that refinery management should be concerned with the CSFs of People-Based Management and People Make Quality, respectively. The CSF weaknesses were specific to Human Resource support of quality objectives, as seen in the score for A17 (see Table 26). In

addition, refinery management were weak in providing clarity on roles, responsibilities, accountability, and authority to achieve quality work (A21; see Table 27). Teamwork, on the other hand, was seen as a strong part of the way the site achieved its work. The behavior exhibited in forming teams was supportive of the quality, reliability, and safe working environment, as referenced in Table 28.

The results of the 47 Part A manifest variables and the 16 Part B manifest variables were evaluated in relation to the RQs. Strengths and weaknesses were identified for each RQ. Concerns and inconsistencies for the application of the business excellence concepts within the facility were referenced to the negative values in the outer coefficients. Recommendations for simplifying the BERS questions were also explained. In the following section, the latent and manifest variable conclusions are summarized.

Conclusion

The demographics of the survey sample were analyzed and determined to be proportional to the groups by means of poststratification. Cronbach's alpha scores were calculated on the CSFs. Four had alphas greater than 0.7, which was the original criterion for reliability mentioned in chapter 3. All coefficients of determination were positive, which was indicative of goodness of fit of the variables within the model. The research questions provided a framework for grouping and compiling the results from the KBEM for refinery management. Inner and outer coefficients agreed throughout the analysis and evaluations.

The weaknesses were easily understood when related to the particular perceptions from the stakeholders. Weaknesses and relationships between latent and manifest variables provided specific areas of focus for refinery managers. The biggest index weaknesses were in People-Based Management and the associated manifest variables, indicating that management must improve the process of providing clarity on the resources, authority, role documents, accountability, and timing for effectively and efficiently performing key work processes. The lowest score on any manifest variable was the lack of human resource support for quality and reliability objectives, with a score of 4.44 out of a possible 10.

The strongest points for the refinery were in Process Management and Teamwork, followed closely by Leadership. RQs2 to 5 specifically addressed strengths and weaknesses, as evidenced by the data from various combinations of the latent and manifest variables regression techniques, including coefficient of determinations, Cronbach alphas, inner and outer coefficients, and mean scores. Some of the relationships were highly correlated in terms of causal factors of greater than 0.7, whereas other manifest variables had little relationship to the model with negative numbers.

The research questions, latent variables, and manifest variables provided the framework for the assessment of the refinery. The manifest variables provided direct observations from stakeholders specific to improvement or strength areas. The inner and outer coefficients provided information on how strongly the terms were related. The Part B survey scores from the external suppliers' were consistently higher than the Part A

survey scores from the internal customers. There could have been a bias having to do with the suppliers not knowing and simply guessing what the customers want. However, suppliers and customers cannot be ignored when assessing business excellence. The process to improving managerial accountability is based on Jaques's (1989) theory for requisite organizational structure, Reason's (1990) for safety infrastructure and human error reduction, and Kanji's (2002) for TQM and business excellence measurement. On the positive side, external stakeholders feel that the organization is adding value. The combined BEI of 72.3 was an important indication of how well the refinery is performing on TQM concepts. Creating safe, reliable, and quality performance is of prime importance for refinery leadership. Actions and recommendations arising from the specific results described in chapter 4 are developed in chapter 5.

CHAPTER 5: SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Introduction

The problem presented in this study was to ascertain the extent of managerial effectiveness in addressing the lack of clarity in the system that produces unanticipated events that impact worker safety and business excellence in a U.S. Gulf Coast oil refinery. The Part A and Part B surveys were applied to internal stakeholders and external suppliers, respectively. In total, 63 questions were framed in 14 critical success factors (CSFs) of Total Quality Management (TQM). The questions were developed specifically for an oil refinery or any other complex manufacturing facility, from the organizational theories of Jaques (1989), Reason (1990), and Kanji (2002). A partial least squares (PLS) regression was used to evaluate the latent and manifest variable relationships.

The results of the analysis described in chapter 4 indicated an overall BEI score of 72.3% for the site. The Part A index was 59.4%, and the Part B index was 83.1%. Oil refinery managers will benefit from the recommendations by gaining an understanding of the actions needed to improve specific weaknesses within the organization. Research questions were linked to combinations of CSF evaluations of relationship strengths and weaknesses. The weakest CSFs in the Part A indices were 44.7% for People-Based Management and 47.7% for People Make Quality. The strongest CSF indices from Part A were 61.7% for People-Based Management: Teamwork and 60.3% for Management by Fact: Process Management. The Part B indices ranged from a low of 76.1% for Organizational Learning (OL) to a high of 83.2% for Performance Excellence Part B

(PEB). This chapter includes a summary of the potential societal impacts and recommendations for future work in this field.

Summary of the Study

The primary purpose of the study was to measure the perspectives of key internal and external stakeholders and make recommendations for refinery managers to achieve business excellence and worker safety within their organization. The recommended actions are a response to the weaknesses identified in chapter 4 and the theories in chapter 2. The purpose of this investigation was to improve the clarity of each employee's accountability in an effort to reduce the likelihood of unsafe acts and unanticipated incidents. As mentioned previously, the weakest score for this refinery was on People-Based Management: People Make Quality. In other words, the organization is not clear that all employees (people) have a responsibility to contribute to business excellence performance in the areas of quality, reliability, environmental compliance, and financial sustainability. A secondary purpose of this study was to add to the body of organizational management knowledge by synthesizing the concepts of TQM, human error, and requisite organizational structure. The goal of this work is to apply measurement in a simultaneous manner to improve personal and organizational accountability.

To reduce uncertainties arising from random organizational improvement efforts, it is necessary to have (a) a common and consistently applied strategy on organizational

structure with accountabilities defined at all levels (Jaques, 1989); (b) measurement and incorporation of customer expectations into business strategies (Kanji, 2002); and (c) design of robust safety barriers, standards, work processes, specifications, personnel competencies, and methods so that the organization can learn to identify and prevent potential unintended consequences before they become severe (Reason, 1990). The refinery under study is strong in the fundamentals of process management and teamwork, but it is weak in matching employee competencies and knowledge to the right roles. The findings and recommended actions for each research question are addressed next.

RQ1. What is the numerical strength of the relationship between the KBEM's CSFs and managerial accountability in the oil refinery under study?

Perhaps this question could have been reworded as, "What is the overall index for the oil refinery under study?" To answer this question required an assumption that the overall effectiveness of business excellence is the accountability of all levels of leadership and the effectiveness of the business systems to achieve business excellence. The numerical results of the CSFs on the Part A and Part B surveys are considered the answer to this complex question. The index on Part A of the BERS from internal stakeholders was 59.42%, the Part B results from external suppliers were 83.17%, and the mean score between Part A and Part B was 71.29%. It should be noted that the overall index was very positive for this refinery. Specific recommended actions should be focused on influencing the weakest manifest variables that are assumed causal to the latent variables, which are the CSFs. In Part B, one can assume that because all of the

scores were acceptably high in the 70% range, the focus should be on internal stakeholders, where the average scores fell below 60%.

RQs2-6. Table 30 shows that the mean score for RQ2 was 7.07, RQ3 was 6.66, RQ4 was 6.48, RQ5 was 6.89, and RQ6 was 5.52. RQ2's high score is an indication of customer satisfaction throughout the organization. The low score of 5.52 is an indication of leaders' and employees' competencies and knowledge being matched to the right roles.

Table 30

Combined Manifest Variable Means from Part A and Part B

Research Question	Average Score
2. How effective is the oil refinery under study in achieving customer satisfaction through various levels of stakeholders, employees, managers, and suppliers?	7.07
3. To what extent does the leadership create distinguished safety, reliability, quality, and financial targets established as part of the business plan?	6.66
4. How do customers perceive the ability of the organizational culture in the oil refinery to improve its products, price, and quality?	6.48
5. How well are leaders and employees aligned on purpose, goals, missions, and strategies of the oil refinery under study?	6.89
6. To what extent are the employees' capabilities, competencies, and knowledge matched to the right roles within the oil refinery?	5.52

It is interesting to note that by using the manifest variable analyses and the latent variable analysis of mean scores, the results were similar in terms of strengths and weaknesses. The weakest area identified in RQ6 in terms of the latent variable mean scores around employee and leadership being matched to their competencies is related to the manifest analysis weak area of People Management being supported by human

resources alignment to support quality and reliability. Following are recommendations for RQs2 to 5.

RQ2. How effective is the oil refinery under study in achieving customer satisfaction through various levels of stakeholders, employees, managers, and suppliers?

Customer satisfaction was viewed in this research in terms of the stakeholders, which included employees, suppliers, or owners. In this case, managers were also considered employees. The analysis that was presented in chapter 4 related to this question was taken from the Part A survey of the internal stakeholders. The respondents were asked to rate how well the refinery as an organization performs on Delight the Customer: Commitment to Customer Satisfaction; Customer Focus: Commitment to Staff Satisfaction; Customer Focus: Commitment to Supplier Relations Satisfaction.

The weakest score of 5.4, with an outer coefficient of 0.7830, corresponding to the latent variable of Customer Focus: Commitment to Staff Satisfaction, specifically was answered in response to the statement, "Refinery management optimizes the allocation of resources (people, money, equipment, and time) to enable people to perform their job." The recommended actions relevant to this question are perhaps best addressed by Kouzes and Posner (2002) in what is referred to as "Commitment number 8: strengthen others by sharing power and discretion" (p. 301). The intent of this commitment is to strengthen people's ability to take action through their own initiative by giving them the power to make choices. This also builds competence and the confidence to act and excel while fostering accountability and responsibility that compels action. Specifically, the

recommendations that may be appropriate to improve this area were identified by Kouzes and Posner as:

1. Offer visible support.
2. Assign critical tasks
3. Enrich people's jobs.
4. Use modeling to develop competencies
5. Stop talking and start building at staff meetings.
6. Enlarge people's sphere of influence.
7. Educate, educate, educate.
8. Create a learning climate. (p. 311)

The potential downside to offering more support is managers' fear that budgets will be overrun because employees who do not have direct accountability for budgets may spend without understanding the impact on other needed expenditures or where resources are already allocated to higher risk items. The action that balances the concern is that people must be educated about budgeting, risk assessment, and consideration of the wider system and longer term implications of budget decisions. In other words, people must learn to balance their individual requests with the needs of other departments across the refinery in a systematic way.

RQ3. To what extent does the leadership create distinguished safety, reliability, quality, and financial performance?

Because RQ5 generally addressed the key topics of oil refinery leadership in the BERS, the areas of integrated work process maturity and decisions based in fact were answered in *RQ3*. The average score on this question was 6.66, with the specific latent variables within the model stated as Management by Fact: Integrated Process; Management by Fact: Process Management; and Process Excellence. The lowest scoring

manifest variable of 5.76, with an outer coefficient of 0.597, was in response to the observation, **"**Our refinery can be visualized as a web of people, equipment, facilities, and work processes linked together as a system." To address this weakness in integrating work processes and decision making, two sources were chosen from chapter 2, namely, the statement, "Attending processes is management's responsibility" (Hammer, 1996, p. 17), and the definition of process as "a group of tasks that together create a result of value to a customer" (Hammer, p. 11). For processes to be centered in an organization, employees cannot act alone because the results are misunderstanding and tasks working at cross purposes, where optimization of any one part happens at the expense of the whole (Hammer). Decisions and the method of making those decisions should be related to providing value to customer-centered processes. Hammer suggested four steps:

1. Identify and name company processes looking horizontally across the organization.
2. Ensure everyone is aware of these processes and understand their role.
3. Establish measures for processes and ensure teams work on a common customer centered objective.
4. Manage processes with a continuous vigilance toward process improvement. (pp. 14, 15, 16, 17)

Dahlgaard et al. (1998) suggested continuous work process measurement, data collection, and reporting of quality facts were necessary for work processes to be effective. Work process metrics should not be based on beliefs and opinions, but on the facts that drive performance. The major actions necessary to creating a fact-based process include the following: Focus on both customer and internal employee satisfaction. Establish quality control points and quality checkpoints within processes. Measure

quality costs in terms of preventive costs, inspection costs, internal failure costs, and external failure costs (Dahlgaard et al.).

RQ4. How do customers perceive the ability of the organizational culture in the oil refinery to improve its products, price, and quality?

Reason (1997) defined organizational culture as "shared values (what is important) and beliefs (how things work) that interact with an organization's structures and control systems to produce behavioral norms (the way we do things around here)" (p. 192). RQ4 was addressed in the Part A survey with Management by Fact: Information Management and Analysis; Continuous Improvement: Prevention; Continuous Improvement: Culture of Continuous Improvement; and OL from the Part B survey. As mentioned in chapter 4, one of the lowest manifest variables in terms of learning was in response to "Refinery regularly reviews and corrects compliance to service/behavioral standards and Refinery personnel are rewarded for learning and speaking honestly about mistakes or errors," with mean scores of 5.408 and 5.46, respectively. These scores suggest the need for improvement in the culture of continuous improvement and organizational learning. "Continuous process improvement is a managerial accountability" (Jaques, 1989, p. 112). People at all layers of the organization have a responsibility to know what they are supposed to do in most situations in order to perform in a safe and predicable manner (Reason, 2000).

A PDCA cycle is essential for the quality learning cycle (Deming, 1982/2000). The Deming cycle defines the learning process as beginning with a plan; ensuring that

documentation and measurable objectives are set against the plan; and then executing the process, followed by collecting the knowledge for the next cycle. A safety culture can be used as a proxy for a culture of learning in quality and reliability. Reason (1997) suggested that the following actions are needed within the systems and structures to establish a safety culture:

1. Establish a goal of maximum safety health, regardless of the leadership's personality.
2. Engineer a reporting culture - an organizational climate in which people are prepared to report their errors and near-misses.
3. Install a just culture where there is an atmosphere of trust. People are encouraged and even rewarded for providing essential safety-related information but they are clear about where the line must be drawn between acceptable and unacceptable. "A no blame culture is neither feasible nor desirable."
4. Install a flexible culture where in times of emergency an organization can switch to a flatter professional structure where control passes to experts and then reverts back to the traditional hierarchical modes once the emergency has passed.
5. Install a learning culture where there is a willingness to collect data, analyze and communicate findings with competence to draw the right conclusions from its safety information systems and to the make major reforms when needed. (pp. 195-196)

RQ5. How well are leaders and employees aligned on the purpose, goals, missions, and strategies of the oil refinery under study?

Combining all the associated variables within RQ5 derived a mean score of 6.89. RQ5 was addressed under the Leadership and Organizational Value latent variables. The two lowest scores were in "Senior Management opens channels of communication to all levels of the organization" and "Senior management provides individual and department goals together for long term quality and reliability improvement," with scores of 6.131 and 6.350, respectively. The major topical weaknesses for this question were not the

weakest for the organization but, instead, were fairly strong, which led to the conclusion that the oil refinery's managers show a high level of leadership. Jaques (2000) suggested actions for the managers at each level of the organization as establishing goals for the organization that are synthesized in the following ways:

1. Design internal communication systems that can be easily understood at each layer of the organization.
2. Establish goals specifying what by when.
3. Establish decision-making methods and authorities.
4. Prescribe policies, rules, regulations, customs, and practices on how the work must be done.
5. Establish quality, quantity, timing, authorities, and resources available.

In terms of translating strategy, goals, and targets into action at a department and individual level, Kaplan and Norton (1996) suggested that a balanced scorecard approach may assist in the process with the following actions:

1. Clarify and gain consensus about vision and strategy.
2. Build a management team.
3. Communicate strategy throughout the organization.
4. Align department and personal goals to the strategy linked to rewards.
5. Identify and align resources to strategic initiatives
6. Link strategic objectives to long-term targets and annual budgets.
7. Align strategic and operational reviews.
8. Sustain investments in intellectual and intangible assets.
9. Obtain feedback to learn about and improve strategy.
10. Provide a foundation for strategic learning. (pp. 291-299)

RQ6. To what extent are the employees' capabilities, competencies, and knowledge matched to the right roles within the oil refinery?

RQ6 was addressed in the Part A survey with the latent variables of People-Based Management; People Make Quality and Teamwork in Cross Functional Teams. These topics are particularly important to TQM and requisite organizations. The scores for the analysis performed in chapter 4 showed these topics, with the exception of teamwork, to be the weakest for the oil refinery's overall score in business excellence. The lowest score of 4.16 was in the category of "Human resource management efforts supporting quality objectives." This was the lowest average score in the BERS. The correlation or weighting for the category was 0.6323. A low score of 5.167 was also received for A16, which stated, "Feedback is given to employees through mentoring, coaching, advising, or regular conversations." The weighting of this variable was lower, but it was still a significant causal factor with a score of 0.3897.

In addition, the People-Based Management: People Make quality latent variable received a low score of 5.226 and a high correlation of 0.7736 made on the specific observation of the manifest variable, "Refinery management aligns the right people capabilities with organizational needs to deliver quality products, and quality services." Another specifically weak score was observed in the manifest variable "Refinery management provides clarity on the resources, authority, role documents, accountability & timing for effectively and efficiently performing key work processes," with score of 5.109 and an outer coefficient of 0.3008.

Jaques (1989), as mentioned in chapters 1 and 2, stated that people-based management and recognition of management's role in creating the conditions for quality

outputs is the focus of a requisite organizational structure. All of the aforementioned topics are examples of how systems drive behavior (Jaques, 2002). These are the managers' responsibilities. In other words, managers must take the lead in planning and modeling the competencies needed to lead organizational improvement. Scholtes (1998) identified leadership competencies as the ability to think and lead systems; understand variability in planning and problem solving; understand how people learn and develop; understand why people behave as they do; understand the interdependence of interactions within systems; and give vision, guidance, and focus to the processes and systems.

Jaques (1989) found that managers must have the mental capacity to process how people and planning integrate for output to be effective and productive in a given time frame. The following recommended actions are a synthesis of the suggestions offered by Jaques (2002), Kanji (2002), and Scholtes (1998):

1. Establish clear policies on the accountabilities and authorities of all employees, as well as the accountabilities and authorities of managers, with particular emphasis on everyone's accountability for doing his or her best for the customer and the business.
2. Ensure that all managers sustain good collateral working relationships among their peers and expectations for clear handoffs between processes.
3. Require that all managers have regular meetings with their subordinates to update priorities and plans, and keep each other informed of important developments and issues. Managers are accountable for maintaining constructive, two-way discussions where coaching, mentoring, advising, or teaching can happen openly.

4. Require subordinates to inform their managers in a timely fashion if successful completion of any assignments is in jeopardy.

5. Hold managers accountable for the results of the work and the working behavior of their subordinates.

6. Require that managers complete annual subordinate performance reviews. Train managers to differentiate between disciplinary issues and personal effectiveness. Upon evidence of infractions against policies and regulations, deselect people when necessary.

7. Managers must learn to take initiative to improve the work processes, interrelationships between systems.

These actions taken by managers and their subordinates support the TQM effort by keeping the roles, responsibilities, accountabilities, timing, and resources focused on a common vision of customer delight.

The weakest CSF with the most influence according to the outer coefficients was People-Based Management. Communicating with all layers of the organization effectively, assessing people's capabilities, receiving compensation, and matching people's competencies to the work requirements is a managerial accountability (Jaques, 1998; Jaques & Cason 1994; Jaques & Clement, 2000). The following specific actions may address the weakness in People-Based Management.

1. Assess each job based on a time horizon and task complexity.

2. Define the roles, responsibilities, accountabilities, purpose, and authority necessary for the business work processes to be effective and efficient.

3. Assess and assign personnel based on reasoning and time horizon capability.

4. Match people's capabilities with the complexity of the work.

5. Create a system to evaluate the effective selection and placement of managers and subordinates.

6. Compensate according to the level of value to the business.

7. Provide training and opportunity assignments for the next levels of job growth because people's mental processing capability changes over time.

Social Implications

Drucker (2002) stated that an organization may be visualized as a living entity; therefore, an oil refinery may be considered an organizational living entity in the sense that hundreds of people work toward the mutual goal of producing oil-based products safely and reliably. Oil refinery employees are citizens of the community first, with common interests in housing, parenting, health, education, the arts, leisure, sports, and so on. The potential implication of achieving business excellence for the stakeholders of an oil refinery is that communities will be safer, healthier, and more productive.

By examining the data and gaining an understanding of the strengths of the causes and effects of relationships, as numerically demonstrated between the latent and the manifest variables, managers can focus and prioritize constrained resources of money, time, and people. If improvement actions are followed up consistently and honestly, a culture or an environment can be created where employees gain a sense of community through their more advanced understanding of the role relationships between managers

and subordinates. When managers and subordinates learn what they are accountable for, they become more confident when exercising judgment in their daily decisions. By working toward solutions to problems encountered within the organization, mutual trust, self-realization, and personal commitment are built. “Good managerial systems bring out mutual trust and commitment in people. Bad systems breed extreme self-interest” (Jaques, 2002, p. 177).

People who work in a business excellence environment learn accountability for their personal development, team development, and business development. Organizations tend to improve when the leaders acknowledge and accept that they always have more to learn (Tichy, 2004). Businesses that subscribe to business excellence learn how to organize and create structure, role clarity, accountability, and governance for the challenges within their organization, society, and the world. Businesses as learning organizations have motivation, resources, and a skilled work force. The skills that people learn within their organization translate to building successful communities and learning systems for markets of the world (Wenger, McDermott, & Snyder, 2002). In addition, society’s economic well-being is impacted when products are produced at lowest environmentally and financially sustainable prices.

Significance of the Research

This research may provide specific recommendations for action to achieve safe, productive, and fulfilling work. The difference between this approach and traditional refinery Solomon benchmarks, as well as other improvements suggested by social

science, is that this is a holistic approach based on the investigations of three theorists: Jaques, Kanji, and Reason. The lack of an integrated approach to the three major areas of technical, business, and people structures prevented the unique insights provided by this study.

As the demand for new energy sources and new technologies increases, understanding the impact of current organizational practices on people is a key management accountability of all large, industrialized societies (Drucker, 1986). The broad yet specific organizational items measured in this study were quality management, organizational structures, and control of human error. A learning outcome of this research will be an increased understanding of the current perceptions within the organization based on the survey data.

Over time, this study may be repeated in a longitudinal approach to continuously improve performance. Setting the conditions for an organizational structure to reduce the likelihood of unanticipated events is part of the oil refinery manager's responsibility. The impact of unanticipated incidents or events is measured in lower performance in safety records, operational utilization, product quality, employee morale, reliability mean time between failures, communication mechanisms, IT system accessibility, work process metrics, capital investments, return on assets, and operating expenses.

Improvements for Future Research

The low influence of some manifest variables could have been improved by using current organizational improvement language instead of TQM wording. For example,

Delight the Customer may have been better stated as going beyond expectations. Perhaps the lower scoring variables were interpreted as irrelevant by some of the respondents. Second, the questions may not have been easily understood because the vernacular did not match the culture of the refinery studied. Third, in an attempt to capture holistic themes around leadership or quality and reliability, there may have been too many topics grouped into one statement. These topics could be asked in separate questions in future studies.

One of the problems with this study was finding a body of knowledge specific to highly complex oil refinery manufacturing environments, which are holistic in their approach. The problem with many organizational change efforts is that they offer little measurable data on how to prioritize actions to achieve business excellence. Any one theory used in isolation may not address the safety barriers, work processes, and systems that must be in place to reduce human errors within an oil refinery. There were potential conflicts among the theories of Kanji (2002), Reason (1990), and Jaques (1989). Senge et al. (1994) uncovered a problem that sometimes occurs in quality programs:

> When two managers of a quality effort don't share the same mental model of quality, they tend to promote different behaviors, teach different skills, and use different measures of performance and success." People can get mixed up, where "…mixed messages can confuse and frustrate employees and inadvertently set up resistance and cynicism,… ultimately resulting in the slow sabotage of the effort. (p. 447)

If this were the case, business excellence performance would be compromised. The present research was based on a single application at one oil refinery from the synthesis of the three theories described above and detailed in chapter 2.

Two potential options are clearly available for future steps. The first is to repeat the application of the two surveys at some predetermined periodic interval after the actions have been implemented at the same refinery. At this point, a new analysis would indicate whether the actions have been successful from the first set of improvement actions. A second option is to perform similar applications at other refineries along the U.S. Gulf Coast, or elsewhere in the world, to see where there may be significant differences. Depending of the number of similar conclusions, there could be a set of fundamental findings that are applicable to other oil refineries and manufacturing facilities. Dissimilarities could be explained by local leadership behaviors, cultures or societal influence, government regulations, or owner influence. A comparison of multiple refineries will lend validity to these findings. In addition, a comparison and integration of these results into existing surveys or benchmarking within an organization may yield common elements or the elimination of action items that are already underway. Although this objective was beyond the scope of this study, it could help to reduce the number of confusing, unsubstantiated, and transient improvement programs. Several manifest variable observations should be modified based on their inner and outer coefficient negative ratings. On the other hand, one has to be careful not to delete breadth of questions because the Business Excellence effort yields a quantitatively complete data set.

The language of the consent forms requesting participation may have been intimidating to some participants. Revising the consent form shown in Appendix G,

paragraph 3 stating, *In the event you experience stress or anxiety during your participation in the study, you may terminate your participation at any time,* could be improved with less focus on stress or anxiety and more encouragement of participation. A letter from the senior leader asking for participation and commitment to improve the organization may also have been helpful in obtaining responses

Future businesses must continue to test, organize, and build upon the business excellence concepts by connecting actions with their social, political, and economic impact (Kanji, 2002). The key is to routinely test to see how societal dynamics are influencing progress. It was the intent of this research to help stakeholders, managers, and employees assess the nature and conditions of their existing organization's performance.

Conclusion

The results in chapter 4 will inform leaders of current organizational strengths and weaknesses directly applicable to business excellence within the oil refinery. The recommendations in chapter 5 are based on delivering business excellence and can be translated to other businesses interested in similar goals of sustainable value propositions. Senge et al. (1994) concluded that "the TQ model is an ongoing set of disciplines which gradually affect the way people think and interact, and leave the organization fundamentally different from the way it was" (p. 447). The one surprise in this study is that even though leaders were rated fairly high in terms of behaviors by internal stakeholders, midlevel managers do not seem to know how to create the conditions for accountability throughout the organization. The importance of organizational information

presented in this study is to reveal the gaps in effectiveness of recent management efforts, structures, systems, organizational strategies, goals, and tactics. With this information, managers know where to focus individual accountability improvement efforts.

This research builds upon the TQM principles of customer satisfaction, quality, and reliability by explaining the leaders' role in understanding and impacting the causes of human error. The gaps in managerial accountability that may be missed by TQM can be resolved through the application of the findings derived from this study. With clear accountabilities, improvement efforts can be measured, and they can drive proactive and preventive business performance. Jaques's (1989) requisite organization lacks an emphasis on customer focus; however, Kanji's (2002) KBEM addresses TQM-based business excellence. Gaps in TQM for systems of safety are addressed in Reason's (1990) general failure types. Managers have a responsibility to build relationships through coaching, teaching, mentoring, dialogue, and debate so that their subordinates can reach their full potential (Jaques). The oil business is a globally competitive commodity business, and its stakeholders want a safe working environment for themselves and their families. Over the next 100 years, the oil business must retain the fundamental ability to adapt by knowing what actions are needed to change business successfully based on cause-and-effect relationships (Drucker, 2002). Knowledge and the organization's ability to examine today's reality will be become the foundation for tomorrow's improvements (Senge, 1990). Reason (1990) stated that instead of seeking to blame people for unanticipated events, managers must be able to see which actions or structures contribute

to safety systems. The organizational culture that seeks continuous improvement in quality and customer delight will excel at business excellence (Kanji, 2002).

This study can be disseminated to various audiences and interested parties: managers at the oil refinery, stakeholders, academics, and diverse professional associations. The requisite organizational actions and steps proposed by Jaques (1989) maintain that managers and subordinates must become closely aligned on tasks, timing, quality, quantity, and resources. The point of this research was to identify the most important actions that will facilitate the most effective results. Reaching beyond the gates of one refinery, the societal goal of this research is to help community leaders in businesses and government organizations realize that managerial leadership is accountable for establishing standard operating procedures, responsible actions, behaviors, and decisions.

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APPENDIX A: BERS QUESTIONNAIRE

Purpose: The purpose of this survey is to determine your perceptions on the effectiveness of current refinery practices on creating business excellence.

Instruction
To take this measure effectively, we need you to asses a series of statements according to how you feel and how you rate the extent to which your refinery practices these concepts. Place a mark in the block indicating your perception.

SECTION 1: CSFs AND BUSINESS EXCELLENCE

	Very Small									Very Large
	1	2	3	4	5	6	7	8	9	10
1. LEADERSHIP (SLEAD): Strategic Planning (SP)										
Senior management sets comprehensive people, reliability, quality, safety, environmental, and investment growth plans.										
Senior management uses balanced metrics to drive improvement strategies and tactics.										
Our senior management leads, participates, and supports quality, reliability, safety, environmental, and learning.										
Individual and department goals are linked to long-term quality and reliability improvement goals.										
Senior Management uses various communication mediums to demonstrate their commitment and accountability for refinery quality and reliability.										
Senior Management acts with respect, integrity, care, and honesty in routine communications.										
Senior management opens channels of communication to all levels of the organization.										
2. DELIGHT THE CUSTOMER (CF): Commitment to Customer Satisfaction (OCCS)										
Refinery consistently delivers products and services meeting or exceeding customer expectations.										
Refinery engages in joint customer strategy setting activities to anticipate and supply the needs of customers										
Refinery consistently focuses on delivering customer satisfaction with on-time and on-spec products.										
3. CUSTOMER FOCUS (CF): COMMITMENT TO STAFF SATISFACTION (CCS)										
Our refinery is a good place to work										
Refinery management optimizes the allocation of resources (people, money, equipment, and time) to										

enable people to perform their job.

Refinery management and staff satisfy needs of customers during abnormal times.

4. CUSTOMER FOCUS (CF): COMMITMENT TO SUPPLIER RELATIONS SATISFACTION (CSR)
Refinery is committed to developing good suppliers rather focusing only on bottom line costs.
Refinery is eager to build long-term relationships with suppliers of outside products, materials, equipment, and services.

5. PEOPLE-BASED MANAGEMENT (PBM)
Feedback through mentoring, coaching, or advising conversations is regularly provided to employees on their performance.
Refinery's overall human resource management efforts support quality objectives.
Means are available for all employees to participate in, and contribute effectively to, meeting the Refinery's quality/reliability/safety objectives.

6. PEOPLE-BASED MANAGEMENT (PBM): PEOPLE MAKE QUALITY (PMQ)
Refinery management aligns the right people capabilities with organizational needs to deliver products and services.
Managers provide the guidance, skill training, and systems so that people ensure quality in every job.
Refinery management provides clarity on the resources, authority, role documents, accountability, and timing for effectively and efficiently performing key work processes.

7. PEOPLE-BASED MANAGEMENT (PBM): TEAMWORK IN CROSS FUNCTIONAL TEAMS (TEAM)
Refinery uses cross functional team based approach to solve complex problems
Personnel are encouraged to take initiative in forming effective informal work teams.
Refinery has a flexible organization to support reliability/quality team based approaches when needed.

8. MANAGEMENT BY FACT (MBF): INTEGRATED PROCESS (IP)

Refinery prioritizes critical infrastructure improvement needs considering all the facts about resource commitments.
Refinery management integrates operations, maintenance reliability, safety, and quality through work processes.
Our refinery can be visualized as a web of people, equipment, facilities, and work processes linked together as a system

9. MANAGEMENT BY FACT (MBF): PROCESS MANAGEMENT (PM)
Refinery uses data appropriately to make decisions and act when flaws are discovered in key work processes.
Refinery management uses fact-based risk assessment in decision processes.
Refinery has well understood metrics to effectively drive and improve performance.

10. MANAGEMENT BY FACT (MBF): INFORMATION MANAGEMENT & ANALYSIS (IMA)
IT systems provide a wide range of complete, timely, & accurate information to analyze the quality and reliability of equipment and people systems.
Refinery facilitates learning & sharing between employees and technology groups to achieve reliability/quality outcomes.

11. CONTINUOUS IMPROVEMENT (CI)
Refinery reacts to trends in its customer satisfaction or adverse customer responses
The extent to which the organization learns and acts on Quality, Reliability, and Safety improvement is
Refinery compares current quality levels of service and products with those of competitors (benchmarking)

12. CONTINUOUS IMPROVEMENT: PREVENTION (PREV)
Personnel utilize a preventive approach to identify, assess, and maintain equipment in good condition.
Work processes, IT, and people systems are designed to predict and prevent potential problems.

13. CONTINUOUS IMPROVEMENT: CULTURE OF CONTINUOUS IMPROVEMENT (CCI)
Refinery regularly reviews and corrects compliance

to service/behavioral standards.

Refinery routinely practices Management Of Change in assessing decisions, assumptions, design, documentation, and procedures, prior to taking actions.
Refinery personnel are rewarded for learning and speaking honestly about mistakes or errors.
Refinery has many long-service high caliber technical support staff
Refinery management creates conditions for mentoring, coaching, training, and motivating personnel.

14. BUSINESS EXCELLENCE (BE): DELIVER CUSTOMER VALUE (DCV)
Refinery creates distinctive performance in operations, maintenance, and turnarounds.
Refinery creates distinctive performance in quality and reliability.
Refinery creates distinctive performance in safety and environmental compliance.
Refinery has strong financial performance (e. g. Profitability, Utilization, NECC, NIAT)
Refinery maintains high credibility with local community, owners, and stakeholders.

PART B EXTERNAL STOCKHOLDERS
1. ORGANIZATIONAL VALUE (SOV)

The Organization communicates what it stands for.

The Organization develops strategy aligned with its values
The Organization builds a sense of community surrounding its values, mission, and vision.

2. PROCESS EXCELLENCE (SPE)
The refinery has mature key processes, process owners, and individuals knowledgeable on the roles and responsibilities necessary to deliver results.
The refinery collects and disseminates a wide range of complete and accurate performance indicators
The refinery compares its process performance with that of its best competitors
The refinery uses key process measurements to drive relationships, accountabilities, and ownership.

3. ORGANIZATIONAL LEARNING (SOL)
The refinery uses balanced performance indicators and other forms of feedback to drive continuous

improvement and learning.

The refinery leadership are accessible, actively listen, and respond to people with respect.
The refinery has a culture of continuous improvement.

4. DELIGHT THE STAKEHOLDERS (SD)
The Organization as a whole listens to its stakeholders needs and works in partnership to provide.
The Organization provides relevant and reliable information to its stakeholders
The Organization has an ethical conduct and effectively deals with complaints

5. STAKEHOLDERS VALUE EXCELLENCE (SVE)
The refinery and its leaders have a good overall image.
The refinery cares about its stakeholders.

The refinery has strong financial performance.

The refinery has a good reputation for quality, reliability, environmental, and safety.

SECTION 2: BACKGROUND INFORMATION (THE FOLLOWING ITEMS ARE FOR STATISTICAL INFORMATION ONLY)
What area of the refining do you work in? (Choose from the following)
Owner representative

Corporate Technical Support Group

Senior Refinery Management

Extended (line) Refinery Management

Day Support of Operations

Production/Operations

Refinery Technical Support

Maintenance Crafts

Supplier

Customer

Stakeholder (other)

APPENDIX B: EXTERNAL STAKEHOLDER VARIABLES (KBES)

Symbol	EXTERNAL STAKEHOLDERS	Variable Type
ξ_{11}	**1. ORGANIZATIONAL VALUE (SOV)**	Endogenous latent
y_{141}	The Organization communicates what it stands for.	Endogenous manifest
y_{142}	The Organization develops strategy aligned with its values	Endogenous manifest
y_{143}	The Organization builds a sense of community surrounding its values, mission, and vision.	Endogenous manifest
η_{13}	**2. PROCESS EXCELLENCE (SPE)**	Endogenous latent
y_{144}	The refinery has mature key processes, process owners, and individuals knowledgeable on the roles and responsibilities necessary to deliver results.	Endogenous manifest
y_{145}	The refinery collects and disseminates a wide range of complete and accurate performance indicators	Endogenous manifest
y_{146}	The refinery compares its process performance with that of its best competitors	Endogenous manifest
y_{147}	The refinery uses key process measurements to drive relationships, accountabilities, and ownership.	Endogenous manifest
η_{33}	**3. ORGANIZATIONAL LEARNING (SOL)**	Endogenous latent
y_{148}	The refinery uses balanced performance indicators and other forms of feedback to drive continuous improvement and learning.	Endogenous manifest
y_{149}	The refinery leadership are accessible, and they actively listen and respond to people with respect.	Endogenous manifest indicator
y_{150}	The refinery has a culture of continuous improvement.	Endogenous manifest
η_{44}	**4. DELIGHT THE STAKEHOLDERS (SD)**	Endogenous latent
y_{151}	The organization as a whole listens to its stakeholders' needs and works in partnership to provide them.	Endogenous manifest
y_{152}	The organization provides relevant and reliable information to its stakeholders.	Endogenous manifest
y_{153}	The organization has ethical conduct and effectively deals with complaints.	Endogenous manifest
η_{55}	**5. STAKEHOLDERS VALUE EXCELLENCE (SVE)**	Endogenous latent
y_{154}	The refinery and its leaders have a good overall image.	Endogenous manifest
y_{155}	The refinery cares about its stakeholders.	Endogenous manifest
y_{156}	The refinery has strong financial performance.	Endogenous manifest
y_{157}	The refinery has a good reputation for quality, reliability, environment, and safety.	Endogenous manifest

APPENDIX C: SYMBOLS AND VARIABLES

Variable Symbol	Variable name or Question	Variable Type
ξ_1	**1. LEADERSHIP (SLEAD): Strategic Planning (SP)**	Prime Exogenous variable
y_{01}	Senior management sets comprehensive people, reliability, quality, safety, environmental, and investment growth plans.	Endogenous manifest indicator
y_{02}	Senior management uses balanced metrics to drive improvement strategies and tactics.	Endogenous manifest indicator
y_{03}	Our senior management leads, participates, and supports quality, reliability, safety, environmental, and learning.	Endogenous manifest indicator
y_{04}	Individual and department goals are linked to long-term quality and reliability improvement goals.	Endogenous manifest indicator
y_{05}	Senior management uses various communication mediums to demonstrate their commitment and accountability for refinery quality and reliability.	Endogenous manifest indicator
y_{06}	Senior management acts with respect, integrity, care, and honesty in routine communications.	Endogenous manifest indicator
y_{07}	Senior management opens channels of communication to all levels of the organization.	Endogenous manifest indicator
η_1	**2. DELIGHT THE CUSTOMER (CF) Commitment to Customer Satisfaction (OCCS)**	Endogenous latent
y_{11}	Refinery consistently delivers products and services meeting or exceeding customer expectations.	Endogenous manifest indicator
y_{12}	Refinery engages in joint customer strategy setting activities to anticipate and supply the needs of customers	Endogenous manifest indicator
y_{13}	Refinery consistently focuses on delivering customer satisfaction with on-time and on-spec products.	Endogenous manifest indicator
η_2	**3. Customer Focus (CF): Commitment to Staff Satisfaction (CCS)**	Endogenous latent
y_{21}	Our refinery is a good place to work	Endogenous manifest indicator
y_{22}	Refinery management optimizes the allocation of resources (people, money, equipment, and time) to enable people to perform their job.	Endogenous manifest indicator
y23	Refinery management and staff satisfy needs of customers during abnormal times.	Endogenous manifest indicator
$\eta 3$	**4. Customer Focus (CF): Commitment to Supplier Relations satisfaction(CSR)**	Endogenous latent

Variable Symbol	Variable name or Question	Variable Type
y31	Refinery is committed to developing good suppliers rather focusing only on bottom line costs.	Endogenous manifest indicator
y32	Refinery is eager to build long-term relationships with suppliers of outside products, materials, equipment, and services.	Endogenous manifest indicator
η4	**5. PEOPLE-BASED MANAGEMENT (PBM)**	Endogenous latent
y41	Feedback through mentoring, coaching, or advising conversations is regularly provided to employees on their performance.	Endogenous manifest indicator
y42	Refinery's overall human resource management efforts support quality objectives.	Endogenous manifest indicator
y43	Means are available for all employees to participate in, and contribute effectively to, meeting the Refinery's quality/reliability/safety objectives.	Endogenous manifest indicator
η5	**6. People-Based Management (PBM): People Make Quality (PMQ)**	Endogenous latent
y51	Refinery management aligns the right people capabilities with organizational needs to deliver products and services.	Endogenous manifest indicator
y52	Managers provide the guidance, skill training, and systems so that people ensure quality in every job.	Endogenous manifest indicator
y53	Refinery management provides clarity on the resources, authority, role documents, accountability, and timing for effectively and efficiently performing key work processes.	Endogenous manifest indicator
η6	**7. People-Based Management (PBM): Teamwork in cross functional teams (TEAM)**	Endogenous latent
y61	Refinery uses cross functional team based approach to solve complex problems	Endogenous manifest indicator
y62	Personnel are encouraged to take initiative in forming effective informal work teams.	Endogenous manifest indicator
y63	Refinery has a flexible organization to support reliability/quality team based approaches when needed.	Endogenous manifest indicator

η7	**8. MANAGEMENT BY FACT (MBF): Integrated Process (IP)**	Endogenous latent
Variable Symbol	**Variable name or Question**	**Variable Type**
y71	Refinery prioritizes critical infrastructure improvement needs considering all the facts about resource commitments.	Endogenous manifest indicator
y72	Refinery management integrates operations, maintenance reliability, safety, and quality through work processes.	Endogenous manifest indicator
y73	Our refinery can be visualized as a web of people, equipment, facilities, and work processes linked together as a system	Endogenous manifest indicator
η8	**9. Management by Fact (MBF): Process Management (PM)**	Endogenous latent
y81	Refinery uses data appropriately to make decisions and act when flaws are discovered in key work processes.	Endogenous manifest indicator
y82	Refinery management uses fact-based risk assessment in decision processes.	Endogenous manifest indicator
y83	Refinery has well understood metrics to effectively drive and improve performance.	Endogenous manifest indicator
η9	**10. Management by Fact (MBF): Information Management & Analysis (IMA)**	Endogenous latent
y91	IT systems provide a wide range of complete, timely, & accurate information to analyze the quality and reliability of equipment and people systems.	Endogenous manifest indicator
y92	Refinery facilitates learning & sharing between employees and technology groups to achieve reliability/quality outcomes.	Endogenous manifest indicator
η10	**11. CONTINUOUS IMPROVEMENT (CI)**	Endogenous latent
y101	Refinery reacts to trends in its customer satisfaction or adverse customer responses	Endogenous manifest indicator
y102	The extent to which the organization learns and acts on Quality, Reliability, and Safety improvement is	Endogenous manifest indicator
y103	Refinery compares current quality levels of service and products with those of competitors (benchmarking)	Endogenous manifest indicator

η11	**12. Continuous Improvement: Prevention (PREV)**	Endogenous latent
Variable Symbol	**Variable name or Question**	**Variable Type**
y111	Personnel utilize a preventive approach to identify, assess, and maintain equipment in good condition.	Endogenous manifest indicator
y112	Work processes, IT, and people systems are designed to predict and prevent potential problems.	Endogenous manifest indicator
η12	**13. Continuous Improvement: Culture of Continuous Improvement (CCI)**	Endogenous latent
y121	Refinery regularly reviews and corrects compliance to service/behavioral standards.	Endogenous manifest indicator
y122	Refinery routinely practices Management Of Change in assessing decisions, assumptions, design, documentation, and procedures, prior to taking actions.	Endogenous manifest indicator
y123	Refinery personnel are rewarded for learning and speaking honestly about mistakes or errors.	Endogenous manifest indicator
y124	Refinery has many long-service high caliber technical support staff	Endogenous manifest indicator
y125	Refinery management creates conditions for mentoring, coaching, training, and motivating personnel.	Endogenous manifest indicator
η13	**14. BUSINESS EXCELLENCE (BE): Deliver Customer Value (DCV)**	Endogenous latent
y131	Refinery creates distinctive performance in operations, maintenance, and turnarounds.	Endogenous manifest indicator
y132	Refinery creates distinctive performance in quality and reliability.	Endogenous manifest indicator
y133	Refinery creates distinctive performance in safety and environmental compliance.	Endogenous manifest indicator
y134	Refinery has strong financial performance (e. g. Profitability, Utilization, NECC, NIAT)	Endogenous manifest indicator

y135	Refinery maintains high credibility with local community, owners, and stakeholders.	Endogenous manifest indicator

APPENDIX D: EMAIL PERMISSION FOR USE FROM THE AUTHOR

Wednesday, March 01, 2006 7:24 AM

Dear Edmund,

It is with great pleasure I give my permission to use my model "Kanji's Business Excellence Measurement system Model" for your research. I also approve the data collection survey methodologies for your research data.

Hope my statement is adequate for your review Board.

Kind regards

Prof. Gopal K. Kanji

Director

Kanji quality Culture Ltd

Sheffield Technology Parks

Arundel Street, Sheffield S1 2NS

U.K.

APPENDIX E: LETTER OF COOPERATION

Edmund Winston

November 10, 2006

Dear Mr. Winston,

Based on my review of your research proposal, I give permission for you to conduct the study entitled "Refinery Business Excellence" within the organization. As part of this study, I authorize you to invite members of my organization, whose names and contact information I will provide, to participate in the study as interview subjects. Their participation will be voluntary and at their own discretion. We reserve the right to withdraw from the study at any time if our circumstances change.

I understand that the data collected will remain entirely confidential and may not be provided to anyone outside of the research team without permission from the Walden University IRB.

Sincerely,

XXXX

General Manager Refinery

APPENDIX F: CONFIDENTIALITY AGREEMENT

Name of Signer:

During the course of my activity in collecting data for this research: "An Application of Business Excellence for U.S. Gulf Coast Oil Refining: A Process for Measuring Managerial Accountability." I will have access to information, which is confidential and should not be disclosed. I acknowledge that the information must remain confidential, and that improper disclosure of confidential information can be damaging to the participant.

By signing this Confidentiality Agreement, I acknowledge and agree that I will not disclose or discuss any confidential information with others, including friends or family. I will not in any way divulge, copy, release, sell, loan, alter, or destroy any confidential information except as properly authorized. I will not discuss confidential information where others can overhear the conversation. I understand that it is not acceptable to discuss confidential information even if the participant's name is not used. I will not make any unauthorized transmissions, inquiries, modification or purging of confidential information. I agree that my obligations under this agreement will continue after termination of the job that I will perform. I understand that violation of this agreement will have legal implications. I will only access or use systems or devices I am officially authorized to access and I will not demonstrate the operation or function of systems or devices to unauthorized individuals. By signing this document, I acknowledge that I have read the agreement and I agree to comply with all the terms and conditions stated above.

Signature:

Date:

APPENDIX G: CONSENT FORM

Business Excellence in Refining Survey

You are invited to participate in a research study of Business Excellence in Refining from Clarity of Managerial Accountability. You were selected as a possible participant due to being a key customer, stakeholder, or supplier for a Refinery. Please read this form and ask any questions you may have before acting on this invitation to be in the study. This study is being conducted by Edmund W. Winston, III, P. E., a doctoral candidate at Walden University. Mr. Winston has been employed in a refinery for over 17 years.

Background Information:

The purpose of this study is to identify performance strengths and weaknesses at Refinery in terms of quality, reliability, safety, environmental, financial, and customer satisfaction.

Procedures:

If you agree to be in this study, you will be asked to fill out the attached survey and return in the enclosed self-addressed envelop by December 10, 2006. It should take no more than 10-15 minutes.

Voluntary Nature of the Study:

Your participation in this study is strictly voluntary. Your decision whether or not to participate will not affect your current or future relations with Refinery, or any it's owners, or partners. If you initially decide to participate, you are still free to withdraw at any time later without affecting those relationships.

Risks and Benefits of Being in the Study:

There are no risks associated with participating in this study. The benefit of this study is that leaders and managers can use this information to sustain or focus improvement actions and plans for the future. In the event you experience stress or anxiety during your participation in the study you may terminate your participation at any time. You may refuse to answer any questions you consider invasive or stressful.

Compensation:

There will be no compensation or reward or other non-monetary benefit provided for your participation in this study.

Confidentiality:

The records of this study will be kept private. In any report of this study that might be published, the researcher will not include any information that will make it possible to identify you. Research records will be kept in a locked file, and only the researcher will have access to the records. There will be no way for your response to be identified to you. The results will be related to general findings within the organization, not to individuals. No unauthorized personnel will review the data without your consent.

Contacts and Questions:

The researcher conducting this study is Edmund W. Winston, III. The researcher's faculty advisor is Dr. Thomas Spencer, who can be contacted at xxx@waldenu.edu. You may ask any questions you have now or later by contacting Ed Winston at xxx-xxx-xxxx or xxx@waldenu.edu. The Research Participant Advocate at Walden University is Leilani Endicott. You may contact her at 1-800-xxx-xxx, extension xxxx, if you have questions about your participation in this study. Please keep a copy of this form for your records.

Statement of Consent:

I have read the above information. I have asked questions and received answers. I consent to participate in the study.

Printed Name of Participant

Participant Signature _____

Signature of Investigator _____

CURRICULUM VITAE

Edmund W. Winston, III, P.E.

Education

Registered Professional Engineer in Electrical Engineering and Control Systems Engineering, Louisiana 1994-present

Master of Business Administration, Louisiana State University, 2001

Bachelor of Science in Electrical Engineering, Louisiana Tech University, 1987

Master of Arts, Music, Louisiana Tech University, 1979

Bachelor of Science in Music Education, Louisiana State University, 1978

Employment Experience

May 2006 - Present

Engineering Manager at a U.S. Gulf Coast Refinery/Chemical Plant. Responsibilities include management of group of professionals for mechanical, electrical, instrumentation, analyzers, control systems, and pressure equipment integrity within the facility. Local skill pool resource manager for professional staff.

August 1990 - May 2006

Increasing responsibilities in engineering to Reliability Manager while employed at a major U.S. Gulf Coast oil refinery. Specific responsibilities included design engineering, field support, project management, engineering team leader, area maintenance engineering, planning and economics analyst, reliability engineering team leader, RCA facilitator, and reliability manager.

October 1989 - July 1990

Consulting Engineer at a major U.S. oil refinery with responsibilities for electrical and instrument project management and technical field support.

August 1987 - October 1989

Substation engineer at an electric utility company. Major responsibilities included electrical distribution modeling, planning, communication systems, SCADA systems, relay coordination, and substation technical maintenance.

Memberships

American Society of Quality

INFORMS

Louisiana Engineering Society

Society of Organizational Learning

Presentations

CRU Furnace Explosion Investigation, 2004, National Conference of Safety and Environmental Professionals, New Orleans.

Gulf Coast Causal Learning Workshop, 2004, Co-designer and presenter.

Root Cause Analysis Methodology, 2002, Co-presenter, Society of Organizational Learning, Cambridge, MA.