UNIVERSITY OF KWAZULU-NATAL

A TOTAL QUALITY MANAGEMENT SYSTEM FOR A UNIVERSITY FACULTY

By
Glen Bright
841847455

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DECLARATION

I, Glen Bright, declare that

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Abstract

Total Quality Management, (TQM), is an internationally recognized system of improving quality in industry. Globally, academic institutions have also adopted the principles of TQM systems to enhance the quality of their operations. The main aim of this study was to determine whether a TQM system can be implemented at faculty level in a University and what resources would make it sustainable.

Research data was obtained by surveying staff and students at the University of KwaZulu-Natal, (UKZN). A probability sample of 330, from a population size of 2500, was drawn from the Faculty of Engineering at UKZN. Qualitative and quantitative data from questionnaires and phenomenological interviews was collected for analysis to meet the studies objectives. A salient feature of the study was that all candidates surveyed believed that a TQM system was needed for the Faculty of Engineering at UKZN. The study also showed that staff and students believed that a TQM system would lead to improved quality, standards, operational efficiency, image and reputation for the Faculty of Engineering.

The overall results revealed that a University faculty's operations would benefit from improved quality. A TQM system would be the most appropriate method of achieving improved quality across the board. The study led to the development of a TQM system framework and model that would benefit operations in a University faculty. The study can assist other University faculties that want to improve their operations, across the board, by using a TQM system.

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CHAPTER ONE
Introduction

1.1 Introduction

Quality is an approach that creates excellence in an organization. Total Quality Management (TQM) is a philosophy that embraces all activities in an organization where the expectations and needs of the customer and the organization are exceeded. TQM systems create value for an organization and can give it a competitive advantage in the market place.

TQM systems have been implemented into Higher Education Institutions (HEI) such as Universities found in Malaysia, United Kingdom and the Netherlands (Lomas 2008). TQM systems have improved operational service and education delivery. High quality service, operational efficiency and education delivery contribute to a faculty's image and reputation (Clayton 2006). Universities, and their facilities, are ranked on standards and accreditation. A TQM system has been researched for a University faculty. The findings have been interpreted and discussed. A flowchart of the layout of the study is presented in Figure 1.1

1.2 Motivation for the Study

TQM systems have been investigated and implemented into Universities in Malaysia, United Kingdom and the Netherlands to improve their operations at managerial level. The motivation for the study was to determine whether a TQM system could be implemented in the Faculty of Engineering at the University of KwaZulu-Natal (UKZN) and what resources would be required to make it sustainable. Investigating and implementing a TQM system at faculty level would result in improved quality, (operation and service), for a University faculty.

To become the faculty of choice among South African Universities in Engineering, the Faculty of Engineering at UKZN would need to improve its quality of operations across the board. To achieve this goal, the Faculty of

Engineering will need to improve the quality, standard and efficiency of its entire operation. It requires a complete quality solution, such as a TQM system, to be formulated and implemented across the board.

The major stakeholder that benefitted from the study was the UKZN. The University has committed itself to become the premier University of African scholarship. It wants to be academically excellent, innovative in research, critically engaged with society and demographically representative. In order to improve its worldwide ranking and strive for improvement, the UKZN wants to ensure the promotion and development of a culture of quality in all faculties at the University. The UKZN is currently ranked 472 on the Academic Rankings of World Universities, ARWU, in 2010 (ARWU 2011).

Students are another major stake holder. They study at the University to gain a higher education. They want to make a meaningful contribution to the South African economy upon graduation. It was essential that all students are given every opportunity to gain a quality higher education. This would lead to an improved economy and enhance the reputation of engineering graduates in the South African workplace.

Parents and sponsors of students are also major stakeholders. They have invested financial resources in students. This investment needs to be realized by the students completing their studies in good time and then contributing to the South African economy.

Industries, from South Africa, are another major stakeholder. Skilled workers are in short supply in South Africa especially in the engineering sector (Public Works 2011). Skilled workers can teach others and make a significant contribution to the growth and Gross Domestic Product (GDP) of South Africa.

The South African Government, who subsidizes higher education in South Africa, is also a major stakeholder. The Government wants entrepreneurs to be skilled so that they can create jobs and grow the South African Economy.

The research study provides details on how to determine whether a TQM system could be implemented in a University faculty and what resources would be required to make it sustainable. Providing the framework and model for implementing a TQM system at faculty level was also a major part of the research study. Universities want to provide superior student teaching and learning operations for students at faculty level. They want high quality research output from faculty staff members. The study showed that a TQM system for a University faculty will provide high quality service and operational efficiency that will make a positive contribution to a faculty's image and reputation.

The benefits of study are that it has provided a solution on how a TQM system can be implemented in a University faculty and what resources are required to make it sustainable. The methods, results and recommendations can be applied in practice to any University faculty to provide high quality service, operation and education delivery for its entire operation. High quality service, operational efficiency and education contribute to a faculty's image and reputation. Universities, and their facilities, are ranked on standards and accredited by professional bodies.

1.3 Focus of the Study

The focus of the study was to research a TQM system that could be implemented in the Faculty of Engineering at UKZN and what resources would be required to make it sustainable. The results provided information on the implementation of a TQM system for a University faculty and how this provided high quality service, operation and education delivery for its entire operation. The following dimensions of the discipline were focused on:

1. A TQM system for the Faculty of Engineering at UKZN.
2. Resources required to implement a TQM system in the Faculty.
3. Key personnel who must manage a TQM system in the Faculty.
4. The implementation of TQM for the Faculty.
5. The impact a TQM system would have on the quality, standard, operational efficiency, image and reputation of the Faculty.
6. A framework and model of a TQM system for a University faculty.

The implementation of the TQM system was discussed in conjunction with the resources such as funding, human capital and experience. A cost analysis was not included. This would need to be done for a University faculty, as part of its business model.

1.4 Problem Statement

The study aimed to solve the problem:

Can a TQM system be implemented in the Faculty of Engineering at UKZN and what resources would be required to make it sustainable?

The study was needed due to the fact that Faculties compete with each other in the University, and with other Universities, for high quality students. Faculties also strive for high quality research output. High quality service, operational efficiency and education contribute to a faculty's image, reputation and output. Universities, and their facilities, are ranked on standards and accreditation (ECSA 2011).

1.5 Research Questions

The critical research questions, answered by this study, were:

1. Was a TQM system required for the Faculty of Engineering at UKZN?
2. What resources were needed to introduce a TQM system for the Faculty of Engineering?

3. Whether key personnel could manage a TQM system for the Faculty of Engineering?
4. How a TQM system should be implemented for the Faculty of Engineering?
5. What the impact of a TQM system would be on the quality, standard, operational efficiency, image and reputation for the Faculty of Engineering?

1.6 Objectives

The literature review was based on a theoretical analysis of the current literature associated with the problem statement, which linked to the objectives. The questions, asked in phenomenological interviews and the questionnaire, were derived from the objectives of the study, such that the information could provide satisfactory answers to the research study as a whole. Figure 1.1 presents the flow layout of the study. The position of the objectives, on the flowchart, indicates how the questions were used to answer the objectives by using statistical analysis and interpretation.

The overall objective of the study was to research and investigate the TQM system for a University faculty and what resources would make it sustainable. The study provided answers on whether a TQM system was required for a University faculty to provide high quality service, operation and education delivery.

As illustrated in Figure 1.1, the study was broken down into the following five objectives:

1. Determine if a TQM system was required for the Faculty of Engineering at UKZN. Quantitative data was analysed to answer the objective.

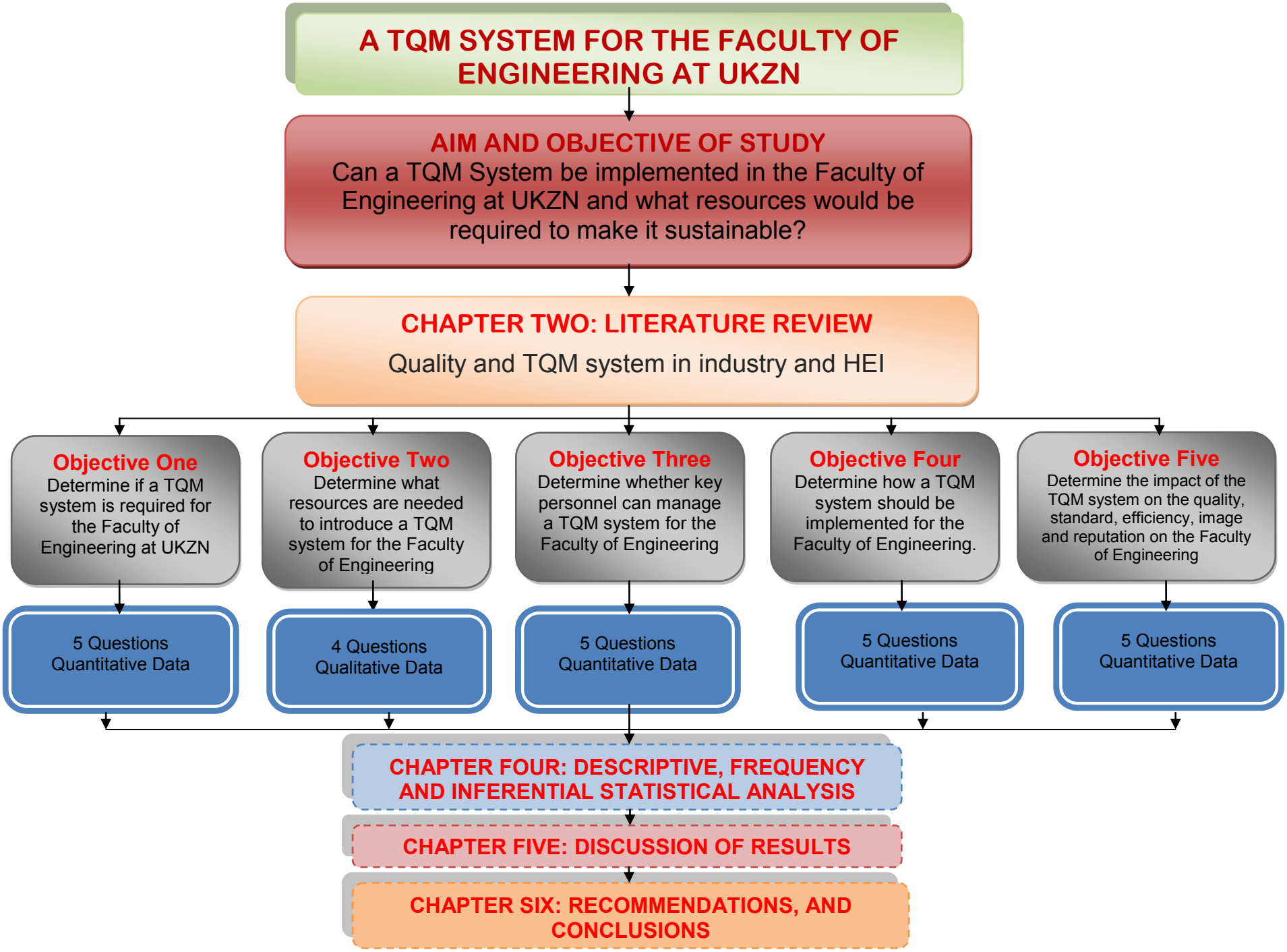

Figure 1.1 Flow Chart of the Research Study

2. Determine what resources were needed to introduce a TQM system for the Faculty of Engineering. Qualitative data was analysed to answer the objective.
3. Determine whether key personnel could manage a TQM system for the Faculty of Engineering. Quantitative data was analysed to answer the objective.
4. Determine how a TQM system should be implemented for the Faculty of Engineering. Quantitative data was analysed to answer the objective
5. Determine the impact of a TQM system on quality, standard, efficiency, image and reputation on the Faculty of Engineering. Quantitative data was analysed to answer the objective.

Research data, associated with the five objectives, was analysed, interpreted and discussed. Theoretical information from the literature review, together with the research data, was then used to develop a framework and model of a TQM system for a University faculty.

1.7 Limitations of the Study

The research approach involved collection of both the quantitative and qualitative data. This data was required to answer the critical questions. The data was only gathered from staff and students across the board in the Faculty of Engineering at UKZN. The sample size was 333 and the population size was 2500. The candidate's responses were not differentiated by age, race, gender and academic year.

Candidates filled in questionnaires, organized and supervised by the MBA research candidate. Descriptive and frequency statistics were presented as narrative text, tables and figures. Inferential statistics used correlation for selected questions. The study's objectives involved quantitative data from a questionnaire and qualitative data from phenomenological interviews. Data was obtained from people that could have been biased and subjective. The statistical analysis of data was not outsourced. It was done by the researcher on a Statistical Package for Social Sciences (SPSS, Version 18).

The cost of researching and implementing a TQM system was not investigated in the study. This would need to be facilitated by the University executive or an outside consulting company as part of a business plan. The costs of a TQM system would be over and above the normal running expense of a University faculty.

1.8 Summary

This chapter introduced the field of study by presenting a statement of quality and TQM. The motivation for the study was to determine if a TQM system could be implemented in the Faculty of Engineering at UKZN and what resources would be required to make it sustainable. Stakeholders included the UKZN, students, parents, sponsors, local industry and the South African government. The unique contribution was identified as a study that determined whether a TQM system should be implemented in a University faculty and what resources would be required to make it sustainable.

The focus of the study used six disciplines to establish whether a TQM system could be implemented a Faculty of Engineering at UKZN and what resources would be required to make it sustainable. This encapsulated the problem statement which was directly linked to five critical questions that the study answered. The overall objectives were linked directly to the critical objectives, where statistical analysis and literature review was used to develop a model and framework of a TQM system for a University faculty. The limitations of the study were summarised as sample size and composition, statistical method analysis and costs. The next chapter now provides a thorough literature survey on Quality and TQM systems in industry and HEIs.

CHAPTER TWO

Total Quality Management Systems

2.1 Introduction

The purpose of the literature review is to provide a sound theoretical back ground to certain Quality and TQM aspects, so that the methodologies within the TQM field can be implemented in an academic faculty at a HEI. The literature survey begins with broad statements and definitions of quality to give points of view from relevant authors. The characteristics of quality and success factors of quality are highlighted and discussed. Thereafter, the philosophy of TQM is introduced and analysed. The characteristics of TQM is discussed where core values, methodologies and tools are scrutinised from a management system perspective.

The literature review has a logical flow wherein TQM systems in Education are introduced after the concepts of quality and TQM have been discussed. TQM systems in HEIs is analysed along with the University of KwaZulu-Natal's Quality Promotion and Assurance Process (QPA). The literature review makes the research statement and objectives clearer. It provides the basis for a qualitative approach, (phenomenological interviews), and quantitative approach, (questionnaire), as well as reasoning within the field of quality and TQM systems. The literature review is evidence based, as it reviews other authors work. It summarizes synthesis and critiques other people's work. The chapter ends with a summary of the literature reviewed.

2.2 Quality

Ehlers & Lazenby (2010) suggested that quality is an approach that strives to create excellence in an organization. It is focused on superior service and customer satisfaction. Quality is based on factors that create value and will give an organization a competitive advantage. Organizations must identify quality as a user based approach that provides customers with high quality goods and services (Ehlers & Lazenby, 2010).

Render, Stair & Hanna (2009) agreed with Kearney (2004) and also suggested that quality must be part of a company's strategy where it is focused on the needs of the customer. Quality must use a scientific and mathematical approach, (statistics), for problem solving and decision making to enhance customer satisfaction (Render *et al* 2009).

According to Nagaprasad & Yogesha (2009), quality must also involve team work and long term commitment to excellence to achieve high quality customer service. This requires staff education and training that prioritizes employee involvement and empowerment (Nagaprasad & Yogesha 2009).

According to Walsh, Hughes & Maddox (2008), continuous improvement is required to provide high quality. This allows a company to produce the highest quality goods and services to its customers. Quality is a measurable and precise set of characteristics when viewed from a product based approach. Quality in manufacturing is based on producing competitive high quality products and services (Walsh *et al* 2008).

Jayalath (2010) suggested that consumers have a difficult time defining quality, but they know it when they see it. Quality is the degree to which the goods and services, manufactured or provided by a company, meets the customer's needs or specifications. Quality is a condition of excellence that is customer, manufacturing, product and value based. It is an approach that strives to create excellence in a company that is focused on superior service and customer satisfaction. It is based on characteristics that create value and give a company a competitive advantage. It is a user based approach that provides customer's quality goods and services. Quality is a measurable and precise set of characteristics when viewed from a product based approach (Jayalath 2010).

2.2.1 Characteristics of High Quality Goods and Services

According to Oakland (2008), definitions of quality usually apply for manufacturing products and providing industry services. Defining quality in manufacturing

organizations for products is often different from services. Manufacturing organizations produce a tangible product that can be seen, touched, and directly measured. The most common quality definition in manufacturing is based on conformance, which is the degree to which a product's characteristics meet preset standards. Other common definitions of quality in manufacturing include performance, reliability, features, durability and serviceability. The relative importance of these definitions is based on the preferences of each individual customer (Oakland 2008).

Kotler & Keller (2009) suggested that in contrast to manufacturing, service organizations produce a product that is intangible. It is experienced. The intangible nature of the product makes defining quality difficult. Perceptions can be highly subjective (Kotler & Keller 2009).

According to Kreitner & Kinicki (2008), quality of services is often defined by perceptual factors. These include responsiveness to customer needs, courtesy and friendliness of staff, promptness in resolving complaints (Kreitner & Kinicki 2008).

Manufacturing Organizations	Service Organizations
Tangible	Intangible
Performance	Consistency
Reliability	Responsiveness to customer needs
Features	Courtesy / friendliness
Durability	Timeliness / Promptness
Serviceability	Atmosphere

Table 2.1 Dimensions of Quality

Adapted from Garvin, D.A. 2008. *Managing Quality.* New York: The Free Press. **Internet.** Available at: http://ojs.acadiau.ca/index.php/ASAC/article/viewFile/567/476 (Accessed 1 February 2011)

According to Garvin (2008), definitions of quality in services include the amount of time a customer has to wait for the service and consistence of service. Defining quality in services can be very challenging. The main dimensions of quality for

manufacturing and service organizations are shown in Table 2.1. This illustrates that organizations that have manufacturing operations would be tangible, as one can observe the product from raw material to final product. However, in terms of service organizations, courtesy/friendliness can be measured by consumer responses at a counter electronically or by a survey of customers (Garvin 2008).

2.2.2 Costs of Quality and Success

Smit, Cronje, Brevis & Vrba (2007) suggested that the reason quality is so important is because of the high cost of poor quality. Quality affects all aspects of the organization and has dramatic cost implications. Problems occur when poor quality causes dissatisfied customers. This leads to loss of business. Quality does have other costs. They consist of costs necessary for achieving high quality. These are called quality control costs. There are two types, namely prevention and appraisal costs. Other costs are called quality failure costs. These include internal and external failure costs. The costs of quality are shown in Table 2.2. The first two costs are incurred in the hope of preventing the second two costs (Smit *et al* 2007).

QUALITY CONTROL COSTS	EXPLANATION OF COSTS
Prevention costs.	Costs of preparing and implementing a quality plan.
Appraisal costs.	Costs of testing, evaluating and inspecting quality.
Internal failure costs.	Costs of scrap, rework and material losses.
External failure costs.	Costs of failure at customer site, including returns, repairs and recalls.

Table 2.2 Costs of Quality

Adapted from Garvin, D.A. 2008. *Managing Quality*. New York: The Free Press. **Internet.** Available at: http://ojs.acadiau.ca/index.php/ASAC/article/viewFile/567/476 (Accessed 3 February 2011)

According to Garvin (2008), prevention costs are all costs incurred in the process of preventing poor quality from occurring e.g. planning costs, cost of product and

process design, employee training costs in quality measurement is included as part of this cost and costs of maintaining records of information and data related to quality. Appraisal costs are incurred in the process of uncovering defects e.g. cost of quality inspections, product testing, performing audits, worker time spent measuring quality and the cost of equipment used for quality appraisal (Garvin 2008).

Heizer & Render (2006) suggested that internal failure costs occur due to poor product quality e.g. rework, which is the cost of correcting the defective item. Scrap costs include all the material, labor, and machine cost spent in producing the defective product. Other types of internal failure costs include the cost of machine downtime due to failures in the process and the costs of discounting defective items for salvage value (Heizer & Render 2006).

According to Besterfield (2009), external failure costs are due to quality problems on the customer site e.g. customer complaints, product returns, and repairs, to warranty claims, recalls and litigation costs resulting from product liability issues. Costs occur due to loss of sales and lost customers. Companies that consider quality important invest in prevention and appraisal costs. This reduces and can prevent internal and external failure costs. The earlier defects are found, the less costly they are to correct. External failure costs are higher for service organizations. There are fewer opportunities to correct defects than there are in manufacturing. Costs can be high due to loss of customer faith and loyalty. This can be difficult to regain (Besterfield 2009).

2.2.3 Success Factors of Quality

According to Baltzan & Phillips (2008), high quality can give a company a competitive advantage. It can create value for a company up and down the Supply Chain. It creates success in businesses or organizations tasks. Quality will improve financial profit. Good quality will increase customer satisfaction. It will improve customer loyalty. It will reduce waste and rework. This will lead to higher productivity (Baltzan & Phillips 2008).

According to Lind, Marchal & Wathen (2010), improved quality increases the level of success and prosperity in an organization. This will improve market position and reduce lead times. Improved quality will lead to improved profitability with lower internal quality leading to problems in production, longer lead times and customer dissatisfaction. When customers are dissatisfied, profitability decreases (Lind *et al* 2010).

2.3 Total Quality Management

According to Besterfield (2009) the term used for customer driven quality is Total Quality Management (TQM). Table 2.3 illustrates the evolution of TQM. The old concept of quality is reactive. It is designed to correct quality problems after they occur. The new concept of quality (TQM) is proactive. It is designed to build quality into the product and process design (Besterfield 2009).

<table>
<tr><td>TIME LINE:</td><td>1900s</td><td>1940s</td><td>1960s</td><td>1980s till present</td></tr>
<tr><td>FOCUS:</td><td>Inspections</td><td>Statistical samplings</td><td>Company quality focus</td><td>Customer driven quality</td></tr>
<tr><td></td><td colspan="3" rowspan="2">Quality inspection done after production.</td><td rowspan="2">Build quality into the process. Identify and correct causes of quality problems.</td></tr>
<tr><td></td></tr>
</table>

Table 2.3 Evolution of Quality

Adapted from Besterfield, R. 2009, *Quality Control*, Eighth Edition, Person Educational International, Prentice Hall, New Hersey, USA.

The focus of quality, with respect to time, is shown in Table 2.3. In the 1900s, quality focused on inspections. In the 1940s, quality focused on statistical sampling and in the 1960s there was a company focused approach to quality. Quality inspection was done after production. From the 1980s and beyond, quality was driven by customer requirements. Quality was built into the process. This identified and corrected causes of quality problems during production.

2.3.1 The Philosophy of Total Quality Management

According to Webster (2008), the philosophy of TQM requires an organization wide effort directed toward the continuous improvement of quality. There are three key ideas in this definition. The first key idea is the notion that quality must be an organization wide concern, not just the purview of those with "quality" in their job title. Secondly, TQM is not a level to be achieved, but a never-ending effort focused on continuous improvement. Thirdly, quality in the context of TQM refers to relative value in the eyes of customers. It can be internal (i.e., "customers" within the firm such as your boss or colleagues in another department) or external. High quality means exceeding customer expectations, which connects right back to the earlier point-high quality raises expectations, thus requiring continual performance increases (Webster 2008).

Webster (2008) also suggested that a TQM system has three guiding principles. It must be organization wide, it must provide continuous improvement and service plus quality must exceed customer expectations. There are three elements of TQM. They include: customer focus, employee empowerment, and data-based decision making. Customer focus reinforces the TQM notion that quality is determined by customer perceptions (Webster 2008).

Klefsjo, Bergquist & Garvare (2008) suggested that employee empowerment involves decision-making and responsibility to lower levels in a company. It represents a shift from hierarchical command and control to horizontal control. It has fewer levels of management. Greater employee empowerment is a response to an educated workforce. Advancing information systems makes it easier to control and coordinate activities without micro management. Employee empowerment recognizes the potential of innovative ideas from employees (Webster 2008). Data-based decisions make use of tools and techniques in combination with information for problem solving and process improvement. It complements employee empowerment. It provides suitable decision-making support for delegating authority (Klefsjo *et al* 2008).

Walsh *et al* (2008) suggested that TQM is a philosophy that embraces all activities in an organization where the expectations and needs of the customer and the organization are met. Analyzing this statement indicates that a company using the TQM philosophy will involve the management of quality in all phases and aspects of its business to ensure that the company meets its objectives with its customers. This includes the design of products, production of products, distribution of products and relevant services (Walsh *et al* 2008).

Render *et al* (2009) suggested that TQM is a quality management system which looks at quality from the external or customer's perspective. TQM is therefore a set of practices geared to ensure the organization consistently meets or exceeds customer requirements by placing strong focus on process measurement as means of continuous improvement (Render *et al* 2009).

According to Nagaprasad & Yogesha (2009), a TQM system is also management technique that aims to improve the quality of goods and services produced by an organization by reducing operating costs and increasing customer satisfaction. This can be analyzed as a quality management technique that achieves optimized, high quality production in the most cost-efficient and effective way possible (Nagaprasad & Yogesha 2009).

Besterfield (2009) suggested that TQM systems should be an organization wide approach to continuously improving the overall quality of all its process, products, and services. All items or services produced by the organization must meet or exceed the customer's expectations. Therefore, quality is an essential part of every stage of the production process and not just an inspection at the end of the process TQM is an approach that provides an organization with quality assurance (Besterfield 2009).

Bishop (2008) suggested that a TQM system requires a thorough understanding by all members of a production or service unit of the needs and desires of the ultimate service recipients, a viewpoint of wishing to provide service to internal, intermediate

service recipients in the chain of service. A TQM system maximizes the full potential of its employees in a continuous drive for improvement, assuming that everyone in the organization is responsible for quality (Bishop 2008).

According to Besterfield (2009), the TQM philosophy is to establish the needs of the customer, satisfy the needs of the customer by supplying goods or services. TQM is about continuously improving the business processes to meet or exceed product or services design specifications. A company that uses the TQM philosophy should strive to satisfy the customer by providing exceptional value for money. This will ensure that the company gets more repeat business, referral business and reduced complaints**.** Satisfying the customer is a major requirement of TQM (Besterfield 2009).

According to Kotler & Keller (2009), customer satisfaction is seen as the company's highest priority where fast responses to customer demand are the goal towards superior quality customer service. Customers want value for money for their products or service purchased. Some top companies not only provide quality products, but they also give extra service to make their customers feel important and valued (Kotler & Keller 2009).

2.3.2 Components of a Total Quality Management System

Klefsjo *et al* (2008) suggested that a TQM system is a combination of three components. These include Core Values, Methods and Tools. Figure 2.1 illustrates that the components are integrated together to achieve higher customer satisfaction with less consumption of resources. An organization must utilize core values. Core values are needed for the methodologies and tools required to provide superior customer service. Some organizations only use parts of a TQM system. They pay no attention to how the values are supported. This creates business risk. A TQM system implementation and integration must be done in a logical order for superior outcomes (Klefsjo *et al* 2008).

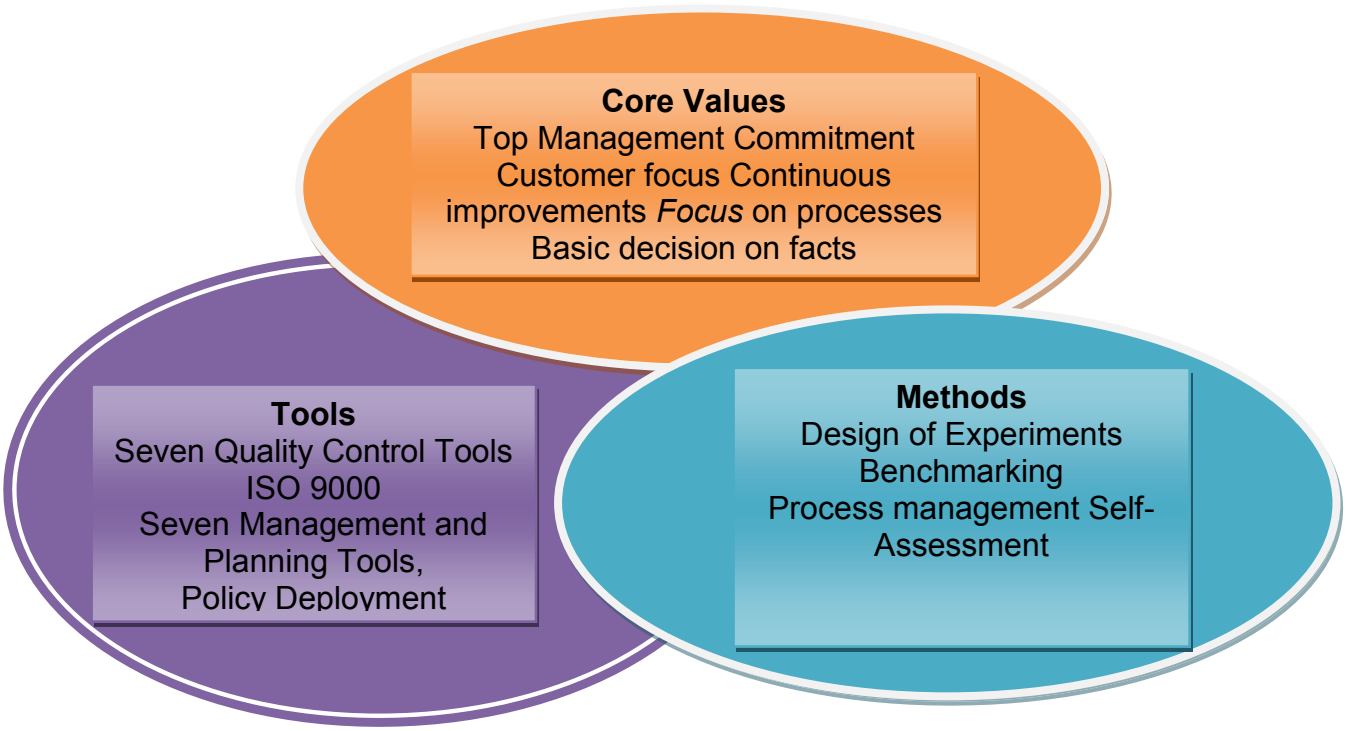

Figure 2.1 Components of a TQM System

Adapted from Klefsjo, L., Bergquist, B. & Garvare, R. 2008. *Quality Management and Business Excellence, Customers and Stakeholders: Do we agree on what we are talking about and does it matter?* The TQM Journal, Emerald Group Publishing Limited, Vol. 20, No. 2, pp. 120-129.

2.3.2.1 Core Values

Besterfield (2009) suggested that a TQM system is based on core values. They can change from time to time. Core values include customer focus, continuous improvement, process orientation and staff commitment. Core values can be termed principles, dimensions, elements or cornerstones in a TQM system. Core values must represent the culture of the organization. Core values must be connected to organizational culture of the business and it is crucial to a TQM system (Besterfield 2009).

Cameron & Sine (2009) suggested that TQM systems have common values. These include focus on customers, management commitment, focus on processes,

continuous improvement and fact-based decisions. TQM systems are represented by quality award models such as the Malcolm Baldrige National Quality Award in the USA or the European Quality Award established by the European Foundation for Quality Management (EFQM) (Cameron & Sine 2009).

Besterfield (2009) also suggested that core values are the cornerstones of a TQM system. However TQM systems need more than just core values. Organizations need a good management system. The management system must be one of the key components of a company's core values as it will create value and give the organization a competitive advantage (Besterfield 2009).

According to Klefsjo *et al* (2008), top management must consider the goals of the company. Finance and resources, (management resources), are necessary for achieving the vision of the company. Commitment and knowledge of the leadership is factor. (Klefsjo *et al* 2008).

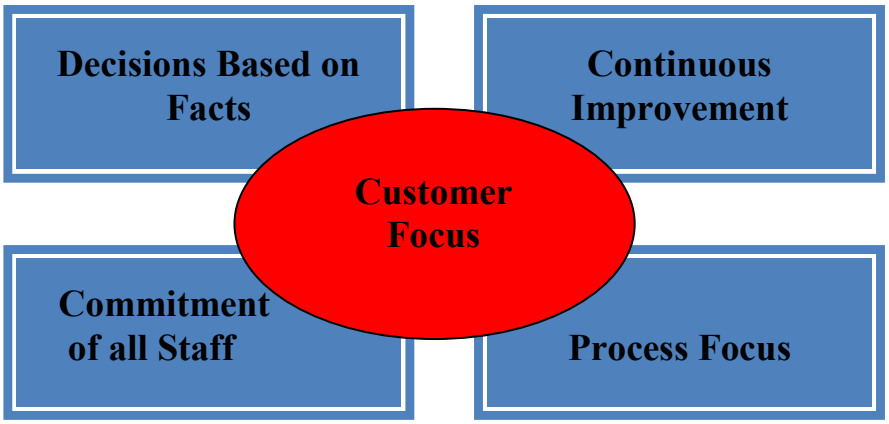

Figure 2.2 Core Values of a TQM system

Adapted from Klefsjo, L., Bergquist, B. & Garvare, R. 2008. *Quality Management and Business Excellence, Customers and Stakeholders: Do we agree on what we are talking about and does it matter?* The TQM Journal, Emerald Group Publishing Limited, Vol. 20, No. 2, pp. 120-129.

Figure 2.2 illustrates how a culture must exist that uses core values to achieve customer focus. The core values of a TQM system include factors such as decisions based on facts, commitment of all staff, continuous improvement and process focus. They each contribute to customer focus. The customer is the central, most important factor. The core values of a TQM system must focus on the customer (Klefsjo *et al* 2008).

According to Webster (2008), in order for a TQM system to be customer focused the organization must know what the customer wants. A TQM system must meet the needs and expectations of the customer. It must produce the right product and service. Both external and internal customers must be satisfied. TQM systems have a strong focus is on external customers. The satisfaction of internal customers, who are employees of the company, must not be neglected. Progression satisfaction of employees is essential (Webster 2008).

According to Heizer & Render (2006), it is important to use different quality control tools in a TQM system. These include Pareto Diagrams, Control Charts, Histograms and Management Tools. Other tools such as Affinity Diagram, Interrelationship Diagraph, and Process Decision Program Chart are also useful for customer focus when using a TQM system in an organization (Heizer & Render 2006).

2.3.2.2 Methods

According to Besterfield (2009), TQM methodologies focus on customer's needs. This can be achieved by using Quality Function Deployment (QFD). QFD is a methodology that progressively identifies customer needs and expectations on service specifications. It transfers these needs to service characteristics and processes. It is an efficient methodology for communication and participation. It requires team members to work together in order to achieve a fundamental basis for continuous and integrated service improvement (Besterfield 2009).

Akao & Kanri (2009) suggested that policy deployment is an important element of the TQM system. It includes systematic planning, utilizing, and observing management systems for improving organization presentation. Policy Deployment works on strategic objectives and daily control of the business to manage continuous improvement and reach business results (Akao & Kanri 2009).

Klefsjo *et al* (2008) suggested that policy deployment must combine planning and implementation in a company in an efficient way. Many organizations use management by control strategy. Management by control considers problem solving rather than planning. Problem solving is necessary for short-term endurance, but it is not enough for long term development. Long-term improvement needs systematic management processes for scheduling, organizing, and performance monitoring. Management by control focuses on problem solving, opinions and sense, while policy deployment focuses on planning, deploying facts and data, and complete communication (Klefsjo *et al* 2008).

Akao & Kanri (2009) suggested that policy deployment also provides the systematic feedback processes essential to continue learning until it becomes time to duplicate the quality function process. Quality function deployment or other strategic planning must have a controlled process for employment and management commitment in order to be useful (Akao & Kanri 2009).

Figure 2.3 illustrates that management must use policy deployment to create value for internal and external customers. An organization is formed by different kinds of processes. Individual processes are done by individuals. Vertical processes relate to a department or unit. Core processes cut across several functions or departments. There are main processes that have the duty of fulfilling external customer and support processes. The system provides resources for main processes, and management processes whose task is to make decisions on the goals and strategies and implement development in other organizational process (Akao & Kanri 2009).

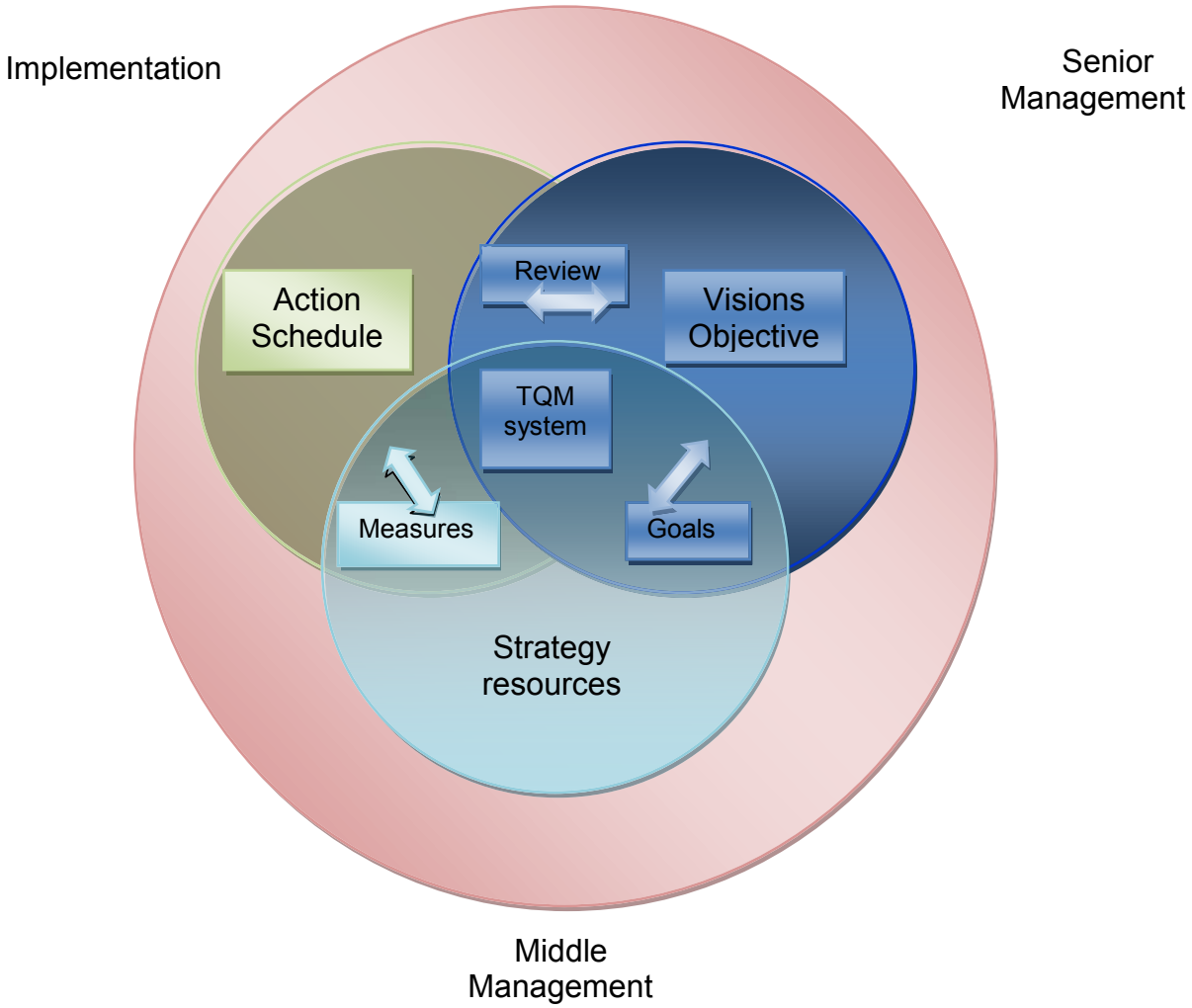

Figure 2. 3 Policy Deployment

Adapted by Akao, Y. & Kanri, H. 2009. Policy Deployment for Successful TQM, Productivity Press Inc., Cambridge, UK.

Akao & Kanri (2009) suggested that the first step for policy deployment involves organizing for improvement. It considers the process, owner and team who work for improvement. The second step is to understanding the customer, supplier, work flow and interfaces of a process. The third step is observing the process. It emphasizes control and measurements. The fourth step is continuous improvement of the process by applying feedback from measurements. Improvement needs quality, efficiency, and adaptability (Akao & Kanri 2009).

According to Besterfield (2009), Dr. E. Deming is credited with the Deming Cycle, illustrated in Figure 2.4 This diagram describes the action steps that are used to manage TQM in a business. It is considered as a methodology for TQM. This cycle is an active part of quality work in every organization and institution. This diagram has four steps. Each step must be completed in order to complete an action (Besterfield 2009). Movement is in a clockwise direction and the steps include:

1) **PLAN:** in order to accomplish, over a period of time, and how to get there.
2) **DO:** to do something to complete the plan.
3) **CHECK:** the results of the actions.
4) **ACT:** by making changes that are needed.

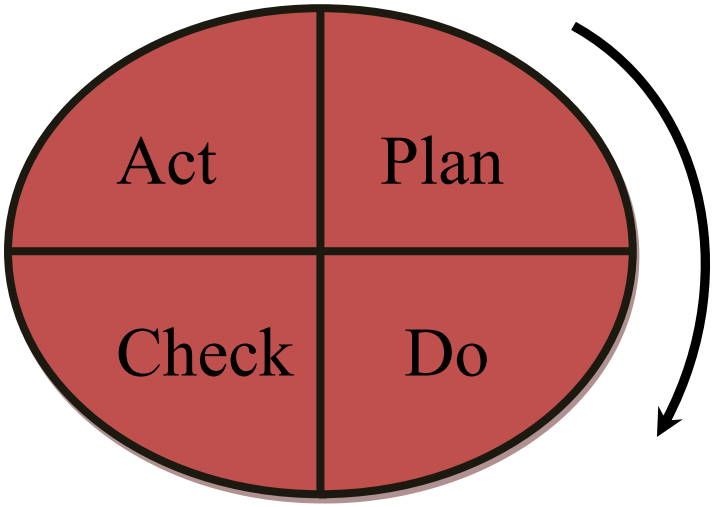

Figure 2.4 The Deming Cycle

Adapted from Besterfield, D.H 2009. Quality Control Eighth Edition, Person Educational International, Prentice Hall, New Jersey, USA.

Figure 2.4 illustrates Deming's four step cycle for a TQM system. Movement is in a clockwise direction, starting with the Plan, Do, Check and Act action. These action steps complete the Deming cycle. The Deming cycle emphasizes the importance of continuous improvement, in every action, in an organization.

Besterfield (2009) suggested that, in addition to the Deming cycle, an organization that wants to implement a TQM system should adhere to Deming's 15 obligations of senior management. These obligations assist senior management with implementing the TQM system. This allows for actions to be taken and then checked. Corrected actions can be introduced, if changes are required. This cycle is also part of continuous improvement. Deming's 15 obligations include:

1. Create and document the purpose and aim of the organization
2. Learn about the TQM philosophy
3. Understand the purpose of a TQM system
4. Do not award business only on price
5. Understand and implement continuous improvement
6. Institute training for all staff across the board
7. Teach and provide leadership
8. Create trust and a climate of innovation free of fear
9. Optimize efforts of groups, teams, staff and workers.
10. Eliminate exhortations for the staff and workers
11. Eliminate numerical quotas for staff and workers
12. Eliminate management by objectives
13. Encourage and ensure pride of workmanship
14. Encourage and provide education and improvement
15. Accomplish transformation in staff and workers. (Besterfield 2009)

These obligations are a benchmark for leadership and senior management to follow to ensure a TQM system is implemented and sustained in an organization Besterfield (2009).

2.3.2.3 Tools

According to Klefsjö *et al* (2008), there are seven management and planning tools that help managers in planning the TQM process effectively and efficiently. The most commonly used are:

1. The affinity diagram that is a business tool used to organize ideas and data. This tool collects large amounts of language data that includes opinions, issues, and ideas. It classifies them in to groupings based on relationships. The main source of data for affinity diagrams is brainstorming. It is used to find out how others view a problem (Webster 2008).
2. The interrelationship diagram that is used to show cause-and-effect relationships between identified factors surrounding an issue. It assumes a central idea or problem and works out the chronological or reasonable links between items. It is based on brainstorming. It is a creative process. Lateral and multi directional thinking is encouraged. It is used when the problem is very complex and the root cause for other problems. It incorporates adjusts and re-evaluation in the process (Klefsjo *et al* 2008).
3. The tree diagram that is a specific type of diagram that has a unique network topology or specific type of network. The tool illustrates the full range of tasks and paths that are needed to achieve a primary goal. The primary goal is then linked to sub goals. This tool is used when the quality implementation is complex. It can be used if there are consequences for not completing other tasks as illustrated (Klefsjo *et al* 2008).
4. The Prioritization Matrices that are used in process improvements to help prioritize decisions. This tool prioritize tasks, product or service characteristics. This is achieved by using known weighted criteria. It also uses a combination of tree and matrix diagram. The tool is used when decision making is important for the survival and future of an organization. It is used when the tasks, product or service characteristics have strong interrelationships (Webster 2006).
5. Other management and planning tools include Matrix diagrams, Process Decision Program Charts (PDPC) and Activity Network diagrams (Besterfield 2009).

Besterfield (2009) suggested that management and planning tools must complement each other. The output of one tool can be the input for another tool. An integrated

approach will save time and money. Strategic planning can reduce time and rework. The seven management and planning tools are often applied when there are limited resources. These include resources for TQM implementation and sustainability such as money, time and human resource (Besterfield (2009).

According to Brassard (2009), a TQM system must improve every aspect of work in an organization. This requires data to be collected and analyzed. Everyone must participate to provide improvement of work. Dr. Kaoru Ishikawa was a Japanese university professor and influential quality management innovator. He used used the total quality control concept and adapted for the Japanese for the analysis of industrial processes. He developed the cause and effect diagram which is sometimes called an Ishikawa diagram or fishbone diagram. He introduced the seven quality control tools for quality improvement. These tools include Data collection, Pareto charts, Stratification charts, Control charts, Histograms, Cause and Effect diagrams and Scatter plots (Brassard 2009).

Brassard (2009) suggested that the following tools are applicable for HEI:

1. Data collection methods are used to collect relevant data. Asking and answering the right questions is important. Quality data is very important. The main point in data collection is gathering useful, efficient and related data to quality problems (Brassard 2009).
2. Histograms are a graphical representation, showing a visual impression of the distribution of data. They are useful for large amounts of data. The number of values in each class is represented by a rectangle. The area of the rectangle is made proportional to the fraction of observations in class. The sum of the areas of the rectangles must equal 1. Histograms show processes and products change (Brassard 2009).
3. Pareto charts contain both bars and a line graph. Individual values are represented in descending order by bars and the cumulative total is represented by the line. These charts are used to decide in which order problems must be solved via the 80%/20% rule. Pareto charts can highlight

serious problems in an organization. When the most serious problem is solved, then the next problem can be solved (Brassard 2009).

4. Cause and Effect diagrams, or Sequence of Events Diagrams, are a type of graphic organizer that describes how events affect one another in a process. They are also called Fishbone and Ishikawa diagrams. They focus on finding the main or root cause of a quality problem. One must first consider and explain the main cause of the problem. Each cause must be analyzed and described in detail. An efficient cause and effect diagram must have many "bones" (Brassard 2009).

Bunney & Dale (2007) also suggested that Data collection, Pareto charts, Stratification charts, Control charts, Histograms, Cause and Effect diagrams and Scatter plots are the quality control tools available for a TQM system. In order to apply quality control tools to a TQM system, the following criteria is required:

1. There must be recognition of the combination of appropriate quality control tools for specific application. Adequate training is also essential for quality control tool implementation.
2. The quality control tools must be used to solve well-defined business problems.
3. The quality control tools must become part of an organization's daily activities.
4. Adequate training must be provided to the right people at the right time in conjunction with the introduction, implementation and application of the quality control tools (Bunney & Dale 2007).

2.3.3 Information Technology

According to Martin, Brown, DeHayes & Hoffer (2009), Information Technology (IT) helps the TQM system achieve its goals for an organization. IT is essential for a TQM system as it provides hardware and software for processing and storing information. It also provides for communication technology for transmitting data such as emails (Martin, Brown, DeHayes & Hoffer (2009).

According to Albrecht (2009), there are three levels of IT for a TQM system:

1. Data recoding and analysing.
2. Information that is made meaningful from analysing data.
3. Knowledge that is a value added process. It is derived from analysis, perception and intelligent manipulation of information.

An IT system is used in the planning, implementation and continuous improvement stages of a TQM system. It is used to gather quantitative and qualitative data for analysis. It is important for a TQM system that the IT system converts information into knowledge. It is the basis for intelligent action of the TQM system (Albrecht 2009).

2.3.4 Quality Control Standards

According to Dattakumar & Jagadesh (2003), ISO is the abbreviation for the International Organization for Standardization. It provides international standards for Business, Government and Society (ISO 2011). The ISO 9000:2000 is described as a quality management system to direct and control an organization with regard to quality. A quality system is a tool for controlling and improving the quality of the company's products and processes. The system must be documented. Documentation of the system is a foundation for quality audits. Three groups of standards can be classified as requirements standards (ISO9001, ISO9002 and ISO9003) ISO9000 makes a distinction between the requirements for quality management systems and requirements for products (Dattakumar & Jagadesh 2003).

Señal, González, Fischer, Hansen & Ponds (2008) suggest that the globally accepted reference standard for higher education is the ISO 9001:2000, Quality Management Systems Standard. The ISO 9001 is recognised as an international standard on best practices in internal quality management. The ISO 9001 is always directed at customer satisfaction and continual improvement in HEI. (Señal, González, Fischer, Hansen & Ponds 2008)

Kitazawa & Sarkis (2010) suggested that the quality management system in ISO 9000 series is based on eight quality management principles. These include customer focus, leadership, involvement of people, process approach, system approach to management, continual improvement, factual approach to decision-making and mutually beneficial supplier relationships. Organizations use these eight quality management principles to meet the quality management system requirements for the ISO 9000 series (Kitazawa & Sarkis 2010).

Ramona & Sower (2007) suggested that process identification, the sequence of these processes, process control, checking the availability of resources and information, analyzing, measuring and monitoring of the processes are special requirements for implementing a TQM system according to standards of the ISO 9000 series (Ramona & Sower 2007).

2.4 Quality in Higher Education Institutions

According to Owlia & Aspinwall (2006), quality for higher education is more difficult to define than that for manufacturing products and services. Quality plays a very important role in today's higher education and impacts on the image and reputation of a University (Owlia & Aspinwall 2006).

Fisher (2008) suggested that competition between institutions and countries is the main factor for the need for quality in education. The quality of products and services is defined by the action, decision-making and thoughts of managers, engineers, workers and teachers. Higher education has entered into the commercial competition domain. It is subject to economical forces and principles (Fisher 2008).

Feigenbaum (2008) suggested that quality in higher education is also due to the improvement of the global education market. Higher education has had to respond to the reduction of the governmental funds, by encouraging HEI to look for other financial sources. HEIs, across the world, are experiencing budget cuts that require leaner operations in University faculties (Feigenbaum 2008).

Cheng & Tam (2007) suggested that quality in education is a rather vague and controversial concept. Identifying what quality means in higher education is a priority. Quality in education is a notoriously ambiguous term. It is important to contextualize quality in higher education. Definitions from industry and services are needed to aid the definitions of quality in higher education in HEI (Cheng & Tam 2007).

According to Pounder (2009), the concept of quality for higher education, in relation to industry, can be adopted and revised. Quality is defined as excellence from a traditional academic view. Specifications are established in detail. Standardized measurements of uniform products and services demonstrate conformity. As products of higher education, graduates must not be identical (Pounder 2009).
According to Campell & Rozsnayi (2008), the characteristics of quality in education are summarized as:

- Quality for fitness for purpose. This approach requires that the product or service has conformity with customer needs, requirements and/or desires.
- Quality as a transformation concept that focuses on students. The better the higher education institution, the more it achieves its goal of empowering students with specific skills, knowledge and attitudes.
- Quality as threshold. Quality sets standards and criteria. A HEI must achieve standards, benchmarks and criteria.
- Quality as value for money. Accountability is central to high quality.
- Quality as enhancement or improvement. This concept emphasizes the pursuit of continuous improvement. Achieving quality is central to the academic requirement. The academics know what is best and what quality is required at any point in time (Campell & Rozsnayi 2008).

According to Lomas (2006), quality of output and reputation of academic research must be prioritized in a HEI. Quality systems need to be adapted from business and industry operations. They need to be reoriented and reinstalled for higher education conditions. The focus must move from management-based to education-based practices (Lomas 2006).

According to Tribus (2004), the differences between education and businesses must be recognized. These include:

- The HEI is not a factory or manufacturing environment.
- The student is not a "product".
- The education of the student is the product.
- Successful completion of the product requires staff and students to be part of the learning process.

According to Kis (2005), the differences between education and industry must be divided into four elements: objectives, processes, input and outputs. For industries, the measure used as an indicator of the effectiveness of organization is profit. The objectives in higher education are not so simple. The objectives of a HEI must be to provide a high quality education for the learners (Kis 2005).

According to Clayton (2006), the objectives of HEI should be to give students the opportunities to improve their knowledge through teaching and learning. Students need to learn and understand. They need to be able to comprehend. Students need to be able to set goals and priorities. They need to develop character to cooperate, to persevere and become respected (Clayton 2006).

Lawrence & Robert (2007) suggested that it is important to identify the customer of higher education. HEI institutions believe that it’s a challenge to do so. The customers of higher education are the students. They are given the highest rank. The remainders, in rank order, were employers, society, faculty, and families. The philosophy behind ranking is that needs and expectations of different groups of customers may differ or even oppose each other. Giving a priority to them is essential for a TQM system (Lawrence & Robert 2007).

Tambi & Kanji (2008) suggested that Universities do not want to have a definition of “customer” in higher education. They do not define the students as customer. This confuses administrators and HEIs. Faculties do not agree with the point to define

students as customer of education. It assumes that the customer is always right (Tambi & Kanji 2008).

Williams (2003) suggested that quality of education should not give students whatever they want. Students must engage with the education process at the HEI to achieve short-term satisfaction. Students must be concerned with passing and graduating. This is in contrast to learning and long-term purposes of education (Williams 2003).

According to Venkatraman (2007), customers in higher education must be regarded as stakeholders. This includes both internal stakeholders like employees and external stakeholders like students and society. The objective of high quality work is to increase the productivity of staff and the University faculty, across the board (Venkatraman 2007).

Becket & Brooks (2006) suggested that in HEIs productivity will have a significant effect on the institutions ability to offer more services. This includes research output. The amount of financial support coming from governments is decreasing worldwide. It is important for HEIs to have productivity. They must plan for reducing waste and reworks. This will reduce the cost of education (Becket & Brooks 2006).

2.5 Total Quality Management in Higher Education Institutions

According to Besterfield (2009), TQM systems are mainly used in industry. TQM systems can be applied to HEI. TQM systems in HEI need to have customer involvement and teamwork. Existing processes at the HEI can be improved by TQM. According to (Marchese 2008), TQM systems must not promote radical change. When the applicability of TQM in education is accepted, the procedure of its process should be addressed. Institutions must carefully review the applicability of TQM within their institutions. They must consider models to prove its applicability and provide trouble free implementation (Besterfield 2009).

Motwani & Kumar (2007) suggested a five step TQM model that is applicable to HEI.

It has five phases that include: Deciding, Preparing, Starting, Expanding and Evaluating. The TQM model is well defined. It clearly describes what should be taken into consideration for TQM system implementation in a HEI. It is very similar to the Deming P.D.C.A. cycle. The phases defined by the TQM model can be integrated into the Deming cycle. The Deming cycle highlights continuous improvement. This provides for improved quality. Therefore, a combination of the Motwani and Kumar TQM model and the Deming cycle offers a TQM model for continuous improvement of quality at a HEI (Motwani & Kumar 2007).

2.6 The UKZN Quality Promotion and Assurance Process

The vision of the University of KwaZulu-Natal is to become the premier University of African scholarship. The mission is to be a truly South African University that is academically excellent, innovative in research, critically engaged with society and demographically representative. It must redress the disadvantages, inequities and imbalances of the past. The UKZN is rated as one of the top 5 universities in South Africa and is also one of only three African Universities rated among the top 500 universities of the world (UKZN 2011).

According to UKZN (2011), in order to keep their ranking, and strive for further improvement, the University has committed itself to a comprehensive quality assurance program called the Quality Promotion and Assurance (QPA) process. The purpose of this program is to ensure the promotion and development of a culture of quality in the University of KwaZulu-Natal (UKZN 2011). This program has the following objectives:

1. Strive for improved quality in teaching, learning, research and service to the University core functions
2. Prepare the University for accreditation, review and institutional audits.
3. Ensure that the University responds to national and international requirements
4. Provides leadership on the implementation and development of quality management systems throughout the University

5. Provide practical advice and support on all quality related activities to the University
6. Use institutional policy development to promote quality.

The Faculty of Engineering falls under the college of Agriculture, Science and Engineering. Each College at the University has a College Quality Committee. The Quality Committee is concerned with all quality-related matters with respect to educational provision in the faculties of the College. The functions also include quality monitoring and quality promotion (UKZN 2011).

According to Clayton (2006), college quality committees should monitor the quality of module and program design through the evaluation of module and program templates. It submits new programs and qualifications from the College to the Academic Affairs Board, for ultimate approval by Senate, and for external approval processes. It monitors the carrying out of annual program and School self-evaluation processes within the College. The committee ensures that systems are in place for keeping track of relevant policies and documents for review processes. It also develops a College or faculty-specific version of University policies on quality assurance and promotion for implementation within the group of faculties concerned (Clayton 2006).

According to Tambi & Kanji (2008), each Quality Committee also facilitates quality promotion and development. It receives and assesses applications for special funding for innovation and creativity in program development and learning and teaching activities, or any other areas needing quality improvement. It identifies needs for training in curriculum development or other staff development. It ensures that consultation and information dissemination processes are in place with respect to quality-related policies, processes and activities (Tambi & Kanji, 2008).

According to Doherty (2003), the Quality committee also has an Advisory function. It submits proposals about new developments in higher education within the relevant group of faculties to Senate. It considers and responds to new external policy proposals relating to quality in higher education through the relevant Committee,

Office or Senate. The committee receives and discusses annual reports on programs and School self-evaluation processes. It offers advice on possible improvement. It also receives and discusses reports. (Doherty 2003).

Figure 2.5 The QPA processes at UKZN

Adapted from QPA, 2011. *Quality Performance Audit Report for UKZN.* **Internet**. Available at http://qpa.ukzn.ac.za/Homepage.aspx (Accessed 21 April 2011).

According to QPA (2011), the QPA system at UKZN has four stages, as illustrated in Figure 2.5. These include Planning, Acting, Observing and Reflecting. The cycle starts with the Planning stage and moves in a clockwise direction. The Planning stage deals with module and program design and approval of templates. The Acting stage deals with support for teaching and learning, professional development, workshops and quality enhancement projects. The Observing stage deals with surveys, student feedback, performance development, internal and external examining and moderation. The Reflecting stage deals with teaching portfolios, module portfolios, program self evaluation, school self-evaluation, audit reviews, institutional audit and support division reviews (QPA 2011).

According to ECSA (2011), the core business of Faculties of Engineering, at Universities in South Africa, is to educate undergraduate students. Education is delivered to students my means of lectures, tutorials and laboratory practicals. The

quality of education, in University Faculties in South Africa, is evaluated and accredited by the Engineering Council of South Africa, (ECSA), every five years. ECSA is a signatory to the Washington Accord from the United States of America. The Washington Accord oversees the quality assurance measures required by ECSA A TQM system, implemented in the School of Engineering at UKZN, would provide quality measures that would be evaluated by ECSA (ECSA 2011).

2.7 Summary

This chapter clearly illustrated that the requirement of quality is the degree to which the goods and services, manufactured or provided by a company, meets the customer's needs or specifications. It was shown that quality is a condition of excellence that is customer, manufacturing, product process and value based. TQM is a customer driven philosophy. It is a process that manages all operations in a company and focuses on superior customer satisfaction, performance, features, reliability, standards, accuracy and repeatability. TQM systems also focus on durability, serviceability, aesthetics and other aspects that improve quality. TQM systems require a combination of core values, methods and tools to provide superior satisfaction to the customer with high quality goods and services. The application of quality control standards is essential to an efficient and effective high quality management system.

The literature review showed that quality in HEI has characteristics that are related to industry; however, some differences were outlined and described. Authors have proposed models that can be used by a TQM system in a HEI system based on the Deming cycle. A TQM system in a HEI must strive to provide superior satisfaction to its stakeholders and guarantee high quality delivery of services. TQM systems should continuously improve processes by working more efficiently and using special high quality methods such as P.D.C.A. and other tools mentioned in this review. Quality Assurance is a methodology that can form part of a TQM strategy for the Faculty of Engineering at UKZN. The next chapter now provides a comprehensive research methodology for the study, including how the research instruments are constructed. and data is analyzed.

CHAPTER THREE

Research Methodology

3.1 Introduction

Research methodology requires careful planning. The execution of the study is based on a sound research methodology. The design for the research study required literature review, choice of study design, selection and allocation of subjects, recording of observations and collection of data. Decisions made throughout the research methodology process effect the quality of the data that needs to be analyzed by the study.

According to Lind, Marchal & Wathen (2010) research methodology provides the process that makes sure that the aim and objectives of the study are achieved by collecting and analyzing data. The data must solve the research problem. This process has been followed where data collection strategies will focus on a questionnaire and interviews based on a sample size. Research design and methods are needed to describe the purpose of the study. Construction of the instrument and recruitment of study participants requires careful planning and logistics. Presentation, validation and administration of the questionnaire and interviews provide the processes for quantitative and qualitative data collection for analysis (Lind *et al* 2010).

3.2 Aim and Objectives of Study

Faculties at universities compete with other faculties within the University, and with other universities, for high quality students. High quality service, operational efficiency and education delivery contribute to a faculty's image and reputation. Universities, and their facilities, are ranked on standards and accreditation (ECSA 2011). The aim of this study is to determine if a TQM system can be implemented in a faculty at UKZN and what resources will be required to make it sustainable.

The study will aim to answer the research problem:

Can a TQM system be implemented in the Faculty of engineering at UKZN and what resources would be required to make it sustainable?

The objectives of the study is to research and investigate the implementation and impact a TQM system would have on a University faculty to provide a high quality service, operational, education delivery for its entire operation. This can be broken down to the following five objectives:

1. Determine if a TQM system is required for the Faculty of Engineering at UKZN.
2. Determine what resources are needed to introduce a TQM system for the Faculty of Engineering.
3. Determine whether key personnel can manage a TQM system for the Faculty of Engineering.
4. Determine how a TQM system should be implemented for the Faculty of Engineering.
5. Determine the impact of the TQM on the quality, standard, efficiency, image and reputation for the Faculty of Engineering.

In addition to the five objectives, a framework and model of a TQM system for a University faculty is proposed. The proposal of a TQM system is based on the literature review of quality and TQM systems for industry and HEI, and the results obtained from statistically analyzing quantitative and qualitative data obtained from the five objectives.

3.3 Participants and Location of the Study

The participants of the research study were selected from personnel, across the board, in the Faculty of Engineering at UKZN. This included:

1. Academic staff in the Faculty of Engineering. There are five schools that make up the Faculty which include Civil Engineering, Mechanical Engineering, Electronic/Electrical/Computer Engineering, Agriculture Engineering and Chemical Engineering. Staff levels range from lecture through to professor.
2. Engineering undergraduate students across the Faculty at UKZN.
3. Engineering postgraduate students, (MSc and PhD), across the Faculty at UKZN.

The location and review of study was the Faculty of Engineering at UKZN. The Engineering Faculty included all five engineering schools located at the Howard College campus, Durban, KwaZulu-Natal, South Africa.

3.4 Data Collection Strategies

According to Lind *et al* (2010), data collection strategies allow for systematic collection of data about people, objects and phenomena. It provides information about the environment in which the data occurs. Data collection can be in the form of qualitative and/or quantitative data (Lind *et al* 2010).

Render *et al* (2009) suggested that qualitative information is obtained from objects, pictures and words. It involves detailed descriptions of observations. The outcome is not always clear and it is subjective. Quantitative data includes numbers. It provides relationships between phenomena. It requires collection of data before analysis, (usually done statistically). The outcome is often known and it is objective (Render *et al* 2009).

A summary of qualitative vs. quantitative research methodologies is illustrated in Table 3.1. It illustrates the relationship between qualitative and quantitative data. It highlights differences between qualitative and quantitative research methodologies. The table also makes the qualitative and quantitative research methodologies clearer for the study and provides a background on the data collection strategies for research.

QUALITATIVE	QUANTITATIVE
All research ultimately has a qualitative grounding.	There's no such thing as qualitative data everything is either 1 or 0.
The aim is a complete, detailed description.	The aim is to classify features, count them, and construct statistical models to explain what is observed.
Researcher may only know roughly in advance what he/she is looking for.	Researcher knows clearly in advance what he/she is looking for.
Recommended during earlier phases of research projects.	Recommended during latter phases of research projects.
The design emerges as the study unfolds.	All aspects of the study are carefully designed before data is collected.
Researcher is the data gathering instrument.	Researcher uses tools, such as questionnaires or equipment to collect numerical data.
Data is in the form of words, pictures or objects.	Data is in the form of numbers and statistics.
Subjective - individuals interpretation of events is important, e.g., uses participant observation, in-depth interviews or discussions etc.	Objective seeks precise measurement & analysis of target concepts e.g., uses surveys, questionnaires etc.
Qualitative data is more rich, time consuming, and less able to be generalized.	Quantitative data is more efficient, able to test hypotheses, but may miss contextual detail.
Researcher tends to become subjectively immersed in the subject matter.	Researcher tends to remain objectively separated from the subject matter.

Table 3.1 Qualitative vs. Quantitative Research Methodologies

Adapted from Brenan, M. 2005. *Qualitative data analysis* Internet. Available at: http/www.staff.ncl. ac. uk/david. harvey/AEF801/MBQual [Accessed 20 March 2011].

Meyers (2008) suggested that there are different ways to classify and characterize types of research. The distinctions between qualitative and quantitative research methods are a common method. Table 3.2 illustrates the difference between qualitative research and quantitative research techniques. It also highlights the five different focus areas that researchers can use to conduct studies.

QUALITATIVE RESEARCH A FOCUS ON TEXT	QUANTITATIVE RESEARCH A FOCUS ON NUMBERS
Action research	Surveys
Case study research	Laboratory experiments
Ethnography	Simulation
Grounded theory	Mathematical modeling
Hermeneutics	Statistical analysis

Table 3.2 Qualitative vs. Quantitative methods

Adapted from Meyers, M.D.2008. Qualitative research in business Internet. Available at: http/books.google.co.za/books?isbn=141292166X. [Accessed 1st of March 2011]

Sekaran & Bougie (2010) suggested that there are two basic sources of data. The first source is primary data, commonly referred to as a sample. It is collected for a specific purpose. The second source is secondary data which is collected for one purpose and is then used for a different purpose. Data collection techniques include:

1. Available Information or historical archive analysis that uses existing data. It is inexpensive and quicker than getting new data. It is sometimes difficult to gain access to records or reports. The data may

not always be complete, exact, reliable or precise (Sekaran & Bougie 2010).

2. An observation involves systematically recording, selecting and watching. It can involve recording behaviour and characteristics of people, objects or phenomena. The two distinctive features of observation research include the way data is organized and the way the data is recorded, interpreted and used. Observations have clear advantages over interviews and questionnaires. Information can be recorded directly without having to rely on retrospective or anticipatory accounts of others. Observations provide information for those who cannot speak, cannot take part in interviews or cannot complete questionnaires (Lind *et al* 2010).
3. Interviews provide an understanding and insight of people's behaviour. Interviews involve oral questioning of respondents. This can be in a group or individually. Answers to questions are recorded during an interview by writing or tape-recording (Meyers 2002).
4. Focus Group Discussions (FGD) include groups of 8 - 12 informants. They are free to discuss topics under guidance from a facilitator or reporter (Lind *et al* 2010).
5. Case studies provide an intensive type of examination for one person, a small group or a company. This approach is undertaken to make practical improvements. Case studies require one to understand the present situation, gather information about past and key variables, test hypothesis and take corrective action (Sekaran & Bougie 2010).
6. Projective Techniques involve a researcher that uses projective techniques. An informant is required to react to some kind of visual or verbal stimulus (Sekaran & Bougie 2010).
7. Mapping and Scaling is a valuable technique for visually displaying relationships and resources. It allows researchers to categorise certain variables that they would not be able to rank themselves. Mapping and scaling may be used as participatory techniques in rapid appraisals or situation analyses (Sekaran & Bougie 2010).

8. Questionnaires are an accepted data collection tool in which written questions are answered by respondents. Methods used include:

a) Sending questionnaires by mail with instructions on how to answer the question. Mailed responses are then requested
b) Gathering part or all of the respondents in one place at one time. They are given oral or written instructions to answer the questionnaires
c) Hand-delivering questionnaires to people and retrieving them later.

A disadvantage of using questionnaires is they can be complex to design. They may need numerous amendments before they can be sufficient and adequate to distribute (Lind *et al* 2010).

According to Cook, Heath & Thompson (2004), the HyperText Markup language (HTML) has enabled data collection to become easy and non-threatening. HTML allows for an interactive medium in which the operators interact directly with the surveying entity. The World Wide Web, (WWW), hypertext transfer protocol (HTTP) and JavaScript has created innovative interfaces and methods of interacting with participants from all over the world. An advantage of web based surveys is the methodological and economic benefits. Data can be saved automatically in an electronic format that is ready for analysis, reducing costs and time-consuming part of research (Cook *et al* 2004).

Besterfield (2009) suggested that there are advantages of using web based surveys. However, the biggest concern in internet surveying is coverage bias or bias due to sampled people not having or choosing not to access the internet. There are wide disparities in internet access among ethnic and socioeconomic groups. The tools for conducting web based surveys continue to grow in sophistication. By utilizing the Apple iPad or iPhone, researchers are able to gain access to a much larger group of participants (Besterfield 2009).

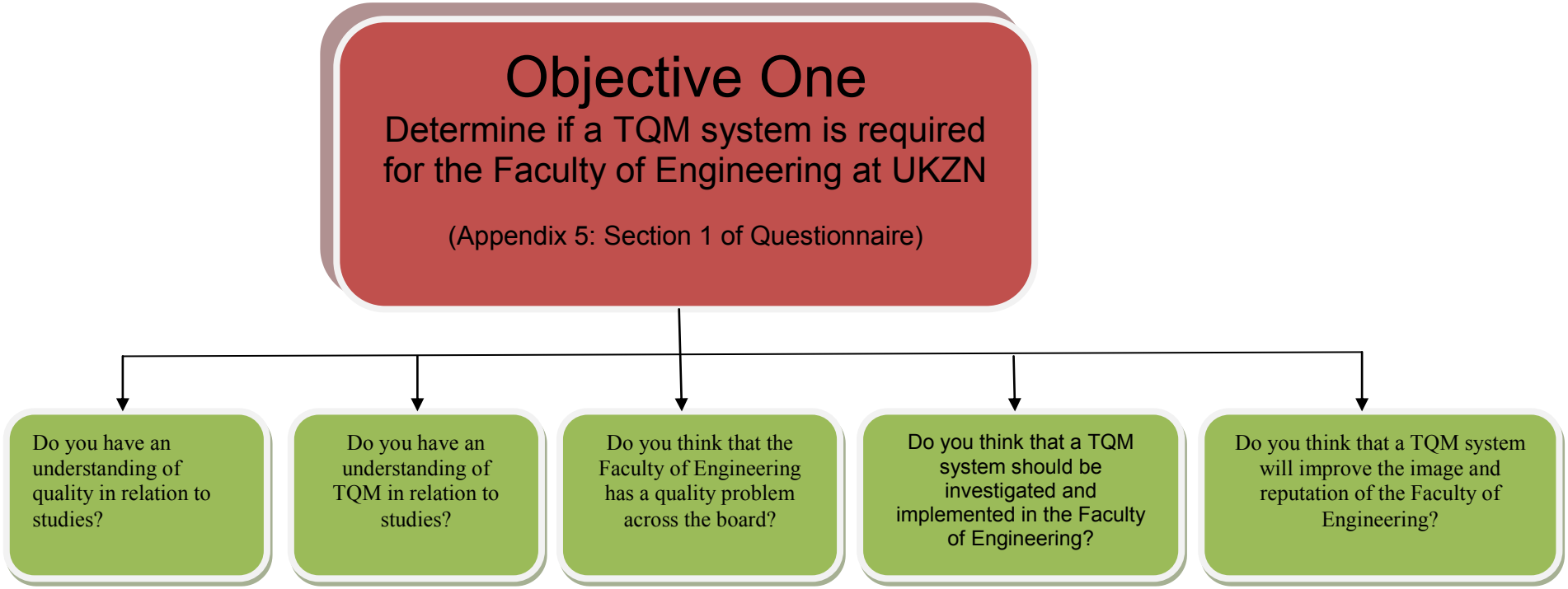

Figure 3.1 Objective One and five Associated Questions (Appendix 5)

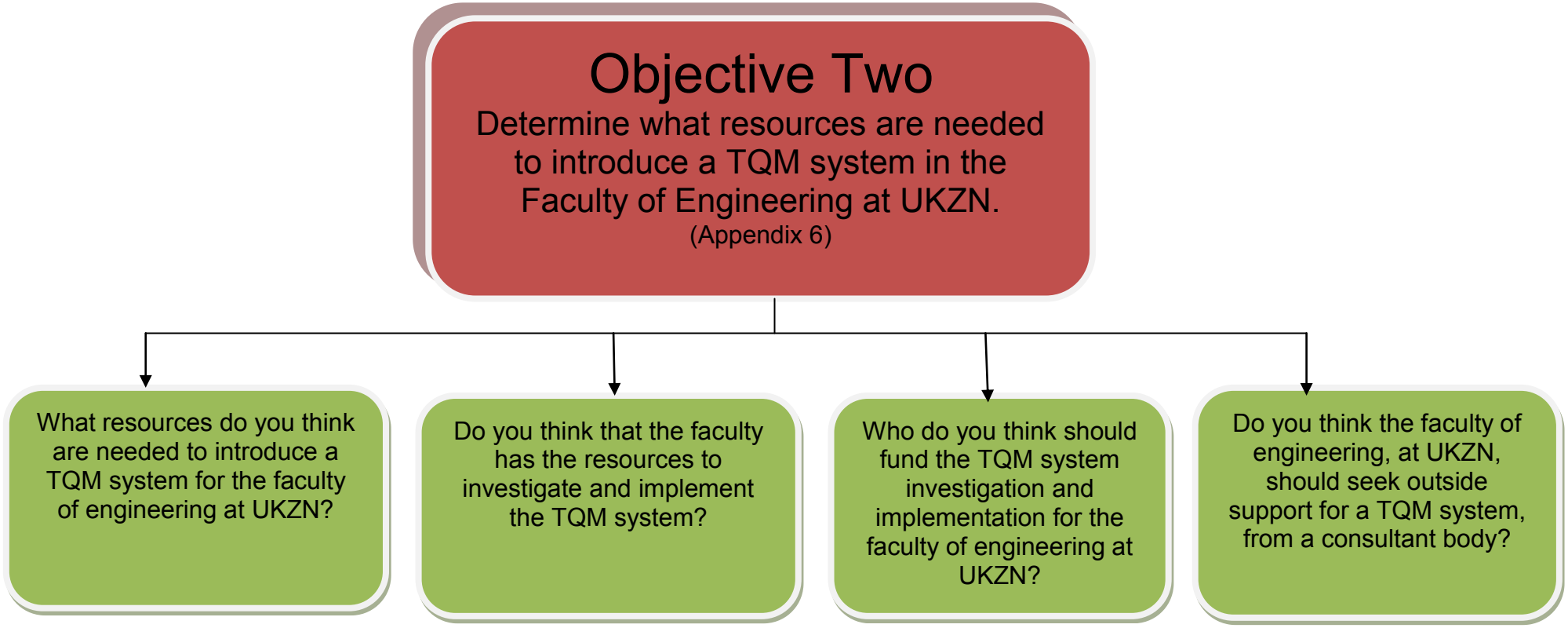

Figure 3.2 Objective Two and four Associated Questions (Appendix 6)

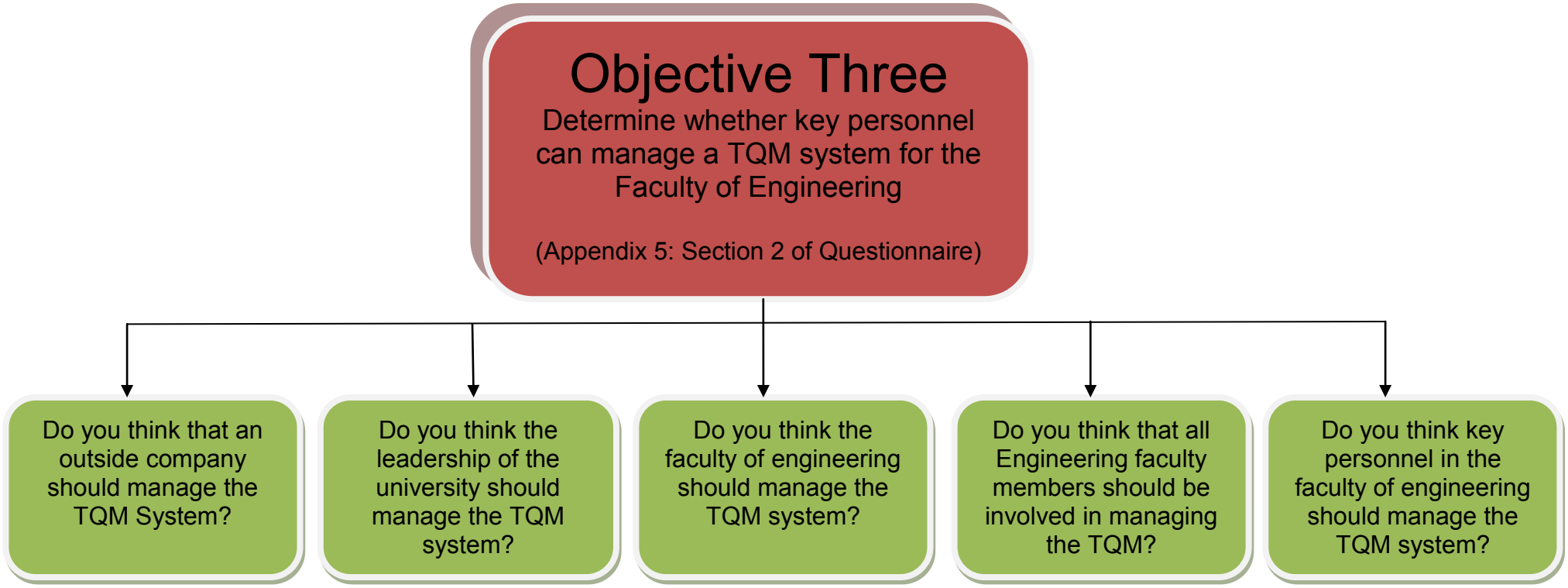

Figure 3.3 Objective Three and five Associated Questions (Appendix 5)

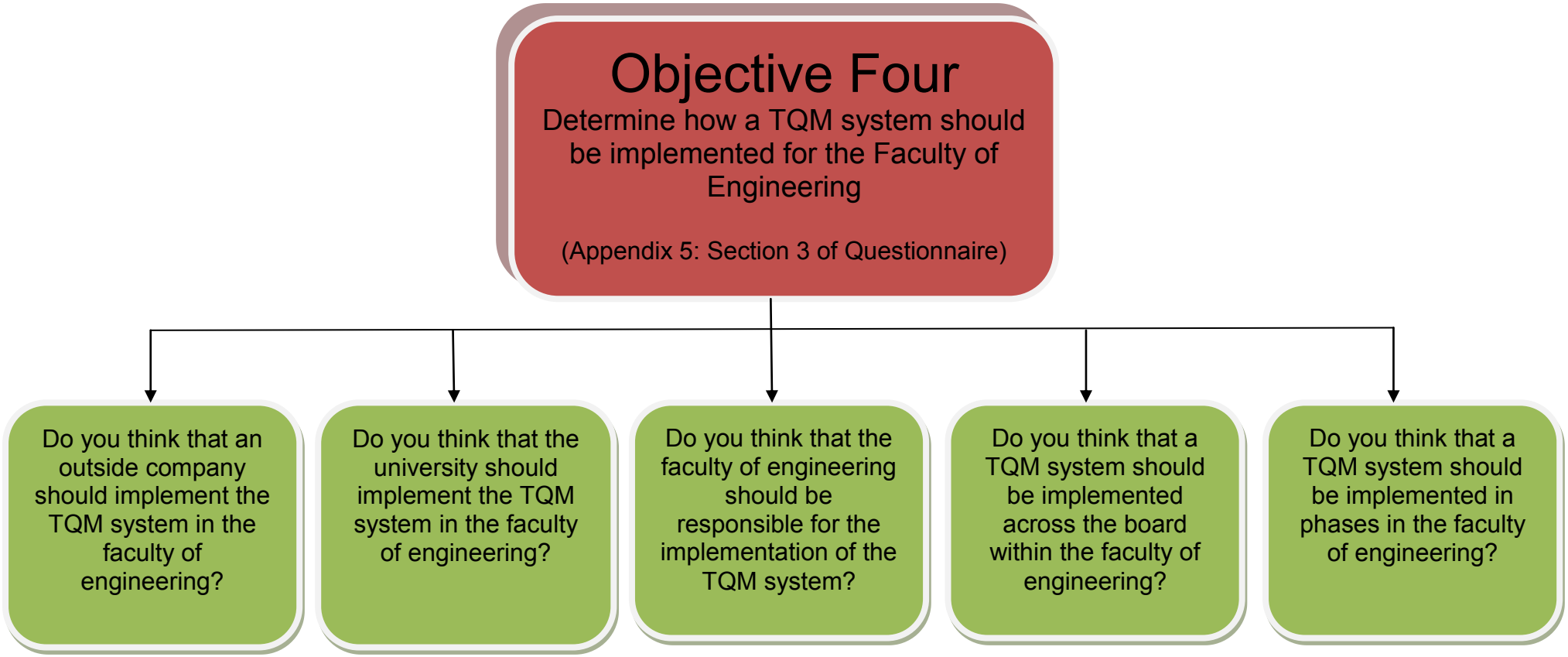

Figure 3.4 Objective Four and five Associated Questions (Appendix 5)

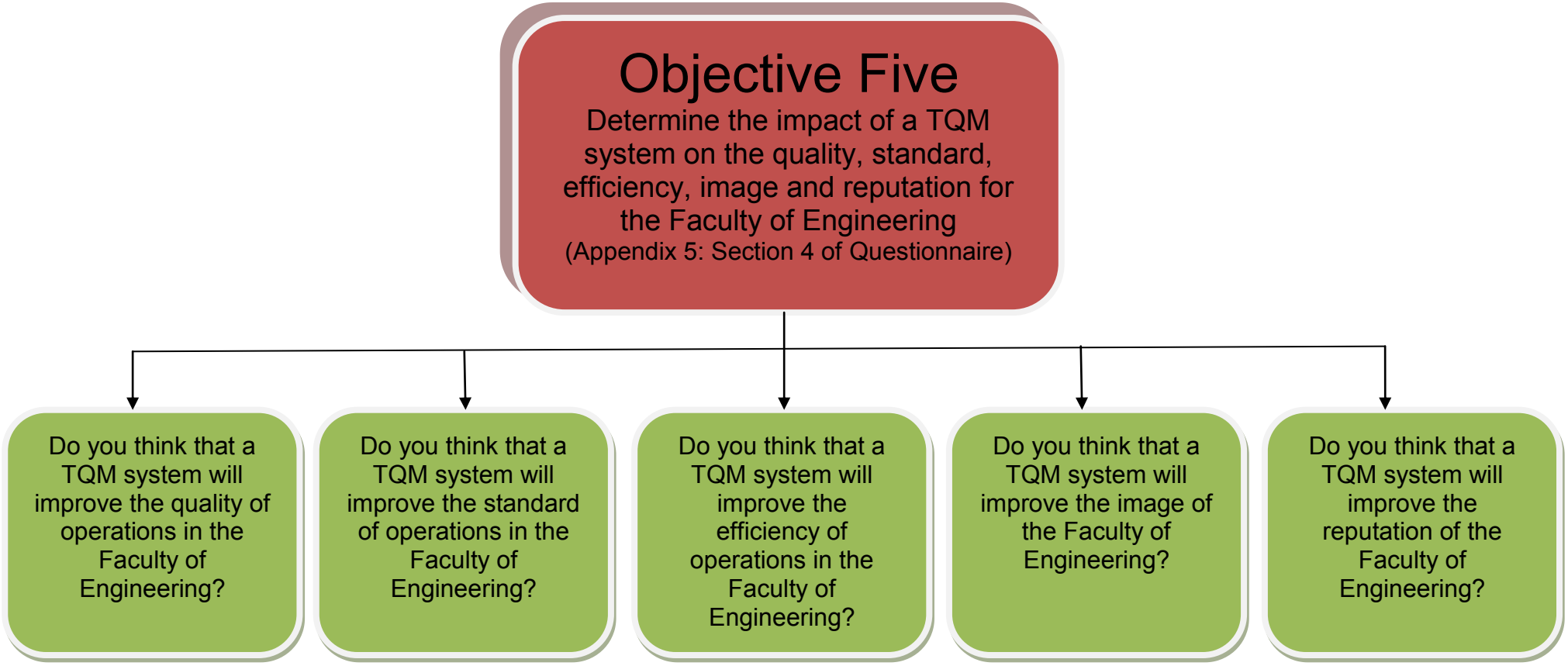

Figure 3.5 Objective Five and five Associated Questions (Appendix 5)

3.5 Recruitment of Study Participants

The study participants were recruited with the sole purpose to complete the questionnaire and interview questions. The data recorded was then used for statistical evaluation. There were 2500 staff and students in the Engineering Faculty (UKZN, 2011). This is known as the population size. A sample of 333 was used to answer questionnaires based on a confidence level of 95% and margin of error of 5% (The Research Advisors 2006).

The questionnaire has 20 questions that covered four of the stated five objectives. The interview had four questions that covered one of the stated five objectives. All questions had to be answered by the candidates for the questionnaire and interview questions to be valid. For the questionnaire, each question has 5 possible answers, ranging from strongly disagree to strongly agree. Strongly disagree attracted a mark of 1.00, agree a mark of 2.00, neutral response a mark of 3.00, disagree a mark of 4.00 and strongly disagree a mark of 5.00 by the statistical processing software package, SPPS. Guidelines were provided to candidates on how to answer the questionnaire and interview questions.

3.6 Pretesting and Valuation of Questionnaires and Interview Questions

According to Sekaran & Bougie (2010), pre-testing and validation are a very import requirement for the questionnaires and the interview questions. For the study, pretesting and validation was required to see if:

1. The candidates understood the questions
2. The question were ambiguous
3. The questions confused the candidates
4. The questions generated answers or data that was incorrect or not required Sekaran & Bougie (2010).

The feedback from the candidates then allowed for adjustments to be made and coding to be corrected to improve and „tighten' the questionnaires on the questionnaire and interviews.

3.6.1 Administration of the Questionnaire and Interview Questions

The administration of the questionnaire and Interview questions was done to ensure that an environment suitable for honest answering of the questioner and interviews was followed. All administration was handled by the author.

For the questionnaire, the author handed out the questions and went through the instructions (Appendix 5). The author monitored the process of the candidates answering the questions Queries were handled by the author where care was taken to lead the candidates. All retuned forms were collected by the author and filed for data processing.

For the phenomenological interviews, the author verbally asked the candidate questions which were recorded by the candidates on forms provided (Appendix 6). Phenomenological discussions were conducted with the candidates, based on the interview questions. This information was recorded as qualitative data. The process was controlled by the author. Queries were handled by the author where care was taken to lead the candidates. All retuned forms were collected by the author and filed for processing.

3.7 Analysis of the Data

Lind *et al* (2010) suggested data can be collected by means of both qualitative and quantitative methods. Qualitative data was analyzed by means of deductive reasoning. For this study, this required analysis of theory, observation, interpretation and then conclusions. Quantitative data was analyzed by means of frequency, descriptive and inferential statistics. The data needed to be analyzed, interpreted and conclusions drawn so that the study's objectives and problem statement were answered.

3.7.1 Reliability of Data

According to Sekaran & Bougie (2010), the Interitem Consistency Reliability is a test of the consistency of candidate's answers to all items in a measure or questionnaire. The most popular test for Interitem Consistency Reliability of data is the Cronbach's

Coefficient Alpha test (Sekaran & Bougie 2010).

Pallant (2007) suggested that in almost every case the Cronbach's Alpha is an adequate test of reliability of data and that a minimum level of 0.7 should be adhered to for Cronbach Alpha. This minimum level was used to test the reliability of the candidate's responses to the questionnaire, as quantitative data, for the study (Pallant 2007).

3.7.2 Frequency and Descriptive Statistics

According to Lind *et al* (2010), descriptive and frequency statistics is presented as numerical data, tables and bar charts. Descriptive and frequency statistics is used to describe basic features of data from a study. It provides summaries about the sample and the associated measures. It provides graphics for analysis. It forms the basis of quantitative data analysis (Lind *et al* 2010).

Descriptive and frequency statistics were used due to the fact that four, of the five objectives, required quantitative data to be recorded from a questionnaire containing five questions per objective. It required numerical data to be presented as numerical answerers in tables and on graphs. Graphical representation of data makes for clearer interpretation and conclusions of numerical data.

3.7.3 Inferential Statistics

According to Pallant (2007), inferential statistics is used to reach conclusions that extend beyond the recorded data. Inferential statistics is used to infer conclusions from sample data. Inferential statistics is used to make numerical judgments of the probability that an observed difference exists between groups. It illustrates whether the judgment is a dependable or not. Inferential statistics was used to make inferences from data (Pallant 2007).

3.7.2.1 Correlation

According to Render *et al* (2009), correlation is a measure, (numerical), of the degree of agreement, (correlation), between two sets of data from the same sample.

Correlation measures are statistically calculated numbers between +1 and –1. A correlation of +1 represents a positive agreement or direct relationship. A –1 is a negative relationship or indirect relationship. This is an inverse relationship. A correlation of 0 is no relationship or correlation (Render *et al* 2009).

Pallant (2007) suggested that Pearson or Spearman correlations describe the relationship between variables. Correlation estimates the extent to which the changes in one variable are associated with changes in the other variable. It describes the degree of relationship between two variables. A positive correlation indicates that as one variable increases so does the other. A negative correlation indicates that as one variable increase, the other decreases (Pallant 2007).

According to Saunders, Lewis & Thornhill (2003), it is extremely unusual to obtain perfect correlations in business. The correlation coefficient quantifiess the strength of the relationship that exists between two quantifiable variables in business. A value of plus one would represented a perfect positive correlation. A value of minus one would represent a perfect negative correlation (Saunders, Lewis & Thornhill 2003).

Inferential statistics was used to calculate correlations between selected questions to test the strength of the respondents. This data was required to interpret, and make conclusions, on whether candidates agreed or disagreed with questions associated with the implementation of a TQM system in the Faculty of engineering at UKZN.

3.8Summary

The research methodology introduced the concept of business research. It illustrated that the aim and objectives of the research was determined by collecting and analyzing data. The data is needed to solve the research problem. The participation and location of study identified the staff and students that will take part in the research at UKZN. Data collection strategies focused on a questionnaire and interview questions.

Research design and methods described the purpose of the study. Construction of the questionnaire, interview questions and recruitment of study participants required careful planning. Presentation, validation and administration of the questionnaire provided the processes for quality data collection. Data reliability was provided by using the Cronbach's Alpha test. The analysis of data by means of descriptive, frequency and inferential statistics was adopted for the research study. The next chapter now presents the quantitative and qualitative data results obtained from the questionnaires and phenomenological interviews.

CHAPTER FOUR

Presentation of Results

4.1 Introduction

The purpose of this chapter is to present data that was recorded for the study in the form of descriptive, frequency and inferential Statistics. Data was collected by means of both qualitative and quantitative methods. Quantitative data was checked for reliability. Descriptive and frequency statistics was then presented as numerical data, tables and bar charts. Inferential statistics was also used to calculate correlations between selected questions. The correlation data was recorded in tables.

Objective One, Three, Four and Five required quantitative data to be recorded from a questionnaire containing five questions per objective. All numerical data was rounded off to two decimal places. Objective Two required qualitative information to be collected by means of phenomenological interviews with engineering staff and students across the board. Four questions were answered, in the interview session, by each candidate. Information was recorded as narrative text. Qualitative and quantitative data was reviewed and tested within the framework of the studies five research objectives.

4.2 Sample Size and Associated Proportions

Since the total staff, postgraduate and undergraduate numbers in the faculty of Engineering totals 2 500, the sample size required was 333 at confidence level of 95% and margin of error of 5% (The Research Advisors 2006).The data was collected in the following proportions:

a. 43 staff (out of 81)
b. 50 postgraduates (out of 120)
c. 60 final year students (out of 519)
d. 60 third year students (out of 510)
e. 60 second year students (out of 550)

f. 60 first year students (out of 720)

The proportions were due to the amount of returns received per group. The research study and analysis of data did not differentiate between staff, post graduates and undergraduates numbers. The study and analysis of data was done on the total no of returns, that being 333. There were no damaged or discarded returns. All questioner data was quantitative.

The data was analyzed using Statistical Package for Social Sciences (SPSS, Version 18). SPSS and presented in terms of reliability, descriptive and frequencies statistics. Inferential statistics, by means of correlations, was used for selected questions for the Objectives One, Four and Five. Tables were edited from SPSS to give relevant information for interpretation and discussion. The interview returns and resulting phenomenological discussions were analyzed from a qualitative perspective for Objective two.

4.3 Research Objectives and Associated Data Collection

The research study had five objectives. Data collection for each objective was collected as follows:

- **Objective One:** Determine if a TQM system is required for the Faculty of Engineering at UKZN. Quantitative data was collected from five questions on a questionnaire. Data was checked for reliability using Cronbach's Alpha.
- **Objective Two:** Determine what resources are needed to introduce a TQM system for the Faculty of Engineering. Qualitative data was collected from four questions involving personnel phenomenological interviews.
- **Objective Three:** Determine whether key personnel can manage a TQM system for the Faculty of Engineering. Quantitative data was collected from five questions on a questionnaire. Data was checked for reliability using Cronbach's Alpha.

- **Objective Four:** Determine how a TQM system should be implemented for the Faculty of Engineering. Quantitative data was collected from five questions on a questionnaire. Data was checked for reliability using Cronbach's Alpha.
- **Objective Five:** Determine the impact of a TQM system on the quality, standard, efficiency, image and reputation for the Faculty of Engineering. Quantitative data was collected from five questions on a questionnaire. Data was checked for reliability using Cronbach's Alpha.

The five questions, for Objectives One, Three, Four and Five, were allocated the following numbers in SPSS:

1. Question One: VAR00001
2. Question Two: VAR00002
3. Question Three: VAR00003
4. Question Four: VAR00004
5. Question Five: VAR00005

Candidates recorded their response against each question with a mark, (X or tick), on the questionnaire, see in Appendix 5. SPSS allocated the following numbers to each response:

1.00 = Strongly disagree
2.00 = Disagree
3.00 = Neutral
4.00 = Agree
5.00 = Strongly agree

The X-axis of the graphs use the SPPS numbers that relate to the candidates responses: strongly disagree, disagree, neutral, agree and strongly agree. Tables have been edited to indicate question numbers instead of SPSS numbers for greater clarity.

4.3.1 Objective One: Determine if a TQM system is required for the Faculty of Engineering at UKZN. (Quantitative data)

1) Reliability of Data

The first process in analyzing the quantitative data for Objective One, from the recorded data, (questionnaire), was to test for reliability. This was done by using the Cronbach's Alpha test. 333 candidates each answered five questions for Objective One. All questions evaluated had valid responses. No data or response was excluded.

Cronbach's Alpha	Number of questions
0.71	5

Table 4.1 Cronbach's Alpha for recorded data

Table 4.1 illustrates that Cronbach's Alpha number for the recorded data associated with the five questions required for Objective One. The number calculated was 0.71.

2) Descriptive Statistics for Objective One

The descriptive statistics for the five questions associated with Objective One are presented in Table 4.2. The number of responses was 333.

	Responses	Minimum	Maximum	Average score
Question one	333	1.00	5.00	4.25
Question two	333	3.00	5.00	4.15
Question three	333	3.00	5.00	3.94
Question four	333	4.00	5.00	4.19
Question five	333	2.00	5.00	4.15

Table 4.2 Descriptive Statistics for Objective One

The minimum, maximum and average score for each question are presented in the Table 4.2. For Question One, the minimum recorded value was 1.00 (strongly disagree) and the maximum was 5.00 (strongly agree). The average was 4.25. For Question Two, the minimum recorded value was 3.00 (neutral) and the maximum was 5.00 (strongly agree). The average was 4.15. For Question Three the minimum recorded value was 3.00 (neutral) and the maximum was 5.00 (strongly agree). The average was 3.94. For Question Four, the minimum recorded value was 4.00 (agree) and the maximum was 5.00 (strongly agree). The average was 4.19. For Question Five, the minimum recorded value was 2.00 (disagree) and the maximum was 5.00 (strongly agree). The average was 4.15.

3) Frequencies Statistics for Objective One

a) Question One: Do you have an understanding of quality in relation to studies? The responses are presented, as recorded in SPSS, from 1.00 – 5.00. The number of responses by each candidate for this question is given as a frequency. The frequency, percent, valid frequency and cumulative frequency for Question One is presented in Table 4.3. Figure 4.1 is a bar chart that graphically illustrates Frequency vs. Response for Question one.

Response	Frequency	Percent	Valid Percent	Cumulative Percent
1.00	1	0.3	0.3	0.3
2.00	1	0.3	0.3	0.6
3.00	1	0.3	0.3	0.9
4.00	240	72.1	72.1	73.0
5.00	90	27.0	27.0	100.0
Total	333	100.0	100.0	

Table 4.3 Frequency Statistics for Question One

Table 4.3 and Figure 4.1 illustrated that one candidate responded with a 1.00 (strongly disagree), one candidate with a 2.00 (disagree) and one candidate with a

3.00 (neutral). 240 candidates responded with a 4.00 (agree) and 90 candidates with a 5.00 (strongly agree).

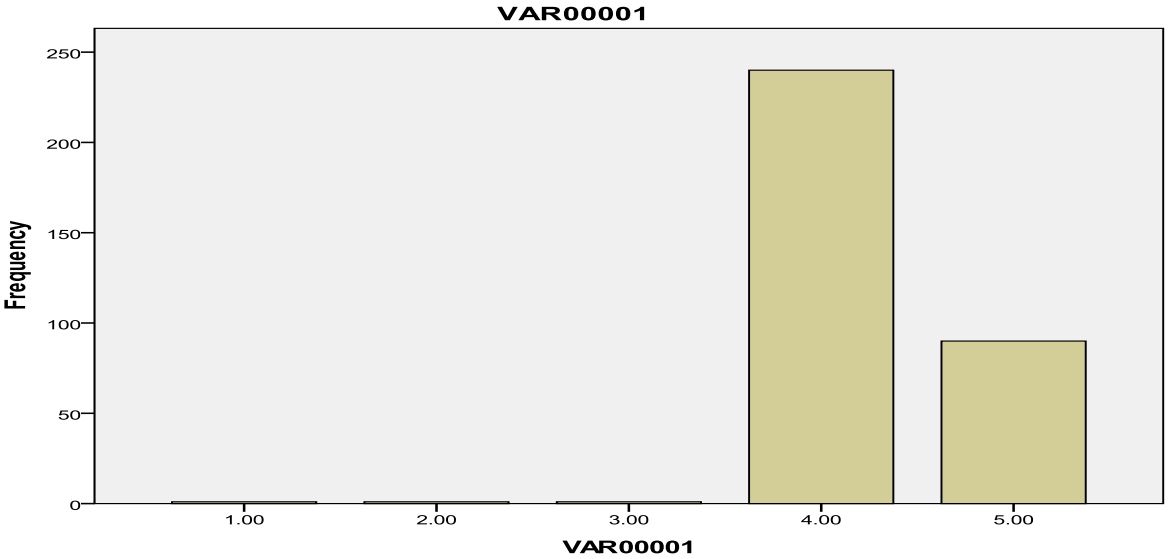

Figure 4.1 Bar Chart of Frequency vs. Response for Question One (VAR00001)

b) Question Two (VAR00002): Do you have an understanding of Total Quality Management in relation to studies? The responses are presented as recorded in SPSS from 3.00 – 5.00. There were no responses for 1.00 and 2.00. The response by each candidate for this question was also calculated as a frequency. The frequency, percent, valid frequency and cumulative frequency for Question Two is presented in Table 4.3. Figure 4.2 is a bar chart that graphically illustrates Frequency vs. Response for Question Two.

Response	Frequency	Percent	Valid Percent	Cumulative Percent
3.00	1	0.3	0.3	0.3
4.00	280	84.1	84.1	84.4
5.00	52	15.6	15.6	100.0
Total	333	100.0	100.0	

Table 4.4 Frequency Statistics for Question Two

Table 4.4 and Figure 4.2 illustrated that one candidate responded with a 3.00

(neutral). 280 candidates responded with a 4.00 (agree) and 52 candidates with a 5.00 (strongly agree). No candidates responded with a 1.00 (strongly disagree) or 2.00 (disagree).

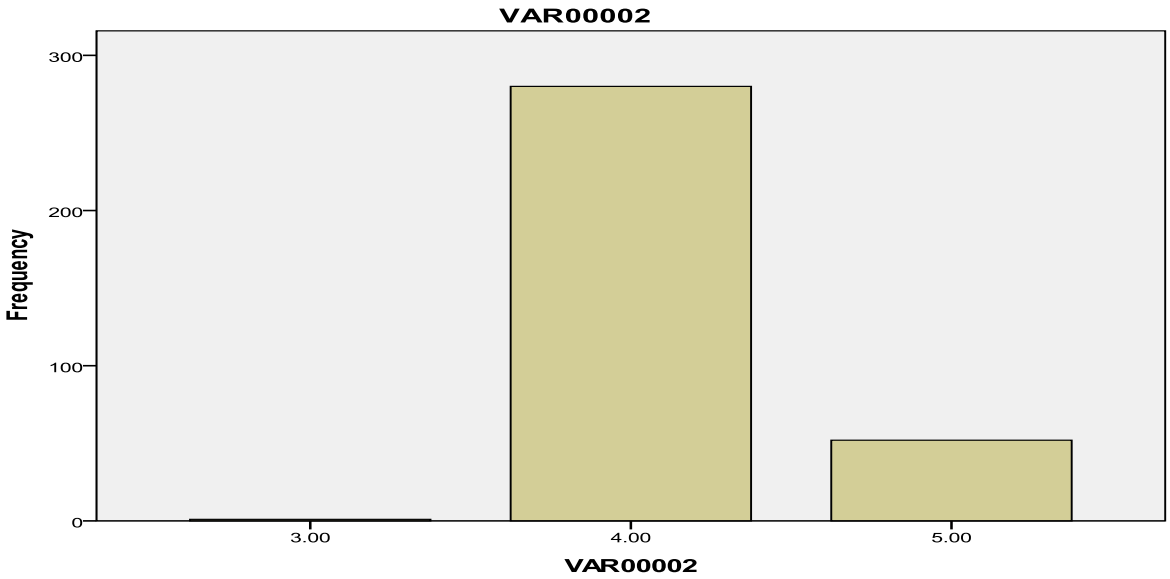

Figure 4.2 Bar Chart of Frequency vs. Response for Question Two (VAR00002)

c) Question Three (VAR00003): Do you think that the Faculty of Engineering has a quality problem across the board? The responses are presented as recorded in SPSS from 3.00 – 5.00. There were no responses for 1.00 and 2.00. The response by each candidate for this question was calculated as a frequency. The frequency, percent, valid frequency and cumulative frequency for Question Three is presented in Table 4.5. Figure 4.3 is a bar chart that graphically illustrates Frequency vs. Response for Question Three.

Response		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3.00	68	20.4	20.4	20.4
	4.00	217	65.2	65.2	85.6
	5.00	48	14.4	14.4	100.0
	Total	333	100.0	100.0	

Table 4.5 Frequency Statistics for Question Three

Table 4.5 and Figure 4.3 illustrated that 68 candidates responded with a 3.00 (neutral). 217 candidates responded with a 4.00 (agree) and 48 candidates with a 5.00 (strongly agree). No candidates responded with a 1.00 (strongly disagree) or 2.00 (disagree)

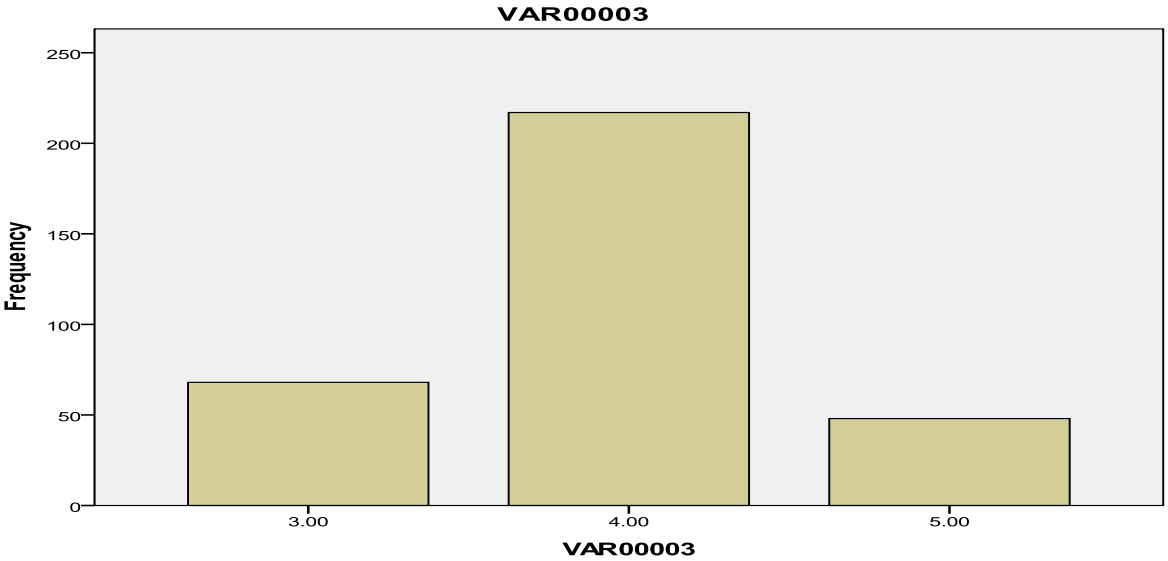

Figure 4.3 Bar Chart of Frequency vs. Response for Question Three (VAR00003)

d) Question Four (VAR00004): Do you think that a TQM system should be investigated and implemented in the Faculty of Engineering? The responses are presented as recorded in SPSS from 4.00 – 5.00. There were no responses for 1.00, 2.00 and 3.00. The response by each candidate for this question was also calculated as a frequency. The frequency, percent, valid frequency and cumulative frequency for Question Four is presented in Table 4.6. Figure 4.4 is a bar chart that graphically illustrates Frequency vs. Response for Question Four.

Response		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	4.00	271	81.4	81.4	81.4
	5.00	62	18.6	18.6	100.0
	Total	333	100.0	100.0	

Table 4.6 Frequency Statistics for Question Four

Table 4.6 and Figure 4.4 illustrated that 271 candidates responded with a 4.00 (agree). 62 candidates responded with a 5.00 (strongly agree). No candidates responded with a 1.00 (strongly disagree). No candidates responded with a 2.00 (disagree) or 3.00 (neutral).

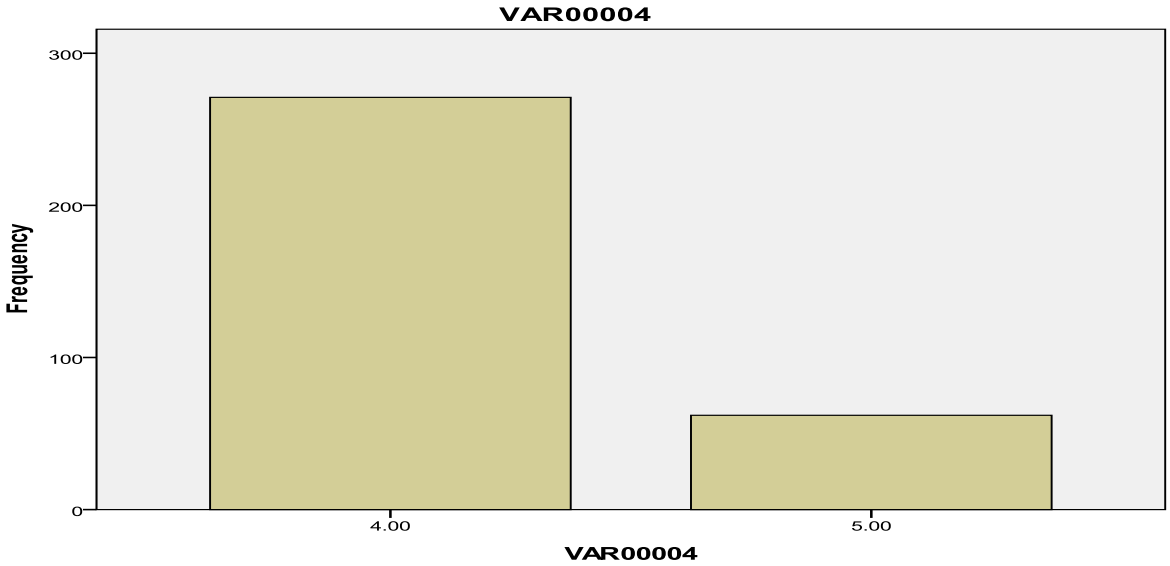

Figure 4.4 Bar chart of Frequency vs. Response for Question Four (VAR00004)

e) Question Five (VAR00005): Do you think that a TQM system is required to improve the image and reputation of the Faculty of Engineering? The responses are presented as recorded in SPSS from 2.00 – 5.00. There was no response for 1.00 and 3.00. The response by each candidate for this question was also calculated as a frequency. The frequency, percent, valid frequency and cumulative frequency for question 5 is presented in Table 4.7. Figure 4.5 is a bar chart that graphically illustrates Frequency vs. Response for Question Five.

Response		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2.00	3	0.9	0.9	0.9
	4.00	273	82.0	82.0	82.9
	5.00	57	17.1	17.1	100.0
	Total	333	100.0	100.0	

Table 4.7 Frequency Statistics for Question Five

Both the Table 4.7 and Figure 4.5 illustrated that three candidates responded with a 2.00 (disagree). 273 candidates responded with a 4.00 (agree) and 90 candidates with a 5.00 (strongly agree). There were no neutral responses (3.00). No candidates responded with a 1.00 (strongly disagree) or 3.00 (neutral)

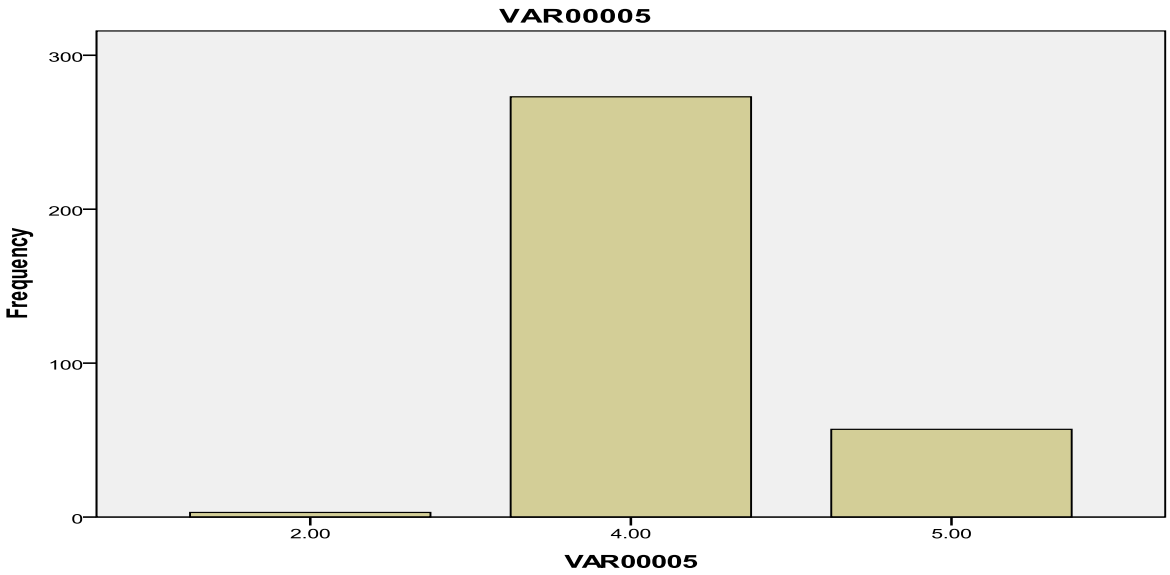

Figure 4.5 Bar Chart of Frequency vs. Response for Question Five (VAR00005)

1) **Correlation between Question Four and Five**

A correlation was done between Question Four and Five to check for similarity using the Pearson Correlation statistical method. The questions were:

- **Question Four:** Do you think that a TQM System should be investigated and implemented in the Faculty of Engineering?
- **Question Five** Do you think that a TQM System should be implemented in phases in the Faculty of Engineering?

The correlation was done in SPSS using the Bivarate method that compares two sets of data for similarity. Table 4.8 illustrates the result of the Person correlation for Question Four and Question Five. The correlation was 0.86 which is above 0.7. There were 333 responses to each question. Analysis is detailed in Chapter Five.

		Question four	Question five
Question four	Pearson Correlation	1	0.86
	No of responses	333	333
Question five	Pearson Correlation	0.86	1
	No of responses	333	333

Table 4.8 Correlation between Question Four and Five

4.3.2 Objective Two: Determine what resources are needed to introduce a TQM system. (Qualitative data)

a) Question One: What resources do you think are needed to introduce a TQM System for the Faculty of Engineering?

From the phenomenological interviews, three primary resources were highlighted by all interviewed candidates. These included funding, human capital and training courses. All candidates responded that without funding, the ability to introduce a TQM system for the Faculty of Engineering at UKZN would not be possible. Funding was the most important resource.

Once funding was secured, then human capital was required to introduce a TQM system for the Faculty of Engineering at UKZN. Training courses for all staff, across the board, would be required to understand and implement the TQM process in the Faculty. Finance and time would also be need for training, implementation, integration and feedback. An improved IT system was also suggested.

b) Question Two: Do you think that the Faculty has the resources to investigate and implement a TQM system?

The overwhelming response from all the respondents was that the Faculty does not have the resources to investigate and implement a TQM system. It was suggested by

all candidates that in the current financial climate that the University finds itself, funding would need to be found from outside donors, government of bank loans. It was also suggested that resources could become available if current resources are allocated and used more efficiently.

c) Question Three: Who do you think should fund the TQM System investigation and implementation for the Faculty of Engineering at UKZN?

The candidates all agreed that the TQM system investigation and implementation, for the Faculty of Engineering at UKZN, should ultimately be funded by the University. Comments were made that the Faculty of Engineering runs on a very lean budget. Funding for the TQM system would need to be budgeted over and above normal budget requirements. Therefore, if the faculty had the budget, it could fund the TQM system.

It was suggested that the Department of Education, (DOE), could be the source of the funds, as the President has allocated increased funds to education in South Africa in the 2011 budget speech. The possibility of Government partnering with large corporations was also discussed.

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d) Question Four: Do you think the Faculty of Engineering, at UKZN, should seek outside support for a TQM system, for both the analysis and implementation of the system, from a consultant body?

The respondents suggested that outside support would make it easier to plan, phase, analyze and implement a TQM system. Discussions were initiated on whether the outside support should be a consultant body. Respondents suggested that it could be a consultant body, if that company had experience with TQM systems. Candidates were unanimous that, while outside support would be an advantage, the TQM system for the Faculty of Engineering should be implemented by the University. The TQM should be sustainable within the University. Empowerment of all staff should take place within the Faculty of Engineering, to assist sustainability of the TQM system.

4.3.3 Objective Three: Determine whether key personnel can manage a TQM system for the Faculty of Engineering. (Quantitative data)

1) Reliability of Data

The first process in analyzing the data for Objective Three, from the recorded data, was to test for reliability. This was also achieved by using the Cronbach's Alpha test. 333 candidates each answered five questions for Objective Three. All questions evaluated had valid responses. No data was excluded.

Cronbach's Alpha	Number of questions
0.76	5

Table 4.9 Cronbach's Alpha for Objective Three.

Table 4.9 illustrates that the Cronbach's Alpha number for the data associated with the five questions required for Objective Three was 0.76.

2) Descriptive Statistics for Objective Three

The descriptive statistics for the five questions associated with Objective Three is presented in Table 4.10. The number of responses was 333.

	Responses	Minimum	Maximum	Average score
Question one	333	2.00	5.00	3.56
Question two	333	2.00	5.00	3.55
Question three	333	2.00	5.00	3.23
Question four	333	1.00	5.00	3.31
Question five	333	2.00	4.00	3.02

Table 4.10 Descriptive statistics for Objective Three

The minimum, maximum and average score for each question are presented in the Table 4.10. For Question One, the minimum recorded value was 2.00 (disagree) and the maximum was 5.00 (strongly agree). The average was 3.56. For Question Two, the minimum recorded value was 2.00 (disagree) and the maximum was 5.00 (strongly agree). The average was 3.55. For Question Three, the minimum recorded value was 2.00 (disagree) and the maximum was 5.00 (strongly agree). The average was 3.23. For Question Four, the minimum recorded value was 1.00 (strongly disagree) and the maximum was 5.00 (strongly agree). The average was 3.31. For Question Five, the minimum recorded value was 2.00 (disagree) and the maximum was 4.00 (agree). The average was 3.02.

3) Frequencies for each Question for Objective Three

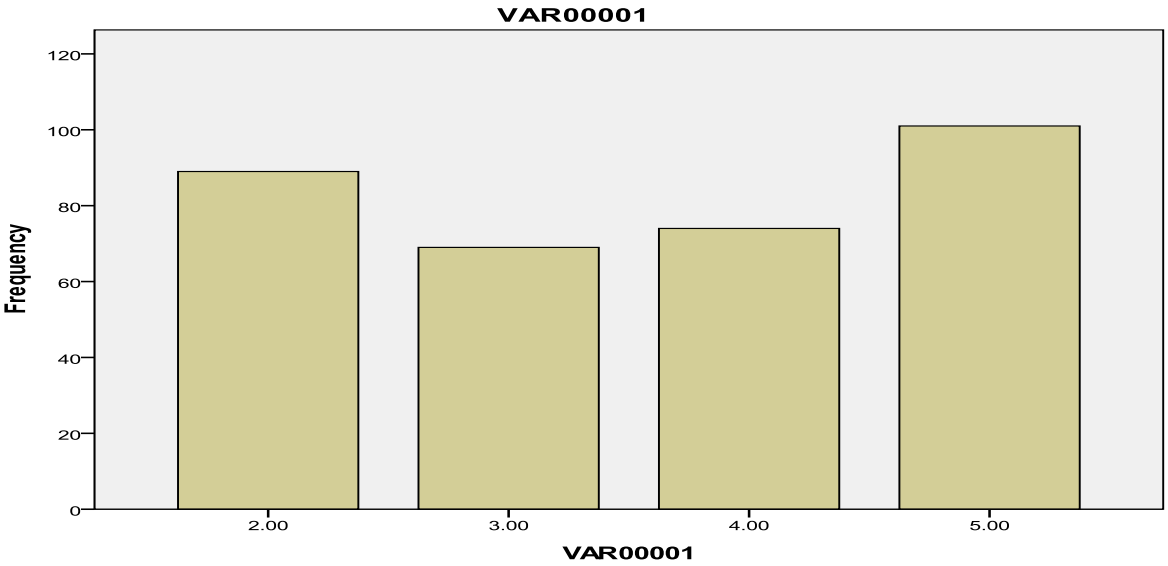
a) Question One (VAR00001): Do you think that an outside company should manage the TQM System? The responses are presented as recorded in SPSS from 2.00 – 5.00. There was no response for 1.00. The response by each candidate for this question was also calculated as a frequency. The frequency, percent, valid frequency and cumulative frequency for question one is presented in Table 4.11. Figure 4.6 graphically is a bar chart that illustrates Frequency vs. Response for Question One.

Response		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2.00	89	26.7	26.7	26.7
	3.00	69	20.7	20.7	47.4
	4.00	74	22.2	22.2	69.7
	5.00	101	30.3	30.3	100.0
	Total	333	100.0	100.0	

Table 4.11 Frequency Statistics for Question One

Table 4.11 and Figure 4.6 illustrated that 89 candidates responded with a 2.00

(disagree) and 69 candidates with a 3.00 (neutral). 74 candidates responded with a 4.00 (agree) and 101candidates with a 5.00 (strongly agree). No candidates responded with a 1.00 (strongly disagree).



Graph 4.6 Bar Chart of Frequency vs. Response for Question One (VAR00001)

b) Question Two (VAR00002): Do you think the leadership of the University should manage the TQM System? The responses are presented as recorded in SPSS from 2.00 – 5.00. There was no response for 1.00. The response by each candidate for this question was also calculated as a frequency. The frequency, percent, valid frequency and cumulative frequency for Question Two is presented in Table 4.12. Figure 4.7 graphically illustrates Frequency vs. Response for Question Two.

Response		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2.00	74	22.2	22.2	22.2
	3.00	34	10.2	10.2	32.4
	4.00	194	58.3	58.3	90.7
	5.00	31	9.3	9.3	100.0
	Total	333	100.0	100.0	

Table 4.12 Frequency Statistics for Question Two

Table 4.12 and Figure 4.7 illustrated that 74 candidates responded with a 2.00 (disagree) and 34 candidates with a 3.00 (neutral). 194 candidates responded with a 4.00 (agree) and 31candidates with a 5.00 (strongly agree). No candidates responded with a 1.00 (strongly disagree).

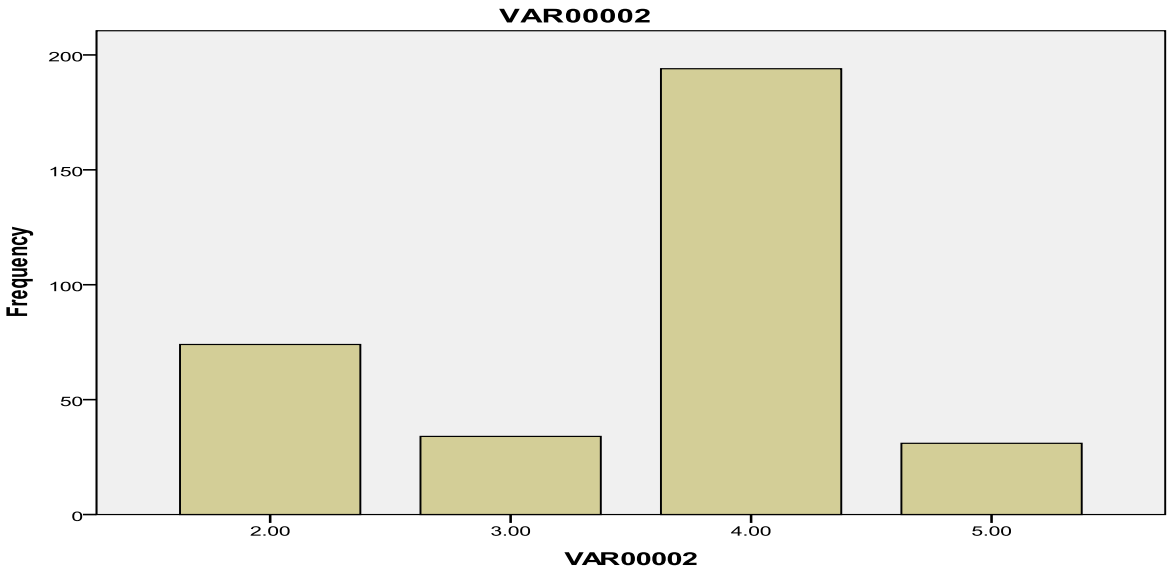


Figure 4.7 Bar Chart of Frequency vs. Response for Question Two (VAR00002)

c) Question Three (VAR00003): Do you think the Faculty of Engineering should manage the TQM System? The responses are presented as recorded in SPSS from 2.00 – 5.00. There was no response for 1.00.The response by each candidate for this question was also calculated as a frequency. The frequency, percent, valid frequency and cumulative frequency for Question three is presented in Table 4.13. Figure 4.8 is a bar chart that graphically illustrates Frequency vs. Response for Question Three.

Response		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2.00	108	32.4	32.4	32.4
	3.00	73	21.9	21.9	54.4
	4.00	121	36.3	36.3	90.7
	5.00	31	9.3	9.3	100.0
	Total	333	100.0	100.0	

Table 4.13 Frequency Statistics for Question Three

Table 4.13 and Figure 4.8 illustrated that 108 candidates responded with a 2.00 (disagree) and 73 candidates with a 3.00 (neutral). 121 candidates responded with a 4.00 (agree) and 31candidates with a 5.00 (strongly agree). No candidates responded with a 1.00 (strongly disagree).

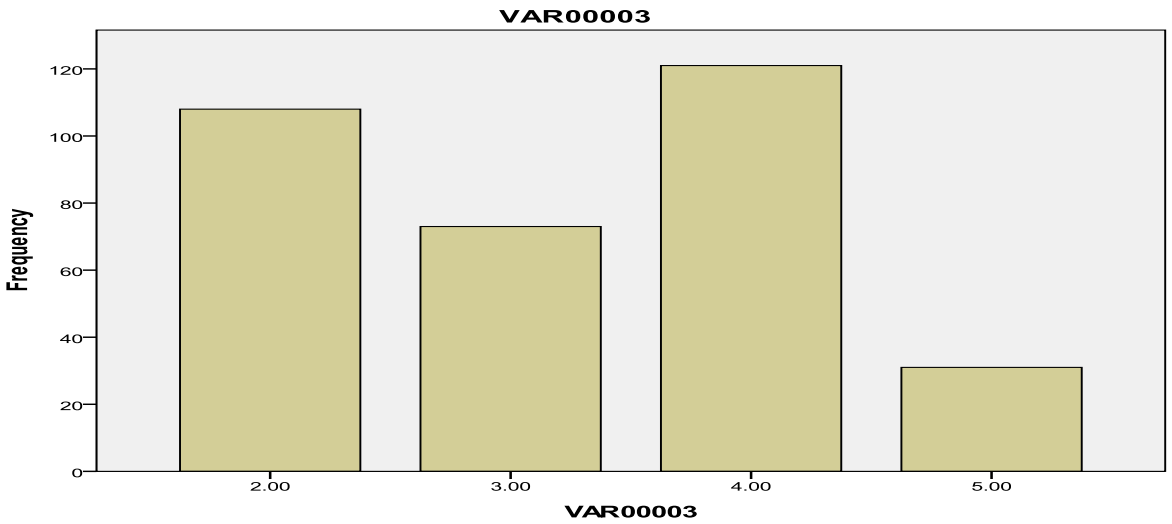


Figure 4.8 Bar Chart of Frequency vs. Response for Question Three (VAR00003)

d) Question Four (VAR00004): Do you think that all Engineering Faculty members should be involved in managing the TQM? The responses are presented as recorded in SPSS from 1.00, 3.00, 4.00 and 5.00. There was no response for 2.00.The response by each candidate for this question was also calculated as a frequency. The frequency, percent, valid frequency and cumulative frequency for Question Four is presented in Table 4.14.

Response		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00	74	22.2	22.2	22.2
	3.00	73	21.9	21.9	44.1
	4.00	121	36.3	36.3	80.5
	5.00	65	19.5	19.5	100.0
	Total	333	100.0	100.0	

Table 4.14 Frequency Statistics for Question Four

Figure 4.9 is a bar chart that graphically illustrates Frequency vs. Response for Question Four. Table 4.14 and Graph 4.9 illustrated that 74 candidates responded with a 1.00 (strongly disagree) and 73 candidates with a 3.00 (neutral). No candidates responded with a 2.00 (disagree). 121 candidates responded with a 4.00 (agree) and 65 candidates with a 5.00 (strongly agree). No candidates responded with a 2.00 (disagree).

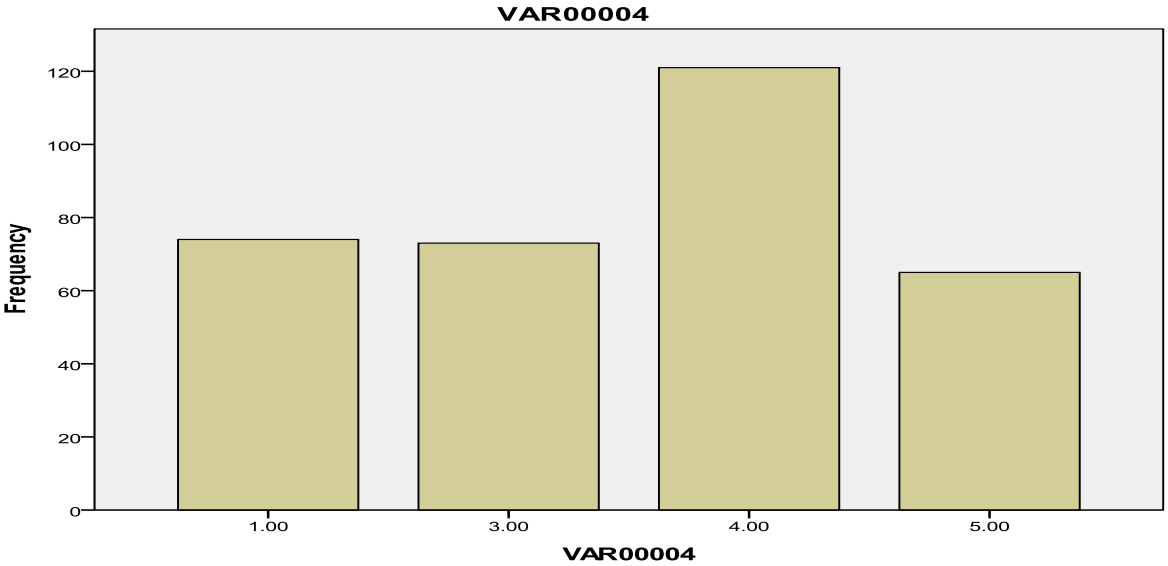


Figure 4.9 Bar Chart of Frequency vs. Response for Question Four (VAR00004)

e) Question Five (VAR00005): Do you think key personnel in the Faculty of Engineering should manage the TQM System? The responses are presented as recorded in SPSS from 2.00 – 4.00. There were no responses for 1.0 and 5.0. The response by each candidate for this question was also calculated as a frequency.

Response		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2.00	147	44.1	44.1	44.1
	3.00	31	9.3	9.3	53.5
	4.00	155	46.5	46.5	100.0
	Total	333	100.0	100.0	

Table 4.15 Frequency Statistics for Question Five

The frequency, percent, valid frequency and cumulative frequency for Question Five is presented in Table 4.15. Figure 4.10 is a bar chart that graphically illustrates Frequency vs. Response for Question Five. Table 4.15 and Figure 4.10 illustrated that 147 candidates responded with a 2.00 (disagree) and 31candidates with a 3.00 (neutral). 74 candidates responded with a 4.00 (agree). No candidates responded with a 1.00 (strongly disagree) or 5.00 (strongly agree)

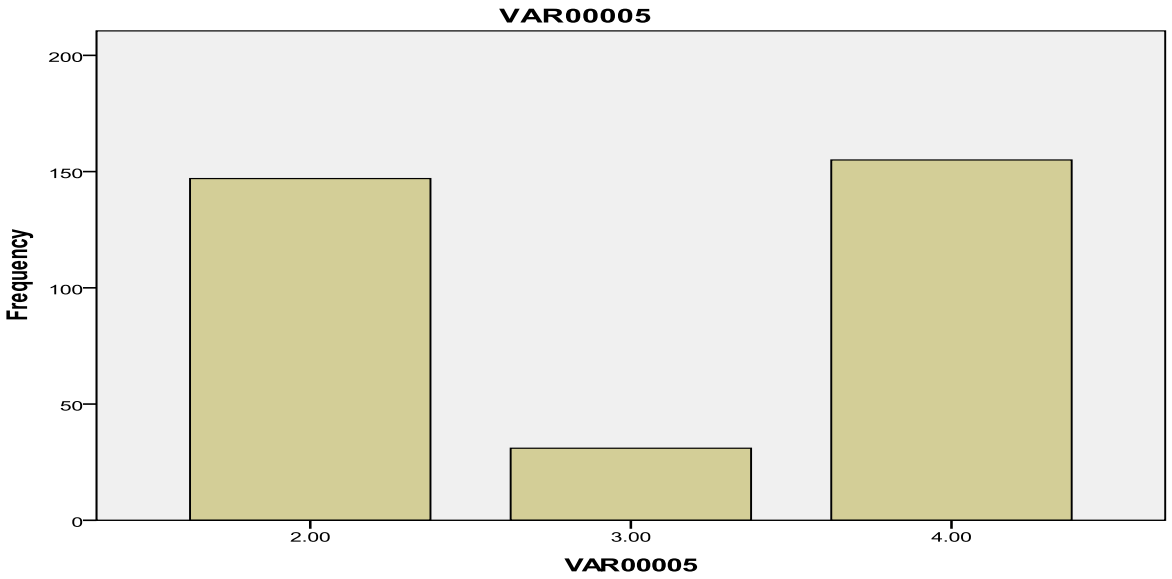


Figure 4.10 Bar Chart of Frequency vs. Response for Question Five (VAR00005)

4.3.4 Objective Four: Determine how a TQM System should be implemented for the Faculty of Engineering.

1) Reliability of Data

The first process in analyzing the data for Objective Four, from the recorded data, was to test for reliability. This was also achieved by using the Cronbach's Alpha test. 333 candidates each answered five questions for Objective Four. All questions evaluated had valid responses. No data was excluded.

Cronbach's Alpha	Number of questions
0.77	5

Table 4.16 Cronbach's Alpha for Objective Four

Table 4.16 illustrates the Cronbach's Alpha for the data associated with five questions required for Objective Four. The number calculated was 0.77.

2) Descriptive Statistics for Objective Four

The descriptive statistics for the five questions associated with Objective Four is presented in Table 4.17. The number of responses was 333.

	Responses	Minimum	Maximum	Average score
Question one	333	2.00	5.00	4.09
Question two	333	4.00	5.00	4.27
Question three	333	3.00	5.00	3.90
Question four	333	3.00	5.00	4.23
Question five	333	4.00	5.00	4.45

Table 4.17 Descriptive Statistics for Objective Four

The minimum, maximum and average score for each question are also presented in the Table 4.17. For Question One, the minimum recorded value was 2.00 (disagree) and the maximum was 5.00 (strongly agree). The average was 4.09. For Question Two, the minimum recorded value was 4.00 (agree) and the maximum was 5.00 (strongly agree). The average was 4.27. For Question Three, the minimum recorded value was 3.00 (neutral) and the maximum was 5.00 (strongly agree). The average was 3.90. For Question Four, the minimum recorded value was 3.00 (agree) and the maximum was 5.00 (strongly agree). The average was 4.23. For Question Five, the minimum recorded value was 4.00 (agree) and the maximum was 5.00 (strongly

agree). The average was 4.45. The individual responses are now given in more detail by means of tables and graphs.

3) Frequencies for each Question for Objective Four

a) Question One (VAR00001): Do you think that an outside company should implement the TQM System in the Faculty of Engineering? The responses are presented as recorded in SPSS from 2.00 – 5.00. There was no response for 1.00. The response by each candidate for this question was also calculated as a frequency. The frequency, percent, valid frequency and cumulative frequency for Question One is presented in Table 4.18. Figure 4.10 is a bar chart that graphically illustrates Frequency vs. Response for Question One.

Response		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2.00	24	7.2	7.2	7.2
	3.00	22	6.6	6.6	13.8
	4.00	186	55.9	55.9	69.7
	5.00	101	30.3	30.3	100.0
	Total	333	100.0	100.0	

Table 4.18 Frequency Statistics for Question One

Table 4.18 and Figure 4.11 illustrates that 24 candidates responded with a 2.00 (disagree) and 22 candidates with a 3.00 (neutral). 186 candidates responded with a 4.00 (agree) and 101 candidates with a 5.00 (strongly agree). No candidates responded with a 1.00 (strongly disagree).

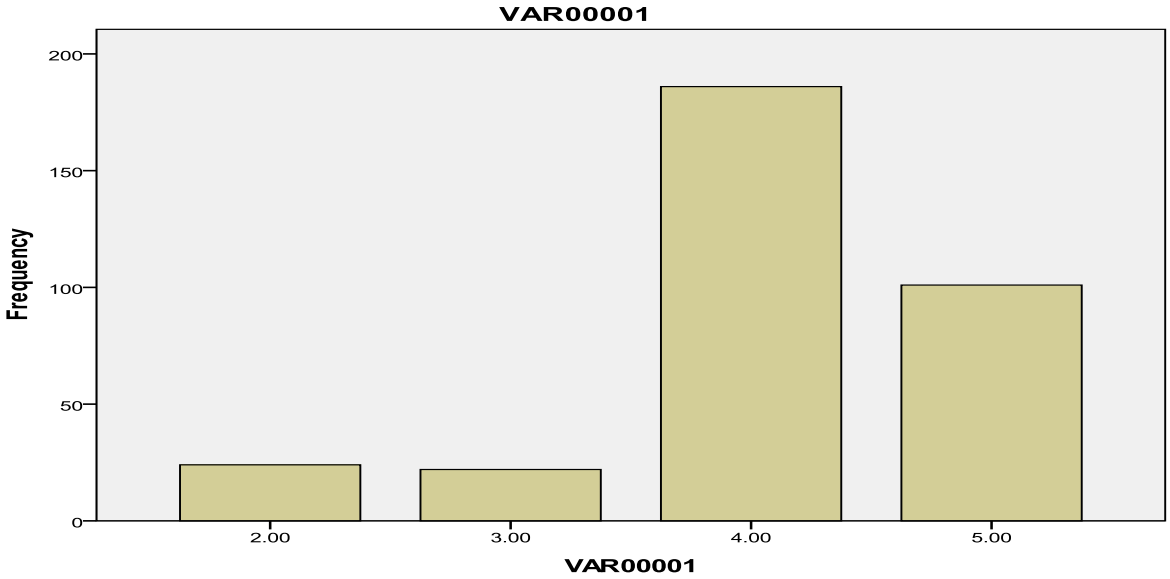


Figure 4.11 Bar Chart of Frequency vs. Response for Question One (VAR00001)

b) Question Two (VAR00002): Do you think that the University should implement the TQM System in the Faculty of Engineering? The responses are presented as recorded in SPSS from 4.00 – 5.00. There was no response for 1.00, 2.00 and 3.00. The response by each candidate for this question was also calculated as a frequency. The frequency, percent, valid frequency and cumulative frequency for question 1 is presented in Table 4.19. Figure 4.12 graphically illustrates Frequency vs. Response for Question Two.

Response		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	4.00	244	73.3	73.3	73.3
	5.00	89	26.7	26.7	100.0
	Total	333	100.0	100.0	

Table 4.19 Frequency Statistics for Question Two

Table 4.19 and Figure 4.12 illustrated that 244 candidates responded with a 4.00 (agree). 89 candidates with a 5.00 (strongly agree). No candidates responded with a 1.00 (strongly disagree), 2.00 (disagree) or 3.00 (neutral).

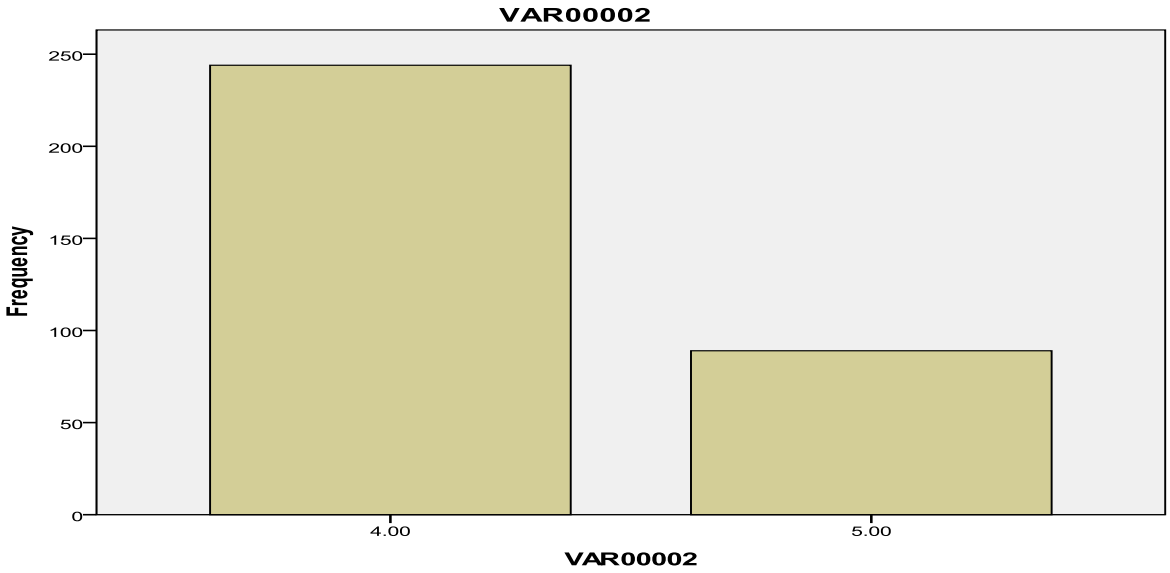


Figure 4.12 Bar Chart of Frequency vs. Response for Question Two (VAR00002)

c) Question Three (VAR00003): Do you think that the Faculty of Engineering should be responsible for the implementation of the TQM System? The responses are presented as recorded in SPSS from 3.00 – 5.00. There was no response for 1.00 and 2.00. The response by each candidate for this question was also calculated as a frequency. The frequency, percent, valid frequency and cumulative frequency for Question Three is presented in Table 4.20. Figure 4.13 is a bar chart that graphically illustrates Frequency vs. Response for Question Three.

Response		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3.00	105	31.5	31.5	31.5
	4.00	158	47.4	47.4	79.0
	5.00	70	21.0	21.0	100.0
	Total	333	100.0	100.0	

Table 4.20 Frequency Statistics for Question Three

Table 4.20 and Figure 4.13 illustrated that 105 candidates responded with a 3.00 (neutral). 105 candidates responded with a 4.00 (agree) and 70 candidates with a

5.00 (strongly agree). No candidates responded with a 1.00 (strongly disagree) or 2.00 (disagree)

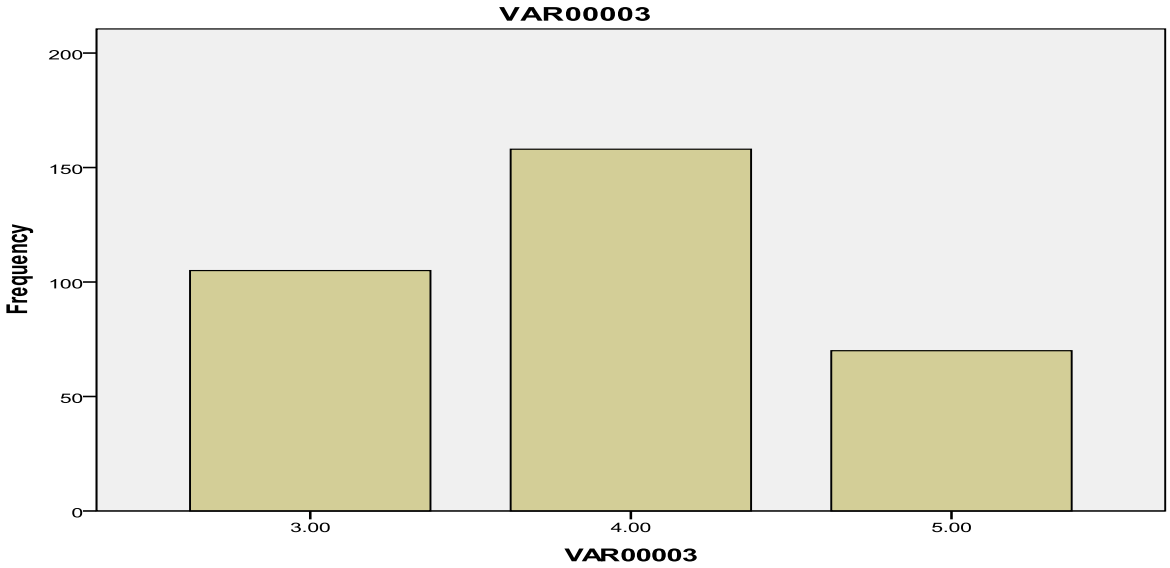


Figure 4.13 Bar Chart of Frequency vs. Response for Question Three (VAR00003)

d) Question Four (VAR00004): Do you think that a TQM System should be implemented across the board within the Faculty of Engineering? The responses are presented as recorded in SPSS from 2.00 – 5.00. There was no response for 1.00 and 2.00. The response by each candidate for this question was also calculated as a frequency. The frequency, percent, valid frequency and cumulative frequency for Question Four is presented in Table 4.21. Figure 4.14 is a bar chart that graphically illustrates Frequency vs. Response for Question Four.

Response		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3.00	35	10.5	10.5	10.5
	4.00	188	56.5	56.5	67.0
	5.00	110	33.0	33.0	100.0
	Total	333	100.0	100.0	

Table 4.21 Frequency Statistics for Question Four

Table 4.21 and Figure 4.14 illustrated that 35 candidates were 3.00 (neutral). 188 candidates responded with a 4.00 (agree) and 110 candidates with a 5.00 (strongly agree). No candidates responded with a 1.00 (strongly disagree) or 2.00 (disagree)

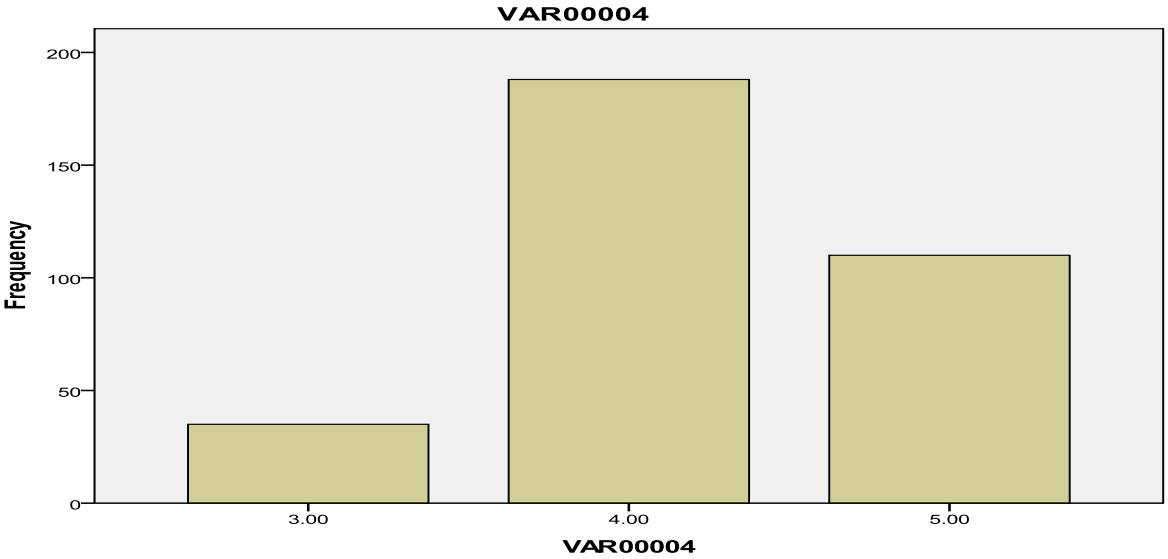


Figure 4.14 Bar Chart of Frequency vs. Response for Question Four (VAR00004)

e) Question Five (VAR00005): Do you think that a TQM System should be implemented in phases in the Faculty of Engineering? The responses are presented as recorded in SPSS from 4.00 – 5.00. There was no response for 1.00, 2.00 and 3.00. The response by each candidate for this question was also calculated as a frequency. The frequency, percent, valid frequency and cumulative frequency for Question Five is presented in Table 4.22. Figure 4.15 is a bar chart that graphically illustrates Frequency vs. Response for Question Five.

Response		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	4.00	184	55.3	55.3	55.3
	5.00	149	44.7	44.7	100.0
	Total	333	100.0	100.0	

Table 4.22 Frequency Statistics for Question Five

Table 4.22 and Figure 4.15 illustrated that 184 candidates responded with a 4.00 (agree) and 149 candidates with a 5.00 (strongly agree). No candidates responded with a 1.00 (strongly disagree), 2.00 (disagree) or 3.00 (neutral).

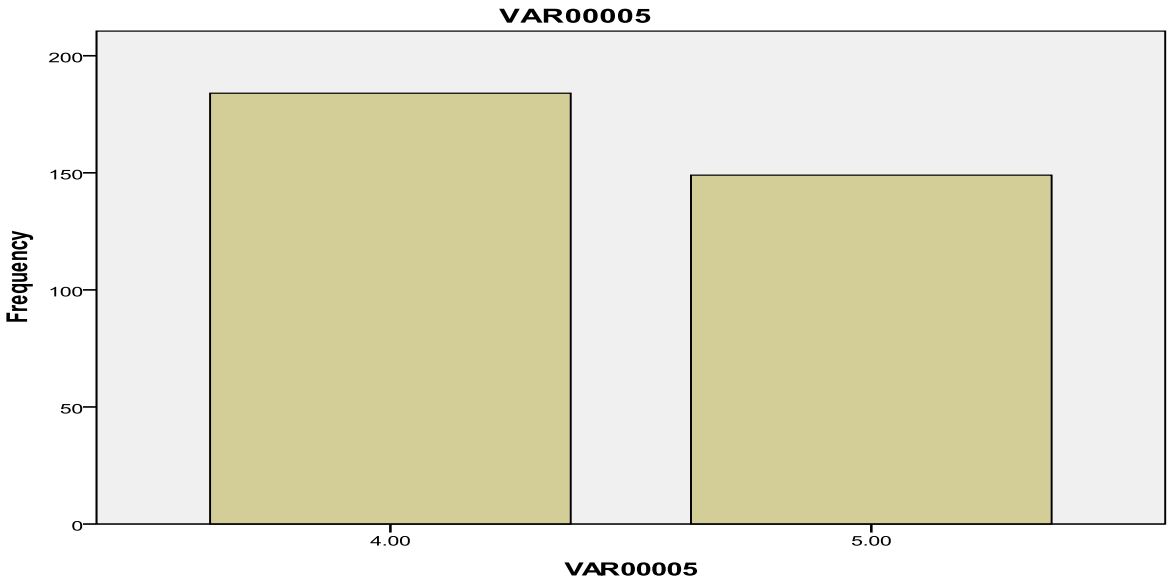


Figure 4.15 Bar Chart of Frequency vs. Response for Question Five (VAR00005)

4) Correlation

A correlation was done between Questions Four and Five to check for similarity using the Person Correlation statistical method. These questions were recorded as:

- **Question Four:** Do you think that a TQM System should be implemented across the board within the Faculty of Engineering?
- **Question Five:** Do you think that a TQM System should be implemented in phases in the Faculty of Engineering?

The correlation was done in SPSS using the Bivarate method that compares two sets of data for similarity. Table 4.23 illustrates the results of a Person Correlation for Question Four and Question Five. The correlation was 0.70. There were 333 responses.

		Question four	Question five
Question Four	Pearson Correlation	1	0.70
	Responses	333	333
Question Five	Pearson Correlation	0.70	1
	Responses	333	333

Table 4.23 Correlation between Question Four and Five for Objective Four

4.3.5 Objective Five: Determine the Impact of a TQM system on the Quality, Standard, Efficiency, Image and Reputation of a University Faculty.

1) Reliability of Data

The first process in analyzing the data for Objective Five, from the recorded data, was to test for reliability. This was also achieved by using the Cronbach's Alpha test. 333 candidates each answered five questions for Objective Five. All questions evaluated had valid responses. No data was excluded.

Cronbach's Alpha	Number of questions
0.83	5

Table 4.24 Cronbach's Alpha for Recorder Data for Objective Five.

Table 4.24 illustrates the Cronbach's Alpha number for the data associated with the five questions required for Objective Five. The number was calculated as 0.83.

1) Descriptive Statistics for Objective Five

The descriptive statistics for the five questions associated with Objective Five is presented in Table 4.25. The number of responses was 333.

	Responses	Minimum	Maximum	Average score
Question one	333	4.00	5.00	4.36
Question two	333	4.00	5.00	4.33
Question three	333	3.00	5.00	4.10
Question four	333	3.00	5.00	4.27
Question five	333	3.00	5.00	4.20

Table 4.25 Descriptive statistics for Objective Five

The minimum, maximum and average score for each question are also presented in the Table 4.25. For Question One, the minimum recorded value was 4.00 (agree) and the maximum was 5.00 (strongly agree). The average was 4.36. For Question Two, the minimum recorded value was 4.00 (agree) and the maximum was 5.00 (strongly agree). The average was 4.33. For Question Three, the minimum recorded value was 3.00 (neutral) and the maximum was 5.00 (strongly agree). The average was 4.10. For Question Four, the minimum recorded value was 3.00 (agree) and the maximum was 5.00 (strongly agree). The average was 4.27. For Question Five, the minimum recorded value was 3.00 (neutral) and the maximum was 5.00 (strongly agree). The average was 4.20. The individual responses are now given in more detail by means of tables and graphs.

2) Frequencies for each question for Objective Five

a) Question One (VAR00001): **Do you think that a TQM System will improve the quality of operations in the Faculty of Engineering?** The responses are presented as recorded in SPSS from 4.00 – 5.00. There was no response for 1.00, 2.00 and 3.00. The response by each candidate for this question was also calculated as a frequency. The frequency, percent, valid frequency and cumulative frequency for Question One is presented in Table 4.26. Figure 4.16 is a bar chart that graphically illustrates Frequency vs. Response for Question One.

Response		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	4.00	212	63.7	63.7	63.7
	5.00	121	36.3	36.3	100.0
	Total	333	100.0	100.0	

Table 4.26 Frequency Statistics for Question One

Table 4.26 and Figure 4.16 illustrated that 212 candidates responded with a 4.00 (agree) and 121candidates with a 5.00 (strongly agree). No candidates responded with a 1.00 (strongly disagree), 2.00 (disagree) or 3.00 (neutral).

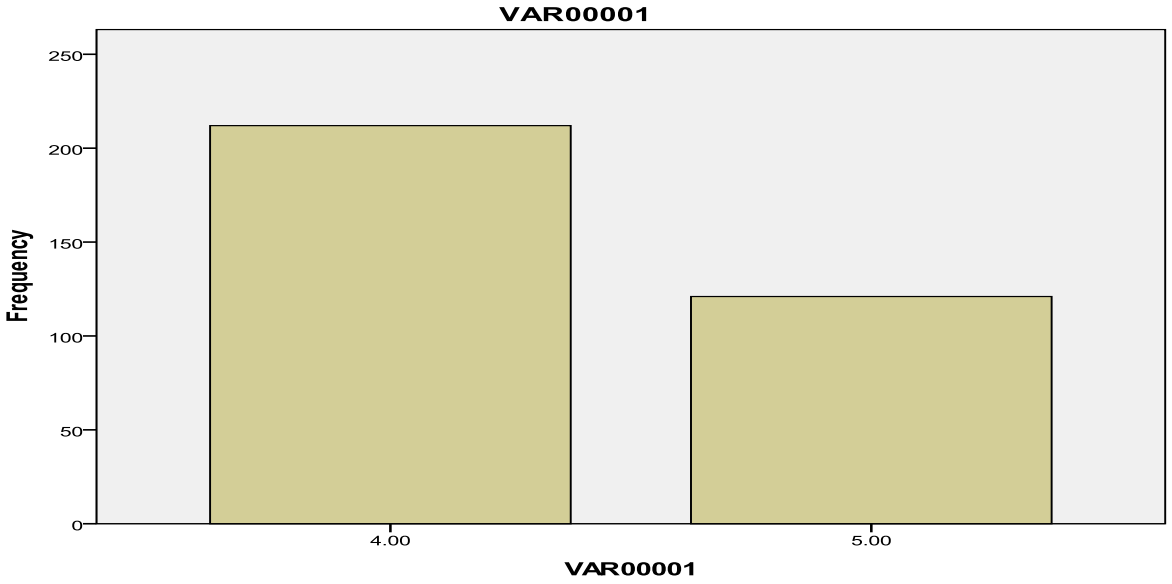


Figure 4.16 Bar Chart of Frequency vs. Response for Question One (VAR00001)

b) Question Two (VAR00002): Do you think that a TQM System will improve the standard of operations in the Faculty of Engineering? The responses are presented as recorded in SPSS from 4.00 – 5.00. There was no response for 1.00, 2.00 and 3.00. The response by each candidate for this question was also calculated as a frequency. The frequency, percent, valid frequency and cumulative frequency for

Question Two is presented in Table 4.27. Figure 4.17 is a bar chart that graphically illustrates Frequency vs. Response for Question Two.

Response		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	4.00	223	67.0	67.0	67.0
	5.00	110	33.0	33.0	100.0
	Total	333	100.0	100.0	

Table 4.27 Frequency Statistics for Question Two

Table 4.27 and Figure 4.17 illustrated that 223 candidates responded with a 4.00 (agree) and 110 candidates with a 5.00 (strongly agree). No candidates responded with a 1.00 (strongly disagree), 2.00 (disagree) or 3.00 (neutral)

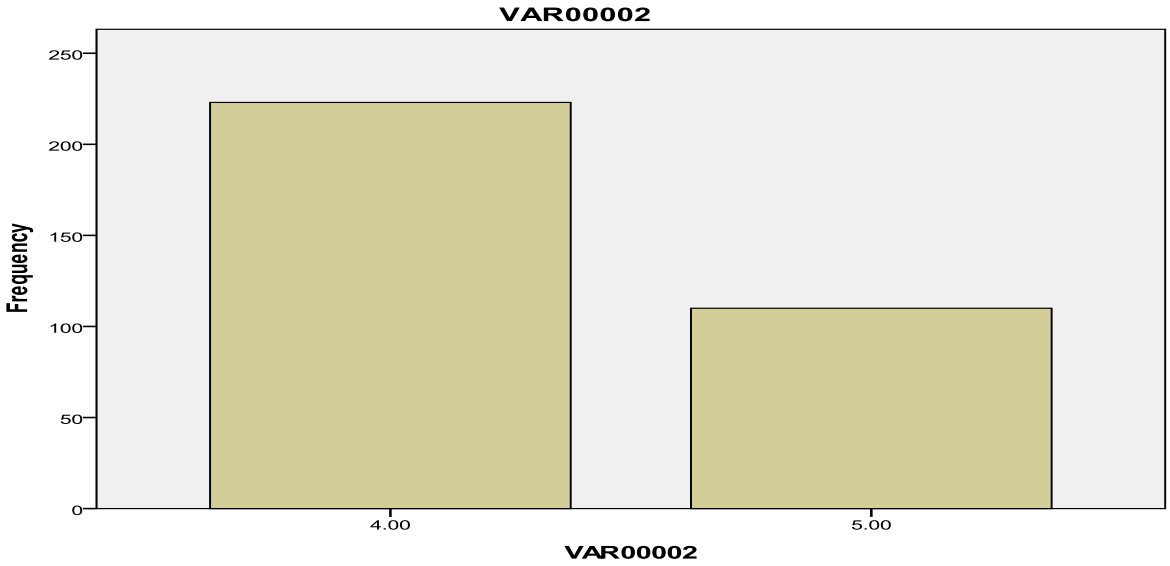


Figure 4.17 Bar Chart of Frequency vs. Response for Question Two (VAR00002)

c) Question Three (VAR00003): Do you think that a TQM System will improve the efficiency of operations in the Faculty of Engineering? The responses are presented as recorded in SPSS from 3.00 – 5.00. There was no response for 1.00 and 2.00.The response by each candidate for this question was also calculated as a frequency. The frequency, percent, valid frequency and cumulative frequency for

Question Three is presented in Table 4.28. Figure 4.18 is a bar chart that graphically illustrates Frequency vs. Response for Question Three.

Response		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3.00	50	15.0	15.0	15.0
	4.00	201	60.4	60.4	75.4
	5.00	82	24.6	24.6	100.0
	Total	333	100.0	100.0	

Table 4.28 Frequency Statistics for Question Three

Table 4.28 and Figure 4.18 illustrated that 50 candidates responded with a 3.00 (neutral). 201 candidates responded with a 4.00 (agree) and 82 candidates with a 5.00 (strongly agree). No candidates responded with a 1.00 (strongly disagree) or 2.00 (disagree).

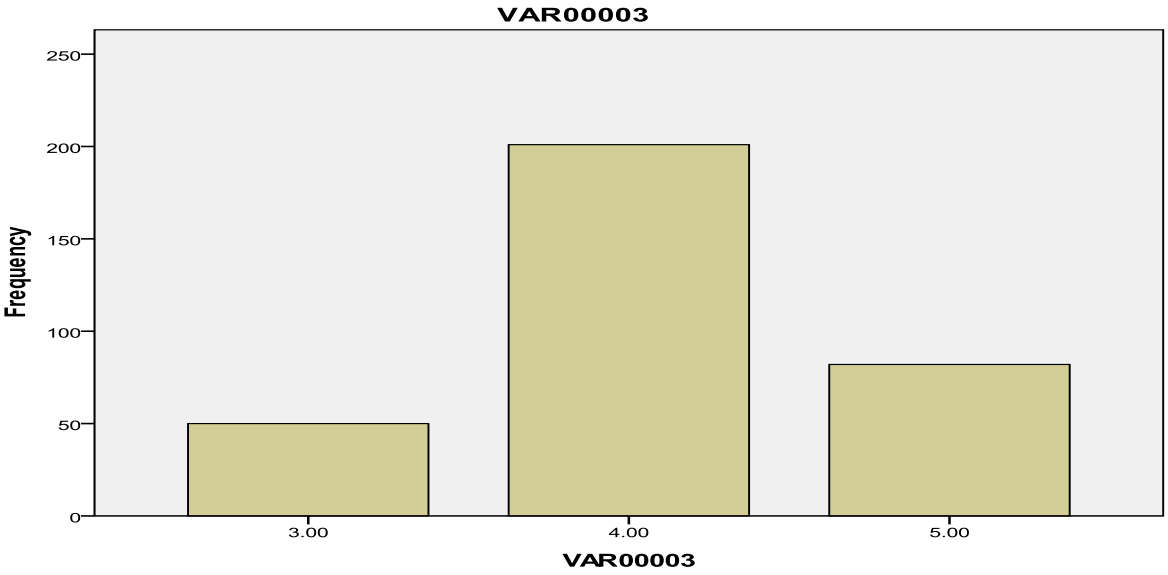


Figure 4.18 Bar Chart of Frequency vs. Response for Question Three (VAR00003)

d) Question Four (VAR00004): Do you think that a TQM System will improve the image of the Faculty of Engineering? The responses are presented as recorded in SPSS from 3.00 – 5.00. There was no response for 1.00 and 2.00. The response by

each candidate for this question was also calculated as a frequency. The frequency, percent, valid frequency and cumulative frequency for Question Four is presented in Table 4.29. Figure 4.19 is a bar chart that graphically illustrates Frequency vs. Response for Question Four.

Response		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3.00	30	9.0	9.0	9.0
	4.00	184	55.3	55.3	64.3
	5.00	119	35.7	35.7	100.0
	Total	333	100.0	100.0	

Table 4.29 Frequency statistics for Question Four

Table 4.29 and Figure 4.19 illustrated that 30 candidates responded with a 3.00 (neutral). 184 candidates responded with a 4.00 (agree) and 119 candidates with a 5.00 (strongly agree). No candidates responded with a 1.00 (strongly disagree) or 2.00 (disagree).

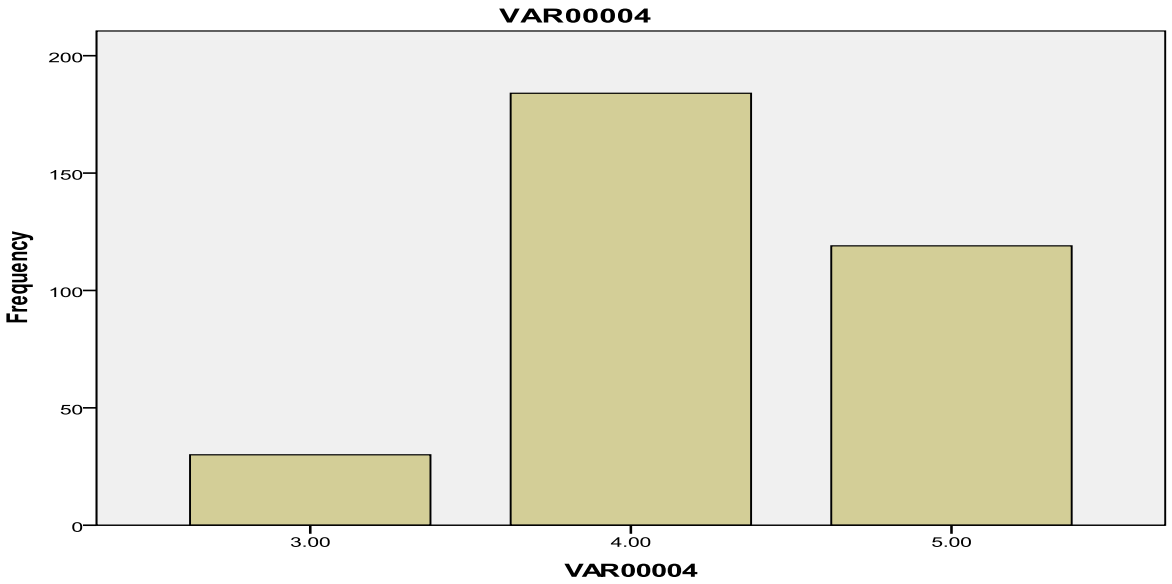


Figure 4.19 Bar Chart of Frequency vs. Response for Question Four (VAR00005)

e) Question Five (VAR00005): Do you think that a TQM System will improve the reputation of the Faculty of Engineering? The responses are presented as recorded in SPSS from 3.00 – 5.00. There was no response for 1.00 and 2.00. The response by each candidate for this question was also calculated as a frequency. The frequency, percent, valid frequency and cumulative frequency for Question Five is presented in Table 4.30. Figure 4.20 is a bar chart that graphically illustrates Frequency vs. Response for Question Five.

Response		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3.00	50	15.0	15.0	15.0
	4.00	167	50.2	50.2	65.2
	5.00	116	34.8	34.8	100.0
	Total	333	100.0	100.0	

Table 4.30 Frequency Statistics for Question Five

Table 4.30 and Figure 4.20 illustrated that 50 candidates responded a 3.00 (neutral). 167 candidates responded with a 4.00 (agree) and 116 candidates with a 5.00 (strongly agree). No candidates responded with a 1.00 (strongly disagree) or 2.00 (disagree).

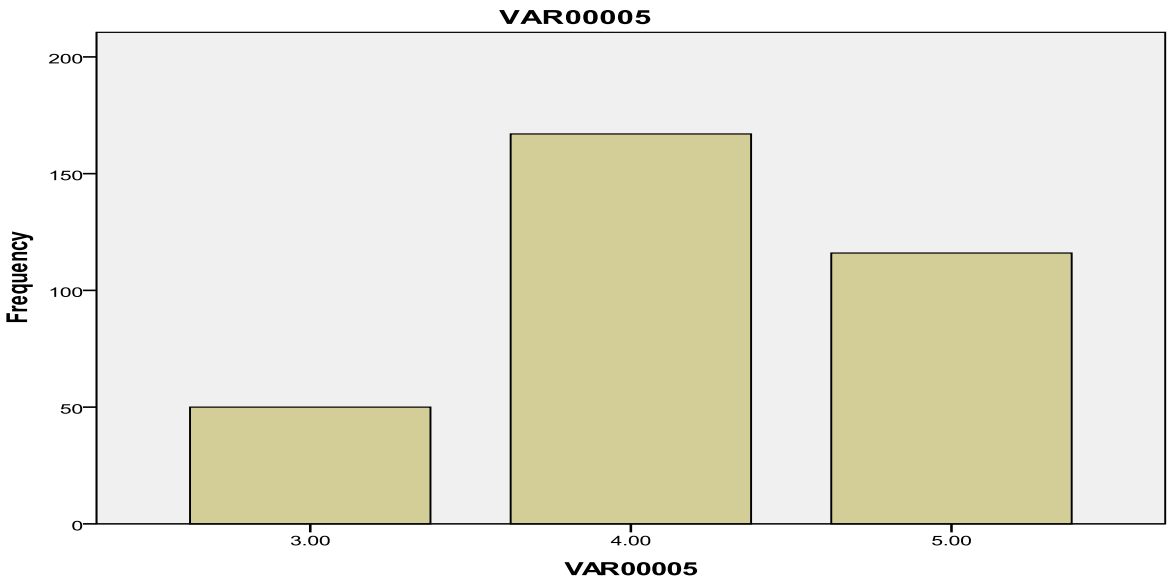


Figure 4.20 Bar Chart of Frequency vs. Response for Question Five (VAR00005)

4) Correlation for all questions for Objective Five

A correlation was done for each question against each other question to check for similarity using the Person correlation statistical method:

- **Question One:** Do you think that a TQM System will improve the quality of operations in the Faculty of Engineering?
- **Question Two:** Do you think that a TQM System will improve the standard of operations in the Faculty of Engineering?
- **Question Three:** Do you think that a TQM System will improve the efficiency of operations in the Faculty of Engineering?
- **Question Four:** Do you think that a TQM System will improve the image of the Faculty of Engineering?
- **Question Five:** Do you think that a TQM System will improve the reputation of the Faculty of Engineering?

The correlations were also done in SPSS using the Bivarate method that compares two sets of data for similarity. Table 4.31 illustrates the results of the Person

Correlations for each question independently. An analysis of the correlations for each question for Objective Five, is detailed in Chapter Five.

		Quality of Operations	Standard of operations	Efficiency of Operations	Image of Faculty	Reputation of Faculty
Question 1 Quality of operations	Pearson Correlation	1	.70	.61	.61	.41
	Responses	333	333	333	333	333
Question 2 Standard of operations	Pearson Correlation	.70	1	.73	.48	.23
	Responses	333	333	333	333	333
Question 3 Efficiency of Operations	Pearson Correlation	.61	.73	1	.42	.30
	Responses	333	333	333	333	333
Question 4 Image of Faculty	Pearson Correlation	.61	.48	.42	1	.75
	Responses	333	333	333	333	333
Question 5 Reputation of Faculty	Pearson Correlation	.41	.25	.30	.75	1
	Responses	333	333	333	333	333

Table 4.31 Correlation between Question One, Two, Three, Four and Five

4.4 Summary

The studies sample size and associated proportions were outlined and described. The research objectives were then presented along with each question. Data was presented in a structured format for each quantitative question in the form of descriptive, frequency and inferential statistics. Descriptive and frequency statistics was presented as numerical data, tables and bar charts. Inferential statistics was presented by means of Pearson's correlations between selected questions for Objectives One, Four and Five to test the strength of the candidate's responses.

Qualitative information was recorded from the candidate's responses to the questions associated with Objective two. This information was obtained by means of phenomenological interviews. Qualitative and quantitative data was recorded from engineering staff and students across the board. Data was documented and

statistically analyzed within the framework of the study's five research objectives. The next chapter now presents a detailed interpretation and analysis of both qualitative and quantitative data.

CHAPTER FIVE
Discussion

5.1 Introduction

The research findings of the study are now analysed by interpreting relevant qualitative and quantitative data. Quantitative data was analysed from the results generated by descriptive, frequency and inferential statistics. A detailed discussion of the results is presented in a structured and logical manner. Both qualitative and quantitative data has been interpreted and discussed. The findings are explained for each question, associated with the relevant objective.

The discussion also links the objectives of the project to the aim and problem statement of the study. Work presented and published by other authors has been compared with the results from the study of a TQM system for a University faculty. A framework and model for a TQM system for the implementation into University faculty is proposed. The TQM system is based on theory and research findings. Its purpose is to improve the operational efficiency and education delivery across the board by creating value and giving the faculty a competitive advantage.

5.2 Discussion of Results for the Aim and Objectives the Research Study

The overall objective of the study was to research and investigate the implementation of a TQM system for a University faculty and how this would impact high quality service, operation and education delivery for its entire operation. The research aimed to solve the problem:

Can a TQM system be implemented in a faculty at UKZN and what resources would be required to make it sustainable?

The discussions, not only links the results to the objectives, but also offer detailed explanations of the findings. The findings are also linked to the aim of the project, through analysis.

5.2.1 Objective One: Determine if a TQM system is required for the Faculty of Engineering at UKZN.

Discussions on quantitative data are divided into the five individual questions and then brought together in a discussion that links the questions to the objective. A discussion on the correlation between Question Four and Question Five is included. The Cronbach's Alpha number for the quantitative data collected for the five questions for Objective one was 0.71. Since it was greater than 0.7, the data was taken to be reliable. (Table 4.1)

a) Question One asked candidates if they have an understanding of quality in relation to studies. 72.1% of candidates responded that they agreed and 27.0% strongly agreed that they have an understanding of quality in relation to University studies. Only one respondent strongly disagreed with the question, one disagreed and one was neutral. (See Figure 4.1) The average score was 4.25. It was biased towards agree. This data clearly showed that, (72.1 +27.0), 99.1% had an understanding of quality in relation to studies at the. This was significant and showed that quality in studies was recognized and understood by staff and students the Faculty of Engineering.

b) Question Two asked candidates if they have an understanding of Total Quality Management in relation to studies. Data recorded for Question Two showed that 84.1% of candidates responded that they agreed and 15.6% strongly agreed that they have an understanding of TQM in relation to University studies. Only one respondent was neutral. (See Figure 4.2) The average score was 4.15. It was biased towards agree. This data also clearly showed that, (84.1% +15.6%), 99.7% had an understanding of TQM in relation to studies at the University. It was interesting to note how more candidates agreed that they had an understanding of TQM, (99.7%), than those who agreed that they had an understanding of quality in relation to studies, (99.1%). This showed that TQM in studies was well recognized and understood by staff and students in the Faculty of Engineering.

c) Question Three asked candidates if they think that the Faculty of Engineering has a quality problem across the board. 65.2% of candidates agreed and 14.4% strongly agreed that the Faculty of Engineering has a quality problem across the board. 20.4% remained neutral. (See Figure 4.3) The average score was 3.94. The data showed that, (65.2% +14.4%), 79.6% believed that that the Faculty of Engineering has a quality problem across the board. This was significant and illustrated that almost 80% of respondents indicated that the Faculty has quality issues.

d) Question Four asked candidates if they think that a TQM system should be investigated and implemented in the Faculty of Engineering. 81.4% of candidates agreed and 18.6% strongly agreed that a TQM system should be investigated and implemented in the Faculty of Engineering (See Figure 4.4). The average score was 4.19. It was biased towards agree. The data also showed that all candidates, (100%), believed that a TQM system should be investigated and implemented in the Faculty of Engineering.

e) Question Five asked candidates if they think that a TQM system is required to improve the image and reputation of the Faculty of Engineering. 82% of candidates agreed and 17.1% strongly agreed that they think a TQM system is required to improve the image and reputation of the Faculty of Engineering. No respondents remained neutral, but 0.9% disagreed. The average score was 4.15. It was biased towards agree. (See Figure 4.5) The data showed that, (82% +17.1%), 99.1% believe that a TQM system was required to improve the image and reputation of the Faculty of Engineering. This was significant. It illustrated the need of a TQM system in the Faculty of Engineering.

f) The correlation between Question Four and Five used the Person correlation statistical method and provided a result of 0.86. This is very close to 1, a positive correlation. This clearly indicates that there was a very strong relationship between candidate's responses that a TQM system should be investigated and implemented in the Faculty of Engineering and that a TQM system was required to improve the image and reputation of the Faculty of Engineering.

5.2.1.1 Discussion of results for Objective One

Objective One required research data to determine if a TQM system was required for the Faculty of Engineering at UKZN. The first two questions provided data that clearly showed that the respondents had an understanding of quality and TQM for academic studies. This was important as, without this understanding, the respondents would not be in a position to fully understand problems of quality in education and a University faculty. They would not be in a position to make a meaningful contribution to questions to determine if a TQM is required for the Faculty of Engineering.

Data analysis for Question Three showed that 79.6% of respondents believed that the Faculty of Engineering had a quality problem across the board. While 20.4% remained neutral, no respondents indicated that there was not a quality problem in the Faculty, which was significant. Question Four and Five clearly indicated that a TQM system should be investigated and implemented in the Faculty and that a TQM system was required to improve the image and reputation of the Faculty. The close correlation between Questions Four and Five, (0.86), also indicated that a TQM system was required for the Faculty of Engineering at UKZN.

Overall, the quantitative data gathered and statistically analyzed from the five questions for Objective One, clearly indicated that a TQM system was required for the Faculty of Engineering at UKZN. The methods and analysis of quantitative data, was sufficient for providing an answer for Objective One.

5.2.2 Objective two: Determine what Resources are needed to introduce a TQM System for the Faculty of Engineering.

Discussions on qualitative data are divided into the four individual questions and then brought together in a discussion that links the questions to the objective. The questions were not only for interview purposes but also for phenomenological discussion.

a) Question One asked candidates what resources they think are needed to introduce a TQM system for the Faculty of Engineering at UKZN. Interestingly, all

responded with funding, human capital and training courses. They recognized funding to be the most important resource. Human capital was then recognized as being important along, with training courses for all staff, across the board to understand and implement the TQM process in the Faculty. In discussions, experienced training personnel was recognized to be important and funding for this would be required. Candidates acknowledged that finance and time was need for training, implementation, integration and feedback.

b) Question Two asked candidates whether they think that the Faculty has the resources to investigate and implement a TQM system. The majority of the candidates responded that the Faculty does not have the resources to investigate and implement a TQM system. Staff and students are aware that universities, worldwide, are operating with budgets cuts across the board. UKZN is no exception. In discussions, staff and students suggested that the Faculty look to donors, government or bank loans. This would be a feasible solution, along with a business plan and clear support from the University executive. Interviewed candidates highlighted the need for current resources to be allocated and used more efficiently, to possible free up resources for a TQM system implementation.

c) Question Three asked candidates who they think should fund the TQM system investigation and implementation for the Faculty of Engineering at UKZN. There was consensus that the TQM system should be funded by the University, if possible. However, in discussions, candidates recognized that UKZN is experiencing budget cuts across the board. The Faculty of Engineering is running on a very lean budget. Candidates suggested that funding for the TQM system would need to be budgeted over and above normal budget requirements and this could be part of five year planning. This would require strategic thinking and implementation over the five year period.

There was consensus that, if the faculty had the financial resources, then it should it fund the TQM system itself. The candidates suggested that the Department of Education, (DOE), could be the source of the financial resources. It is true that the

President of the Republic of South Africa has committed increased financial resources to education in his 2011 „State of the Nation' speech.

d) Question Four asked candidates if they think the Faculty of Engineering, at UKZN, should seek outside support for a TQM system, for both the analysis and implementation of the system, from a consultant body. It was interesting to note that candidates suggested that outside support, from a consultant company, would make it easier to plan, phase, analysis and implement the TQM from a financial perspective. This shows that staff and students recognize the budget constraints that the Faculty is facing, across the board.

Discussions on using an outside company or using the University to implement a TQM system were initiated. An outside company, (consultant company), would be more specialized in TQM planning and implementation. It was recognized that it would have valuable experience in implementation and integrating TQM systems in industry. However, from the phenomenological interviews, the overall consensus was that the University should be involved in planning, implementation and sustaining the TQM system for the Faculty of Engineering. The TQM should be sustainable within the Faculty, where empowerment of all staff must take place within the Faculty of Engineering. Staff must be included in all phases of planning, implementation and feedback of the TQM system.

5.2.2.1 Discussion of Results for Objective Two

The interviews and discussions highlighted funding, human capital and training courses to be the most important resources to introduce a TQM system. Experienced training personnel was recognized to be important for the TQM process. Time was also recognized for training, implementation, integration and feedback. Staff and students rightly recognized that the faculty does not have resources to investigate and implement a TQM system. Due to budget constraints, the Faculty does not have the funds to finance the TQM process. Funds would need to be sourced externally. This has been successful in overseas models, but staff and students were not aware of this, which is understandable.

Overall, the qualitative data gathered from the four questions for Objective Two clearly indicated the resources required to introduce a TQM system for the Faculty of Engineering. In addition, it was suggested the University should implement the TQM system and that staff should be included in all phases of planning, implementation and feedback of the TQM system. The methods and analysis of qualitative data was sufficient for providing an answer for Objective Two.

5.2.3 Objective Three: Determine whether Key Personnel can manage a TQM system for the Faculty of Engineering.

Discussions on quantitative data are also divided into the five individual questions and then brought together in a discussion that links the questions to the objective. The Cronbach's Alpha number for the quantitative data collected for the five questions for Objective Three was 0.76. Since it was greater than 0.70, the data was taken to be reliable. (Table 4.9)

a) Question One asked candidates if they think that an outside company should manage the TQM System**.** 26.7 % of candidates responded that they disagreed. 22.2% agreed and 30.3% strongly agreed that an outside company should manage the TQM System**.** 20.7% remained neutral. (See Figure 4.6) The average score was 3.56. It was only slightly biased towards agree. The data showed that, (22.2 +30.3), 52.5% of the candidates believed, (agreed and strongly agreed), that an outside company should manage the TQM System**.** This was only just over half of the 333 candidates or 175 candidates. he average was more biased to agree than neutral.

b) Question Two asked candidates if they think the leadership of the University should manage the TQM System. 58.3% of candidates responded that they agreed and 9.3% strongly agreed that the leadership of the University should manage the TQM System. (58.3 + 9.3) 67.6% of the candidates believed the University leadership should manage the TQM system. 10.2% were neutral and 22.2% disagreed which indicates that they do are not confident that the University leadership should manage the TQM system. (See Figure 4.7) The average score was 3.55. It was only slightly biased towards agree. The overall result (67.6%) was higher than the result (50.5%)

for Question One, which indicates the need for the leadership of the University to manage the TQM system.

c) Question Three asked candidates if they think that the Faculty of Engineering should manage the TQM System. 32.4% of the candidates disagreed. 36.3% of candidates responded that they agreed and 9.3% strongly agreed that the Faculty of Engineering should manage the TQM System. 21.9% of the candidates were neutral which was significantly higher than the responses for whether on outside company of the University leadership should manage the TQM system. The average score was 3.23. It was slightly biased towards neutral (See Figure 4.8). The data showed that only, (36.3 + 9.3), 45.6% of the candidates believed, (agreed and strongly agreed), that the Faculty of Engineering should manage the TQM System. This is lower than the 50% and 67.6 % for Question One and Two. From the responses it can be deduced that overall, the candidates would not want the Faculty of Engineering to manage the TQM System.

d) Question Four asked candidates if they think that all Engineering Faculty members should be involved in managing the TQM system. 22.2% of the candidates disagreed. 36.3% of candidates responded that they agreed and 19.5% strongly agreed that that all Engineering Faculty members should be involved in managing the TQM system. 21.9% of the candidates were neutral which was still significant. The average score was 3.31. It was biased towards neutral. (See Figure 4.9) The data showed that, (36.3 + 19.5), 55.8% of the candidates believed, (agreed and strongly agreed), that all Engineering Faculty members should be involved in managing the TQM System. This is higher than the 50% even though the average was based towards neutral. Overall the candidates believed that all Faculty members should be involved in managing the TQM system.

e) Question Five asked candidates if they think that key personnel in the Faculty of Engineering should manage the TQM System. 46.5% of candidates responded that they agreed that key personnel in the Faculty of Engineering should manage the TQM system. 44.1 % disagreed. 9.3% were neutral for Question Five. The average

score was 3.02, neutral. (See Figure 4.10) The overall result of 44.1 % was lower than Question One, Two and Three.

5.2.3.1 Discussion of Results for Objective Three

Objective Three required research data to determine whether key personnel should manage a TQM system in a Faculty. 52.2 % believed that an outside company should manage the TQM system, 67.6 % believed that the leadership of the University should manage the TQM system and, 45.6 % believed that the Faculty of Engineering should manage the TQM system. The results clearly showed that most candidates, (67.6%), believed that the leadership of the University should manage the TQM system. This is important as it shows that the candidates have confidence in the University leader's ability to manage the TQM system.

In terms of being involved in managing the TQM system, 55.8% believed that all Engineering Faculty members should be involved and 46.5% believed that key *et al* in the Faculty of Engineering should manage the TQM system. More importance was placed on including all staff to be involved in managing the TQM system in the Faculty.

Overall, the quantitative data gathered and statistically analyzed from the five questions for Objective Three clearly indicated that all staff should be involved in the managing of the TQM, with the leadership of the University taking a key role in managing the process. The methods and analysis of quantitative data was sufficient for providing an answer for Objective Three.

5.2.4 Objective Four: Determine how a TQM system should be implemented for the Faculty of Engineering.

Discussions on quantitative data are divided into the five individual questions and then brought together in a discussion that links the questions to the objective. A discussion on the correlation between Question Four and Question Five is included. The Cronbach's Alpha number for the quantitative data collected for the five questions for Objective one was 0.77. Since it was greater than 0.7, the data was

taken to be reliable. (Table 4.18)

a) Question One asked candidates if they think that an outside company should implement the TQM System in the Faculty of Engineering. 7.2 % of the candidates disagreed. 55.9% of candidates responded that they agreed and 30.3% strongly agreed that that an outside company should implement the TQM System in the Faculty of Engineering. 6.5 % of candidates remained neutral. That means that, (55.9 + 30.3), 86.2% candidates believed that that an outside company should implement the TQM System. The average score was 4.09. (See Figure 4.11)

b) Question Two asked candidates if they think that the University should implement the TQM System in the Faculty of Engineering. 73.3% of candidates responded that they agreed and 26.7% strongly agreed that the University should implement the TQM System in the Faculty of Engineering. That means that all candidates, (100%), suggested that the University should implement the TQM system in the faculty of Engineering (See Figure 4.12) Since no candidates were neutral, strongly disagreed or disagreed it showed how important it was to have the University implement the TQM system.

c) Question Three asked candidates if they think that the Faculty of Engineering should be responsible for the implementation of the TQM system. 47.4% of candidates agreed and 21.0% strongly agreed that the Faculty of Engineering should be responsible for the implementation of the TQM system. 31.5% remained neutral. (See Graph 4.13) The average score was 4.23. It was biased towards agreement that the Faculty of Engineering should be responsible for the implementation of the TQM system. The data also showed that, (47.4% + 21.0%), 68.4% believe that the Faculty of Engineering should be responsible for the implementation of the TQM system.

d) Question Four asked candidates if they think that a TQM system should be implemented across the board within the Faculty of Engineering. 56.5% of candidates agreed and 33.0% strongly agreed that a TQM system should be implemented across the board within the Faculty of Engineering. (See Figure 4.14) The average

score was 4.19. It was biased towards agree. 10.5% were neutral. (56.5% + 33.0%) 89.5% believed that a TQM system should be implemented across the board within the Faculty of Engineering which was significant.

e) Question five asked candidates if they think that a TQM system should be implemented in phases in the Faculty of Engineering. 55.3% of candidates agreed and 44.7% strongly agreed that they think a TQM system should be implemented in phases in the Faculty of Engineering. No respondents remained neutral, disagreed or strongly disagreed. (See Figure 4.15) The average score was 4.45. It was slightly biased towards agree. The data showed that, (55.3% + 44.7%), 100% of the candidates believed that a TQM system should be implemented in phases in the Faculty of Engineering. This was significant and illustrated the need for a TQM system to be implemented phase by phase in the Faculty of Engineering.

f) The correlation between Questions Four and Five used the Person correlation statistical method. It provided a result of 0.70. This is close to 1, a positive correlation. This clearly indicated that the candidates believed that a TQM system should be implemented across the board within the Faculty and that a TQM system should be implemented in phases in the Faculty of Engineering. The candidates saw the need for a phased implementation across the board to reduce disruptions and secure “buy in” from staff.

5.2.4.1 Discussion of Results for Objective Four

The results on who should implement the TQM system showed that the majority, (100%), were in favor of the University implementing the TQM system in the Faculty of Engineering. It must be noted that 86.2% were in favor of an outside company and only 68.4% in favor of the faculty. The candidates recognized the need and importance that the University should implement the TQM system.

89.5% of candidates believed that a TQM system should be implemented across the board within the Faculty of Engineering which indicated the inclusive nature of the TQM requirement for all staff to be involved. Significantly, 100% of the candidates

believed that a TQM system should be implemented in phases in the Faculty of Engineering. The correlation showed a strong relationship between implementing the TQM system across the board within the Faculty and in phases.

Overall, the quantitative data gathered and statistically analyzed from the five questions for Objective Four clearly indicated that the University should implement the TQM system, in phases, across the board in the Faculty of Engineering. The methods and analysis of quantitative data was sufficient for providing an answer for Objective Four.

5.2.5 Objective Five: Determine the Impact of a TQM system on the Quality, Standard, Operation Efficiency, Image and Reputation for the Faculty of Engineering.

Discussions on quantitative data are divided into the five individual questions and then brought together in a discussion that links the questions to the objective. A discussion on the correlation between Question One, Two, Three, Four and Five is included. The Cronbach's Alpha number for the quantitative data collected for the five questions for Objective one was 0.83. Since it was greater than 0.7, the data was taken to be reliable. (Table 4.24)

a) Question One asked candidates if they think that a TQM System will improve the quality of operations in the Faculty of Engineering. 63.73% of candidates agreed and 36.3% strongly agreed that they think a TQM system will improve the quality of operations in the Faculty of Engineering. No respondents remained neutral, disagreed or strongly disagreed. (See Figure 4.16) The average score was 4.36. It was slightly biased towards agree. The data showed that 100% of the candidates believed that a TQM system will improve the quality of operations in the Faculty of Engineering. This was significant and clearly illustrated the need for a TQM system to be implemented in the Faculty of Engineering to improve the quality of operations.

b) Question Two asked candidates if they think that a TQM system will improve the

standard of operations in the Faculty of Engineering. 67% of candidates agreed and 33% strongly agreed that they think a TQM system will improve the standard of operations in the Faculty of Engineering. No respondents remained neutral, disagreed or strongly disagreed. (See Figure 4.17) The average score was 4.33. It was slightly biased towards agree. The data showed that 100% of the candidates believed that a TQM system will improve the standard of operations in the Faculty of Engineering. This was also significant. It clearly illustrated the need for a TQM system to be implemented in the Faculty of Engineering to improve the standard of operations.

c) Question Three asked candidates if they think that a TQM system will improve the efficiency of operations in the Faculty of Engineering. 60.4% of candidates agreed and 24.6% strongly agreed that they think a TQM system will improve the efficiency of operations in the Faculty of Engineering. Interestingly, 15% remained neutral. This may be due to the fact that a lot of Faculty operations are driven by software, (e.g. registration), and therefore the candidates are happy with the response they receive. No candidates disagreed or strongly disagreed. (See Figure 4.18) The average score was 4.10. It was more biased towards agree. The data showed that, (60.4% + 24.6%), 85.0% of the candidates believed that a TQM system will improve the efficiency of operations in the Faculty of Engineering. This further illustrated the need for a TQM system in the Faculty of Engineering.

d) Question Four asked candidates if they think that a TQM system will improve the image of the Faculty of Engineering. 55.3% of candidates agreed and 35.7% strongly agreed that they think a TQM system will improve the image of the Faculty of Engineering. It was also interestingly to note that 9% remained neutral, 6% less than that for question three. No candidates disagreed or strongly disagreed. (See Graph 4.19) The average score was 4.27. It was more biased towards agree. The data showed that, (55.3% + 35.7%), 91% of the candidates believed that a TQM system improve the image of the Faculty of Engineering. This was also significant and reinforced the need for a TQM system in the Faculty of Engineering

e) Question Five asked candidates if they think that a TQM system will improve the

reputation of the Faculty of Engineering. 50.2% of candidates agreed and 34.8% strongly agreed that they think a TQM system will improve the reputation of the Faculty of Engineering. Once again 15% remained neutral, the same as for question three (See Graph 4.18). The average score, (4.20), was more biased towards agree than strongly agree. The data showed that, (50.2% + 34.8%), 85% of the candidates believed that a TQM system will improve the reputation of the Faculty of Engineering. This is also significant and illustrates the need for a TQM system in the Faculty of Engineering.

f) Correlations were calculated between Questions One, Two, Three, Four and Five. They were done independently against each other, because a relationship between each was sought, with respect to whether a TQM System will improve the quality of operations, the standard of operations, the efficiency of operations, the image of the Faculty and the reputation for the Faculty of Engineering.

The strongest correlation was between Questions Four and Five, (0.75), which indicated that candidates strongly believed a TQM System will improve the image and therefore the reputation in the Faculty of Engineering. This represents a strong link between image and reputation in the Faculty. This indicated that image and reputation are important to staff and students.

A strong correlation also existed between Questions Two and Three, (0.73), which also indicated that candidates believed a TQM System will improve the standard of operations and therefore the efficiency of operations in the Faculty of Engineering. This showed a strong relationship and link between standard and efficiency in the Faculty. This also indicates that standard and efficiency of operations are important to staff and students.

A strong correlation also existed between Questions One and Two, (0.70), which also indicated that candidates believed a TQM System will improve the quality of operations and therefore the standard of operations in the Faculty of Engineering. This showed a strong relationship between quality and standards with respect to

operations in the faculty. This showed a strong link between quality and standards with respect to operations in the faculty. This also indicates that quality and standard of operations are important to staff and students.

The “weakest” correlation was between Questions Two and Five, (0.25). This was still a positive relationship which indicated that candidates believed a TQM System will improve the standard of operations and the hence the reputation of the Faculty of Engineering. This showed that there is a relationship between standard and reputation for the Faculty. This showed a link between standard and reputation for the faculty.

The correlation between Questions Two and Five was found to be 0.30. This was still a positive relationship which indicated that candidates believed a TQM System will improve the efficiency of operations and the hence the reputation of the Faculty of Engineering. This showed that there is a relationship between efficiency and reputation for the Faculty. This also showed a link between standard and reputation for the faculty.

Overall, all the correlations were positive between all the questions, independently calculated against each other. The strongest was between Questions One and Two and the “weakest”, while still positive, was between Questions Two and Five. Candidates believed that a TQM system would have an impact on the quality, standard and efficiency of operations in the Faculty and this would be related to the image and reputation of the Faculty of Engineering.

5.2.5.1 Discussion of Results for Objective Five

Overall the quantitative data suggested that a TQM system will have a positive impact on the quality, standard, operation efficiency, image and reputation of a University Faculty. This was demonstrated by the positive responses of the candidates to the individual questions on the questionnaire and the strong correlations that independently existed between the quality of operations, the standard of operations, the efficiency of operations, the image of the Faculty and the

reputation of the Faculty of Engineering. The methods and analysis of quantitative data was sufficient for providing an answer for Objective Five

5.3 Summary

A discussion of the qualitative and qualitative data, obtained from analysing information from the questionnaires and interviews, was used to answer the stated objectives. It was found that a TQM system was required for the Faculty of Engineering at UKZN. The study indicated that resources such as funding, human capital, training and time were required to introduce a TQM system in the Faculty of Engineering. Staff should be included in all phases of planning, implementation and feedback of the TQM system.

The study found that all staff should be involved in managing the TQM system and the leadership of the University should take a key role in the TQM system management process. In addition, the University should implement the TQM system in phases, across the board, in the Faculty of Engineering. The study found that a TQM system would have a positive impact on the quality, standard, operation efficiency, image and reputation of the Faculty of Engineering.

The study has shown how a TQM system can be implemented in the Faculty of Engineering at UKZN and what resources that would make it sustainable. The research study has provided a framework and model of a TQM system for a University faculty that could be implemented to provide high quality service, operation and education delivery for its entire operation. A TQM system, for a University faculty, will create value for the faculty and institution. It will give the faculty and University it a competitive advantage amongst universities. The next chapter now presents the recommendations and conclusions of the study

CHAPTER SIX
Recommendations and Conclusions

6.1 Introduction

The research study aimed to provide answers to whether a TQM system can be implemented in a University faculty and what resources would be required to make it sustainable. The overall objective of the study was to research and investigate the implementation and impact that a TQM system would have on a University faculty to provide high quality service, operation and education delivery for its entire operation. The study was needed because faculties at Universities compete with other faculties within the University and with other Universities for high quality students. High quality service, operational efficiency and education contribute to a faculty's image and reputation.

The literature review provided a sound theoretical back ground to Quality and TQM in industry and Higher Educational Institutions. Five objectives were set out as critical questions that were answered by the research study. The answers to these objectives were found by analyzing both qualitative and quantitative data using phenomenological interviews as well as descriptive, frequency and inferential statistics. A framework and model of a TQM system (Figure 6.3) for a University faculty has been developed based on literature review and research findings.

6.2 Solution of the Research Problem

The research study solved the problem on whether a TQM system can be implemented in a faculty at UKZN and what resources were required to make it sustainable. This was solved by using and analysing qualitative and quantitative data to answer the following critical questions:

1. Was a TQM system required for the Faculty of Engineering at UKZN?

1a. The research clearly showed that a TQM system was needed by the respondents for the Faculty of Engineering at UKZN by means of analysing and interpreting quantitative data.

2. What resources are needed to introduce a TQM system for the Faculty of Engineering?

2a. The research showed that funding, human capital and experience were the main resources along with time for training, implementation, integration and feedback. Research was carried out by means of analysing and interpreting qualitative data.

3. Whether key personnel could manage a TQM system for the Faculty of Engineering?

3a. The research indicated that all staff must be involved in the managing of a TQM system, with the leadership of the University taking a key role in managing the process. Research was carried out by means of analysing and interpreting quantitative data.

4. How a TQM system should be implemented for the Faculty of Engineering?

4a. The research indicated that the University must implement the TQM system in phases, across the board, in the Faculty of Engineering. Research was carried out by means of analysing and interpreting quantitative data.

5. What will be the impact of a TQM system on the quality, standard, operation efficiency, image and reputation for the Faculty of Engineering?

5a. The research found that a TQM system will have a positive impact on the quality, standard, operation efficiency, image and reputation for the Faculty of

Engineering. Research was carried out by means of analysing and interpreting quantitative data.

Based on these findings, a framework and model of a TQM system for a University faculty has been developed. Details on the development of the TQM system, and how it should be implemented, across the board in a University faculty, are outlined and described in Section 6.4.1.

6.3 Implications of the Research study

The methods, results and recommendations of the research study can be applied in practice to a University faculty to provide high quality service, operation and education delivery for its entire operation. A TQM system will improve operations across the board and therefore a University faculty will have the ability to attract and graduate high quality students. High quality service, operational efficiency and education contribute to a faculty's image and reputation.

6.3.1 Stakeholders that will benefit from the Research Study

The University is a major stakeholder that will benefit from the study. The UKZN has committed its self to become the premier University of African scholarship. A TQM system will assist the University to be academically excellent, innovative in research, critically engaged with society and demographically representative. The University will ensure the promotion and development of a culture of quality in all its faculties with a TQM system.

The students are the major stakeholder as they come to a University to get a quality education and make a meaningful contribution to the South African economy when they finally graduated. Parents and sponsors of the students are major stakeholders. They have invested resources in their children and students. A TQM system will assist students to get a high quality education. It will help them complete their studies in good time so they can contribute to the South African economy.

Local industry and the employers of skilled workers of the South African economy are also stakeholders that will benefit from a University faculty TQM system. Skilled workers make a significant contribution to the growth of the South African economy. The South African Government who subsidizes higher education in South Africa are also considered stakeholders. The Government wants skilled workers and entrepreneurs to create jobs and grow the economy. The quality of life of all South African will be improved with an increase in job supply.

6.4 Recommendations to solve the Research Problem

The overall objective of the study was achieved, where the study researched and investigated the implementation of a TQM system for a University faculty and how this impacts high quality service, operations and education delivery for its entire operation.

It is recommended that the cost of the TQM system be financed from the University's main fund, as it would be over and above the normal running expense of a faculty. Should an outside company be involved in the TQM process, then the costs would be higher. If just the University and faculty were involved, the TQM investigation and implementation costs could be included into the Universities budget and business plan. Securing a grant from the Department of Education highly is recommended to assist the funding of the faculty TQM system.

6.4.1 Total Quality Management System for a University Faculty

Based on the analysis of qualitative and quantitative data, obtained in the research study, a TQM system was developed for a University faculty, within the context of the literature review. The University of KwaZulu-Natal wants to be a research lead institution (UKZN 2011). The quality of output and reputation of academic research will be prioritized in a HEI. Tribus (2004) correctly suggested that:

- The faculty is not a factory or manufacturing environment.
- The student is not a "product".
- The education of the student and research output is the product.

- Successful completion of the product will require staff and students to be part of the learning process.

A TQM system will improve every aspect of work in the University faculty, across the board. It will require extensive data to be collected and analyzed. Everyone will participate to provide improved delivery of education delivery and research output.

A TQM system, for a University faculty, will have five basic concepts:

1. Commitment from the executive and Faculty management to ensure long term, top to bottom University support.
2. Focus on high quality operations and education delivery across the board.
3. Involvement and utilization of the entire staff, both support and academic.
4. Continuous improvement of operations and education delivery.
5. Established high performance measures for the TQM system.

6.4.2 Strategic Planning

Planning a TQM system, from a strategic perspective for a University faculty, starts with the principle that operational quality and high quality education will be required. The faculty will know what its education delivery requirements are in the future.

The TQM system will bring together all the key stakeholders by:

1. Prioritising the education of the student and research output. The faculty will identify the future needs of student education and research output that it wants to achieve. What will they be? Will the student base change? What will the stakeholders want? How will the faculty meet and exceed the expectation of educating students and improving research output?
2. Positioning the faculty with respect to educating the student and improving research output. How will the faculty retain and improve student education and research output? Poor student education and research output, associated with

poor quality performance, will be targeted for improvement or eliminated. The faculty will concentrate its efforts on excellence.

3. Predicting the future. The faculty will predict future conditions that will affect the education of students and research output for at least the next five years. Demographics, politics, economic forecasts and technical assessments or projections are tools that will predict the future.
4. Identifying the gap: Strategic planners for a TQM system of faculty will identity the gaps between the current state and the future state of a faculty. An analysis of the core values is a technique for pinpointing gaps.
5. Analysing and closing the gap: The strategic plan will analyse the gap. Strategies and solutions will be developed to close the gap by establishing goals and responsibilities to ensure high quality operations, education delivery and research output across the board All stakeholders will be included in the strategic plan.
6. Aligning the strategic plan. The strategic plan will be aligned with the mission, vision and core values of the faculty and University. Without this alignment, the strategic plan will have little chance of success.
7. Implementing the TQM system: Resources for the TQM system will be allocated to collecting and analysing data. Resources will be made available for designing and overcoming resistance to change from all the staff, across the board. Monitoring and evaluating TQM system activities will ensure that progress is being made. The strategic planning group will meet regularly to assess progress and make corrective actions.

6.4.3 Framework and Model

The three components, suggested by Klefsjö *et al* (2008) for TQM systems, are relevant for a **TQM framework** as designed here for a University faculty. They include core values, methods and tools. Figure 6.1 illustrates that the components will be integrated together to provide high quality operations and education delivery with reduced consumption of resources. The core values are used in conjunction with the methods and tools to provide superior service.

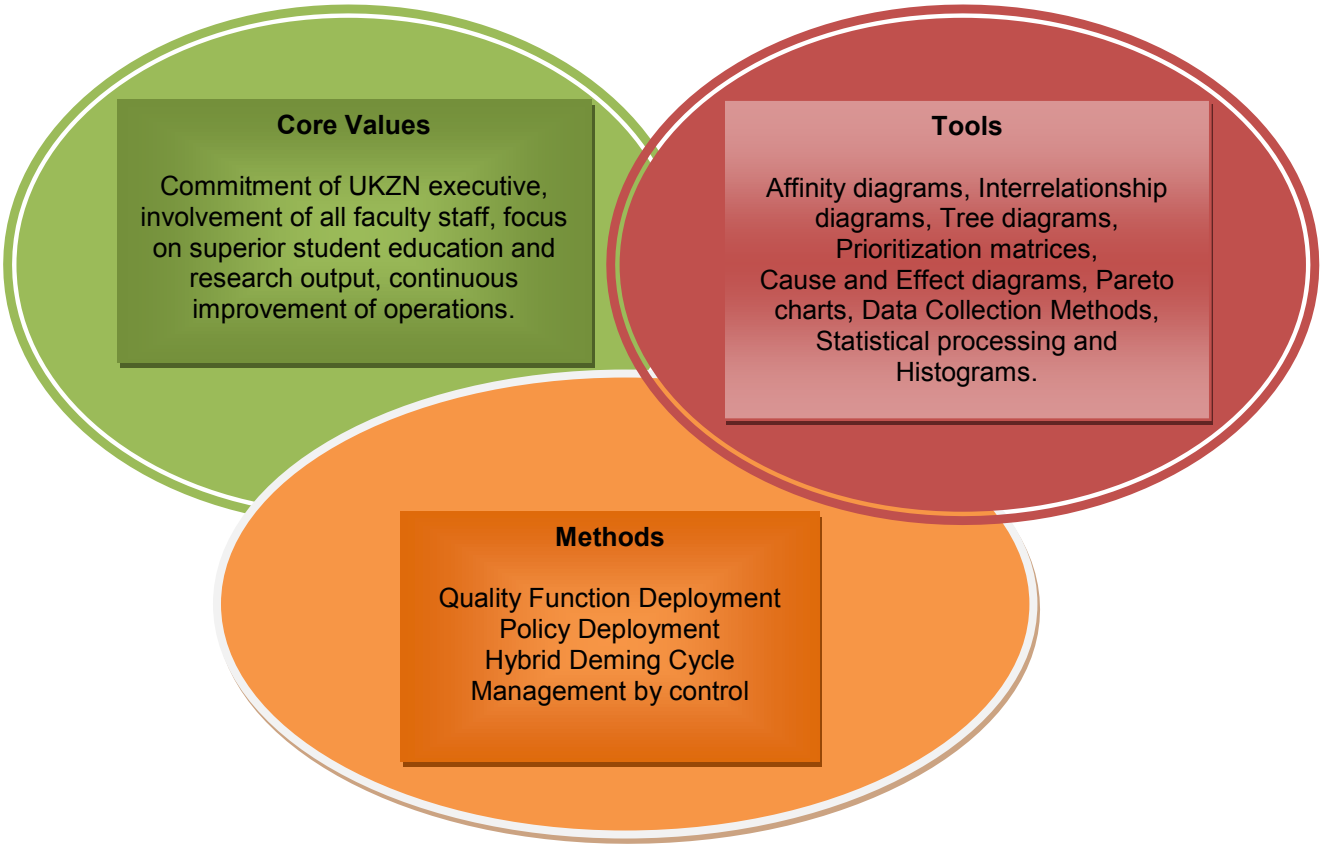


Figure 6.1 Components of a TQM System for a University Faculty

6.4.3.1 Core Values

A TQM system for a University faculty will be based on core values as suggested by Cameron and Sine (2009). The core values for a University faculty will include commitment from executive, involvement of all faculty staff, focus on superior student education and research output and continuous improvement of operations in the faculty across the board. The core values will represent the culture of the faculty. They will be connected to culture of teaching, learning and research output.

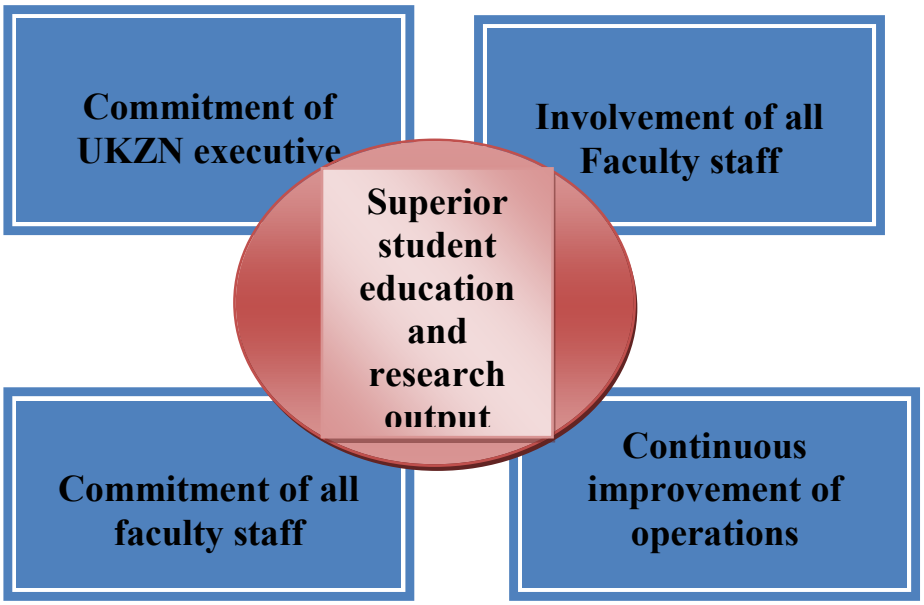


Figure 6.2 Core Values for a University Faculty TQM System

Figure 6.2 illustrates how a University faculty culture must exist that uses core values to achieve customer focus. Factors such as decisions based on facts, commitment of the staff, continuous improvement and process focus all interact to provide superior student education and research output. The University faculty will need a good management system. The management will work together to accomplish the aim of the faculty. It will be one of the key components of a University's core values. Executive management will consider the goals of the University and where the faculty must contribute. Commitment and knowledge of the leadership is important for a University TQM system. Finance and resources, (management resources), are necessary for achieving the vision of the University.

6.4.3.2 Methods

A University TQM system will focus on superior student's education delivery and research output. This will be achieved by using a Quality Function Deployment (QFD). The QFD method will progressively identify student education needs and expectations for staff research outputs. It will transfer these needs to service characteristics and operational processes, across the board. It is an efficient method for communication and staff participation across the board. Staff will work together in

order to achieve a fundamental basis for continuous and integrated improvement throughout the faculty.

A University faculty TQM system will provide systematic planning, utilizing and observing management systems for improving faculty operations across the board. Policy deployment for a University faculty will focus on planning, deploying facts, data and efficient communication. A University TQM system will provide systematic feedback processes, essential to continuous learning until it becomes time to duplicate the quality function process. Quality Function Deployment and other strategic planning will control the process for employment and management commitment. Management will create value for the faculty and University. Process efficiency will provide efficient utilization of resources in the faculty. Benchmarking is an effective methodology for continuous improvement of quality and will be used by a University faculty. Benchmarking will be used for self-evaluation and self-improvement through organized and mutual comparison of practice and performance.

The combination of the Motwani and Kumar model, together with the Deming cycle, provides the basis for a University faculty TQM model. A **TQM model** for a University faculty, with continuous improvement, must have five steps that include:

1. Strategic planning: This will require understanding the educational delivery requirements and faculty research outputs. Implementation and outcomes of the TQM system for a University Faculty.
2. Implementation of the TQM system: Staff will be involved in implementing the TQM system, with the leadership of the University taking a key role in managing the process. The TQM system will be implemented in phases, across the board, in the faculty.
3. Observing the TQM system: This will be the observing process. Emphasis will be put on control, measurements and benchmarks of the TQM process.
4. Continuous improvement. This will be achieved by applying feedback from the measurements and be monitored across the board in the faculty.

5. Error analysis: Changes will be made by the TQM system for a University faculty as and when required. This will provide improvement in terms of efficiency, adaptability and quality

The University faculty model will emphasize the importance of continuous improvement in every action in the faculty. Figure 6.3 shows the recommended TQM system cycle for a University Faculty. Movement is in a clockwise direction, starting with Strategic Planning, Implementation: TQM, Observing, Continuous Improvement, and Error Analysis. These action steps complete the University Faculty TQM system cycle.

Figure 6.3 Recommended TQM System cycle for a University Faculty

6.4.3.3 Tools

Management and planning tools will be used for a TQM system for a University faculty. They will assist the managers in the strategic planning phase and implementation phase of a TQM process. The tools will include Affinity diagrams,

Interrelationship diagrams, Tree diagrams and Prioritization matrices. TQM tools will be used for finding problems, solving problems, collecting data, processing data and interpreting data. The tools will include Cause and Effect diagrams, Pareto charts, data collection methods (literature review, questionnaires and phenomenological interviews), statistical processing and Histograms.

Quality control tools will be applied by the TQM system process. They can be part of a University faculty's Quality Promotion and Assurance Process (QPA), such as that used by the UKZN. The application of quality control tools for a University faculty will use a combination of appropriate tools for specific application. Quality control tools will be used to solve well-defined faculty problems. They will become part of a faculty's daily activities. Adequate training will be provided to the right people at the right time. The application of quality control tools will have a positive impact on the quality, standard, operation efficiency, image and reputation of a University faculty.

6.4.4 Implementation of a Total Quality Management System

The implementation of a TQM system for a University faculty will begin with a commitment from the University executive. The study clearly indicated that while all staff should be involved in the managing of the TQM system, the leadership of the University will take a key role in implementing and managing the process. There will be a commitment from executive management and most importantly, the Vice Chancellor of the University. The importance of the roles of the executive management, namely the Deputy Vice Chancellor of the college, Dean and Deputy of the faculty, cannot be overstated. Leadership is essential during implementation phase, especially at the start of the process. Indifference and lack of involvement by the executive management are the principal reasons for the failure of TQM systems. Delegation and dictatorship is insufficient and not recommended. Visible leadership and involvement will be required.

The role of senior management of a University facility will also be critical. If senior management, (Heads, Deputy Heads and Program Directors of the faculty), are not been involved and educated in the TQM concepts for the faculty, then the TQM system is doomed for failure. In addition to formal education, Heads, Deputy Heads

and Program Directors will need to visit successful TQM organizations, attend TQM seminars and conferences. They will need to read widely on TQM strategies, implementation and failures in relevant articles and books.

Timing of the TQM system implementation process, for a University faculty will be very important. It will be established by surveys, (questionnaires, phenomenological interviews and other outputs), whether a University faculty is ready to take on a TQM system and process. There will be problems during implementation, such as a reorganization of the faculty, change in senior management personnel, interpersonnel conflicts of academic and support staff, current crises and time-consuming activities.

The implementation process will require the formation of a quality council. The membership and duties of the quality council will be an important part of the implementation of a TQM system for a University faculty. The development of core values, vision statements, mission statements and a quality policy statement, with input from all personnel, will be completed first. It will then be overseen by the quality council. In summary, the quality council will assist in the:

1. Development of the core values, vision statement, mission statement and quality policy statement with input from all personnel.
2. Development of the strategic long-term plan with goals and the annual quality improvement program with objectives for the University faculty.
3. Development of the total education and training program and plan for all staff.
4. Determination and monitoring of cost of poor quality throughout the faculty
5. Determination and approval of the performance measures for the faculty.
6. Determination of projects that will improve the TQM process, particularly those that affect service, operation and education delivery.
7. Establishment of multifunctional projects and work-group teams
8. Monitoring of the progress of multifunctional projects and work-group teams
9. Establishment and revision of the recognition-and-reward system to account for the TQM system.

6.4.5 Resources for Sustainability

The research study indicated that resources are required for the planning, implementation and continuous improvement stages of a TQM system for a University faculty. The study found that resources are required to make the TQM system sustainable across the board. Funding, human capital and training courses were the primary resources required to make a TQM system sustainable. The study revealed that, without adequate funding, the ability to plan and implement a TQM system for the Faculty of Engineering at UKZN would not be possible. Funding was the most important resource. Without funding the planning stage cannot start. The cost of educating and training all personnel is significant. Approaching Government, through the Department of Education (DOE), for a grant is strongly advised.

The study also indicated that once funding was secured, then human capital resource was required for a TQM system for the Faculty of Engineering at UKZN. Education and training courses for all staff, across the board, would be required to understand and implement the TQM process in the faculty. Time would also be needed for training, implementation, integration and feedback.

A high level IT system be will be used to assist the TQM system achieve its goals for a University faculty. The IT system will be used in the planning, implementation and continuous improvement stages of a TQM system. It will be used to gather quantitative and qualitative data. It must also be used for statistical analysis. The IT system will be used for generating and executing the framework and model of the TQM system for the University faculty. It must be a knowledge base system. It will add value to the TQM system. The IT system will be the basis for intelligent action of the TQM system. It is important for a TQM system that the IT system converts information into knowledge.

The resources required for the implementation of a TQM system will provide the foundation for its sustainability. Continuous improvement and sustainability will be enhanced by the TQM system producing progress report on teams and processes.

Reports will be generated on education quality and student satisfaction. Progress on meeting goals for the TQM system will be generated and evaluated by the quality council and professional bodies. New teams and projects will have to be created from time to time. Recognition of achievements for staff will be initiated and continued. Benchmarking reports and conformation with the chosen education quality standard will be vigorously pursued and updated. There can always be improvements. Competition from other faculties requires continuous improvement.

Sustainability resources will provide staff with the ability to work smarter, not harder. Worker suggestions will be a source of continuous improvements. They will provide suggestions on how to improve a process and eliminate waste or unnecessary work. Resources will provide the foundation to meet quality standards and methods. In addition, resources will provide staff with:

- A sense of responsibility for active participation in making improvements
- The skills needed to make improvements
- The habit of annual improvements so that each year the organisation's quality is significantly better than the previous year

The TQM system will be developed from the departmental level, with operating personnel involvement, through functional areas, to the organization-wide level.

6.5 Research Study's Contribution

A contribution was made on the collection and analysis of qualitative and qualitative data for investigating the viability of a TQM system for the Faculty of Engineering at UKZN. This included providing answers on how to determine if a TQM system was required, resources needed to introduce a TQM system and information on the key personnel that could manage a TQM system for the Faculty of Engineering. A contribution was also made on how a TQM system should be implemented and the impact a TQM system would have on the quality, standard, operation efficiency, image and reputation for the Faculty of Engineering at UKZN.

A further contribution was also made in the research and development of a framework and model of a TQM system for a University faculty by the researcher. The implementation of the proposed TQM system framework and model will provide high quality service, operation and education delivery for its entire operation. The TQM system will create value for the University faculty and its institution.

6.6 Recommendations for Future Studies

Problems were encountered in conducting the research study. Problems and recommendations for future research include:

- Research data was only gathered from staff and students across the board in the Faculty of Engineering at UKZN. The sample size was 333 and the population size was 2500. The candidate's responses were not differentiated by age, race, gender and academic year. A truly representative sample would look at a heterogeneous sample comprising a number of different institutions. It is also important to research opinions from other stakeholders like students from other institutions, parents and sponsors of students, local industry employers and the Department of Education.
- A study of more HEI could highlight needs and requirements of TQM systems for University faculties.
- A study of people in different income brackets may generate different requirements and needs for a University faculty TQM system.
- The cost of researching and implementing a TQM system was not investigated in the study. This would need to be facilitated by the University executive as part of its business plan. The costs of a TQM system would be over and above the normal running expense of a University faculty.

6.7 Summary

The study solved the research question: Can a TQM system be implemented in the Faculty of Engineering at UKZN and what resources would be required to make it sustainable? Five objectives were formulated to answer the research question. Qualitative and quantitative data was analysed and used to provide results for the

objectives. Research data was obtained from questionnaires and phenomenological interviews.

The research data confirmed that a TQM system was required for the Faculty of Engineering at UKZN. All staff should be involved in managing the TQM, with the leadership of the University taking a key role in the managing process. The University should implement the TQM system in phases, across the board in the Faculty of Engineering. A TQM would have a positive impact on the quality, standard, operation efficiency, image and reputation of the Faculty of Engineering. The study also provided a framework and model of a TQM system for a University faculty that will provide high quality service, operation and education delivery for its entire operation.

It can be concluded that a TQM system can be implemented into a University faculty. The research study provided a framework and model of a TQM system that could be used by a University faculty. Implementation of a TQM system will create value for the faculty and University. A TQM system for a University faculty will give it a key competitive advantage and support the University's desire to improve its international rankings.

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APPENDIX 1

The Dean
Prof Fambirai Takawira
Faculty of Engineering
UKZN
28 November 2011

Dear Sir

PERMISSION TO CONDUCT RESEARCH IN THE FACULTY OF ENGINEERING AS PART OF AN MBA QUALIFICATION

It is a requirement of the UKZN MBA qualification that all students conduct a practical research project in their final year. Prof Glen Bright is conducting research entitled **A Total Quality Management system for a University Faculty.** This project will be a practical problem solving exercise which requires data to be obtained by means of interviews and questionnaires.

Prof Bright would like to request permission to conduct the study in the Faculty of Engineering at UKZN. Please be assured that all information gained from the research will be treated with the utmost circumspection. In terms of the University's ethics policy, the student is required to strictly adhere to confidentiality and anonymity of respondents.

Prof Bright would be grateful if you could provide written permission on a faculty letterhead and signed by the relevant authority.

Thank you for your assistance in this regard.

Yours sincerely

_____

Prof Glen Bright

APPENDIX 2

UNIVERSITY OF
KWAZULU-NATAL
INYUVESI
YAKWAZULU-NATALI

2 February 2011

Professor G. Bright
Head of School
Mechanical Engineering
Howard College

Re: **Permission to conduct research in the Faculty of Engineering as part of an MBA qualification**

I hereby grant you , Professor Glen Bright, permission to conduct practical research in the Faculty of Engineering for your MBA project entitled 'Total Quality Management system for a University Faculty'.

Sincerely

Professor F. Takawira
Dean
Faculty of Engineering

Faculty of Engineering
Postal Address: Howard College
Durban, 4001, South Africa
Telephone: +27 (0) 31 260 3210
Telefax: +27 (0) 31 [illegible]
Email: [illegible]

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Founding Campuses
Pietermaritzburg
Howard College
Medical School
Pietermaritzburg
Westville

APPENDIX 3

UNIVERSITY OF
KWAZULU-NATAL

Research Office, Govan Mbeki Centre
Westville Campus
Private Bag X54001
DURBAN, 4000
Tel No: +27 31 260 3587
Fax No: +27 31 260 4609
dmcap@ukzn.ac.za

21 February 2011

Prof. G Bright (841847455)
Graduate School of Business

Dear Prof Bright

PROTOCOL RECEIVED NUMBER: HSS/0082/011M
PROJECT TITLE: A Total Quality Management system for a University Faculty

In response to your application dated 31 January 2011, the Humanities & Social Sciences Ethics Committee has considered the above-mentioned application and the protocol has been given FULL APPROVAL.

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment /modification procedure before implementation. In case you have further queries, please quote the above reference number.
PLEASE NOTE: Research data should be securely stored in the school/department for a period of 5 years.

We wish you the best with everything you do in your study.

Yours faithfully

Professor Steven Collings (Chair)
HUMANITIES & SOCIAL SCIENCES RESEARCH ETHICS COMMITTEE

cc. Supervisor – Jenny McCabe
cc. Mrs. C Franklin

Postal Address:

APPENDIX 4

Informed Consent Letter 3C

UNIVERSITY OF KWAZULU-NATAL

Dear Respondent,

MBA Research Project

Researcher: Prof Glen Bright 031 260 1275

Supervisor: Mr. D McCabe 031 7645939

Research Office: Ms P Ximba 031-2603587

I, Glen Bright, am a MBA student at the Graduate School of Business, University of KwaZulu-Natal. You are invited to participate in a research project entitled: Total Quality Management system for a University Faculty. The aim of this study is to research and solve the problem: Can a TQM be implemented in a faculty at UKZN and what resources will be required to make it sustainable?

Through your participation, I hope to understand how a TQM system can be implemented in a University faculty and what resources will be required to make it sustainable. The results of the focus group are intended to contribute to the investigation of the implementation and impact a Total Quality Management (TQM) system would have on a University faculty. Your participation in this project is voluntary. You may refuse to participate or withdraw from the project at any time with no negative consequence. There will be no monetary gain from participating in this survey/focus group. Confidentiality and anonymity of records identifying you as a participant will be maintained by the Graduate School of Business, UKZN.

If you have any questions or concerns about completing the questionnaire or about participating in this study, you may contact me or my supervisor at the numbers listed above. The survey should take you about 10 minutes to complete. I hope you will take the time to complete this survey.

Sincerely

Investigator's signature 

Date 07/02/2011 **This page is to be retained by participant**

UNIVERSITY OF KWAZULU-NATAL

MBA Research Project

Researcher: Prof Glen Bright 031 260 1275

Supervisor: Mr. D McCabe 031 7645939

Research Office: Ms P Ximba 031-2603587

CONSENT

I……(full names of participant) hereby confirm that I understand the contents of this document and the nature of the research project, and I consent to participating in the research project.
I understand that I am at liberty to withdraw from the project at any time, should I so desire.

SIGNATURE OF PARTICIPANT **DATE**

……

This page is to be retained by researcher

APPENDIX 5

QUESTIONNAIRE: A TOTAL QUALITY MANAGEMENT SYSTEM (TQM) FOR A UNIVERSITY FACULTY

FACULTY NAME: ENGINEERING

Overview

This questionnaire has been designed in order to test questions that exist in the role of a TQM system from a University perspective relating to understanding, key personnel, whether and how a TQM system would be implemented in a University faculty.

Your participation in this review is highly appreciated by the researcher.

In each question you are presented with a statement to which you should indicate the EXTENT of your agreement/disagreement. Your possible answers are:

A = Strongly Disagree B = Disagree C = Neutral D = Agree E = Strongly Agree

Section 1: Determine if a TQM system is required for the Faculty of Engineering at UKZN

Question	Strongly Disagree (A)	Disagree (B)	Neutral (C)	Agree (D)	Strongly Agree (E)
Do you have an understanding of quality in relation to studies?					
Do you have an understanding of TQM in relation to studies?					
Do you think that the Faculty of Engineering has a quality problem across the board?					
Do you think that a TQM system should be investigated and implemented in the Faculty of Engineering?					
Do you think that a TQM system will improve the image and reputation of the Faculty of					

SECTION 2: Determine whether key personnel can manage a TQM system for the Faculty of Engineering.

Question	Strongly Disagree (A)	Disagree (B)	Neutral (C)	Agree (D)	Strongly Agree (E)
Do you think that an outside company should manage the TQM System?					
Do you think the leadership of the University should manage the TQM System?					
Do you think the Faculty of Engineering should manage the TQM System?					
Do you think that all Engineering Faculty members should be involved in managing the TQM					
Do you think key personnel in the Faculty of Engineering should manage the TQM System?					

SECTION 3: Determine how a TQM system should be implemented for the Faculty of Engineering.

Question	Strongly Disagree (A)	Disagree (B)	Neutral (C)	Agree (D)	Strongly Agree (E)
Do you think that an outside company should implement the TQM System in the Faculty of					
Do you think that the University should implement the TQM System in the Faculty of Engineering?					
Do you think that the Faculty of Engineering should be responsible for the implementation of the TQM System?					
Do you think that a TQM System should be implemented across the board within the Faculty of Engineering?					
Do you think that a TQM System should be implemented in phases in the Faculty of Engineering?					

SECTION 4: Determine the impact of the TQM on the quality, standard, efficiency, image and reputation on the Faculty of Engineering.

Question	Strongly Disagree (A)	Disagree (B)	Neutral (C)	Agree (D)	Strongly Agree (E)
Do you think that a TQM System will improve the quality of operations in the Faculty of					
Do you think that a TQM System will improve the standard of operations in the Faculty of					
Do you think that a TQM System will improve the efficiency of operations in the Faculty of Engineering?					
Do you think that a TQM System will improve the image of the Faculty of Engineering?					
Do you think that a TQM System will improve the reputation of the Faculty of Engineering?					

APPENDIX 6

INTERVIEW QUESTIONS

Objective 2: Determine what resources are needed to introduce a TQM system in the Faculty of Engineering at UKZN.

1. What resources do you think are needed to introduce a Total Quality Management (TQM) system for the Faculty of Engineering at UKZN?

   ---

2. Do you think that the Faculty has the resources to investigate and implement a TQM system?

   ---

3. Who do you think should fund the TQM system investigation and implementation for the Faculty of Engineering at UKZN?

   ---

4. Do you think the Faculty of Engineering at UKZN should seek outside support for a TQM system in both the analysis and implementation of the system from a consultant body?

APPENDIX 7

Sample Size Table

http://www.research-advisors.com/tools/SampleSize.htm

The table was used to determine the appropriate sample size for the study. The first column of the table was used (Confidence Level = 95%, Margin of Error = 5%).

Required Sample Size†

Population Size	Confidence = 95% Margin of Error				Confidence = 99% Margin of Error			
	5.0%	3.5%	2.5%	1.0%	5.0%	3.5%	2.5%	1.0%
10	10	10	10	10	10	10	10	10
20	19	20	20	20	19	20	20	20
30	28	29	29	30	29	29	30	30
50	44	47	48	50	47	48	49	50
75	63	69	72	74	67	71	73	75
100	80	89	94	99	87	93	96	99
150	108	126	137	148	122	135	142	149
200	132	160	177	196	154	174	186	198
250	152	190	215	244	182	211	229	246
300	169	217	251	291	207	246	270	295
400	196	265	318	384	250	309	348	391
500	217	306	377	475	285	365	421	485
600	234	340	432	565	315	416	490	579
700	248	370	481	653	341	462	554	672
800	260	396	526	739	363	503	615	763
1,000	278	440	606	906	399	575	727	943
1,200	291	474	674	1067	427	636	827	1119
1,500	306	515	759	1297	460	712	959	1376
2,000	322	563	869	1655	498	808	1141	1785
2,500	333	597	952	1984	524	879	1288	2173
3,500	346	641	1068	2565	558	977	1510	2890
5,000	357	678	1176	3288	586	1066	1734	3842
7,500	365	710	1275	4211	610	1147	1960	5165
10,000	370	727	1332	4899	622	1193	2098	6239
25,000	378	760	1448	6939	646	1285	2399	9972
50,000	381	772	1491	8056	655	1318	2520	12455
75,000	382	776	1506	8514	658	1330	2563	13583
100,000	383	778	1513	8762	659	1336	2585	14227
250,000	384	782	1527	9248	662	1347	2626	15555
500,000	384	783	1532	9423	663	1350	2640	16055
1,000,000	384	783	1534	9512	663	1352	2647	16317
2,500,000	384	784	1536	9567	663	1353	2651	16478
10,000,000	384	784	1536	9594	663	1354	2653	16560
100,000,000	384	784	1537	9603	663	1354	2654	16584
300,000,000	384	784	1537	9603	663	1354	2654	16586