AN INVESTIGATION INTO THE USE OF QUALITY MANAGEMENT TECHNIQUES IN NZ IT PROJECTS

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ABSTRACT

The risks in an IT project are very high both because of its complexity and also because the context of rapidly-developing technology leads to a high degree of uncertainty. IT projects should have comprehensive formal quality management fully integrated within all aspects of project management.

A review of the quality management in IT project literature suggests, customer-focused TQM is now synonymous with good management. TQM combines the use of computerised data collection and statistical experimentation with a focus on teamwork, group participation and a culture of continuous improvement in operating systems (Robert, 1993).

Using the survey methodology and through two case studies, qualitative data was gathered to develop a model of quality management implementation process in New Zealand.

Key words: Quality, Total Quality Management (TQM), Quality Control (QC), Quality Assurance (QA), Quality Model.

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INTRODUCTION

Global competition and increasingly sophisticated and demanding customers are two important factors that are driving industries around the world to create, develop, and sustain higher levels of quality.

Many organizations have come to realize that they are not able to survive or make profits unless they constantly meet the changing needs, wants and requirements of their customers' and competitors' pressures. Global changes in the micro-electronics, information technology, telecommunication revolution and labour market have created an increase in international competition and concern for productivity levels (Peter 1997).

Customers are becoming more aware as they exercise their knowledge and power of choice about the number of product and service alternatives available. Their requirements are becoming more difficult to meet since they demand faster responses, better value for money products or services, more product varieties, and expect lower prices, reliable delivery, and product integrity.

Since 1984, New Zealand has experienced dramatic political, economic and social change. The country lived with protectionist policies for nearly 50 years. The New Zealand government has moved rapidly to a free market philosophy with a free-floating exchange rate, the removal of high tariffs, and the dismantling of import restrictions, quotas and licences. The removal of these barriers to competition has severely affected the manufacturing sector. New Zealand consumers now have access to products of higher design, quality, and functionality at lower prices than previously possible (Everett, Corbett et al. 1994).

Scope of Quality

The definition of the term "quality" is an issue. Dictionary definitions are too vague to be of much help. Many people define quality as "correct implementation of the specification". Such a definition can be used during product development, but it is inadequate for facilitating comparisons between products.

Standards organizations have tended to refer to "meeting needs or expectations". The International Organization for Standardization (ISO) defines quality as "the total characteristics of an entity that bear on its ability to satisfy stated or implied needs" (Angel, Martínez-Lorente et al. 1998).

Crosby defines four Absolutes of Quality (Harold 2001):

1. Quality means conformance to requirements;
2. Quality comes from prevention;
3. Quality means that the performance standard is "zero defects";
4. Quality is measured by the cost of non-conformance.

Some aspects of quality are readily understood and can be agreed upon by many, but for IT projects, there can be significant differences of opinion on identifying what constitutes quality, or what degree of quality is appropriate. In some circumstances, this occurs because improvement often requires an admission of imperfection or even failure. Likewise, organizations often seem unable to address their problems or admit their shortcomings. The improvement of quality relies upon parameters which can be measured, but other facets of quality are philosophical and elusive (Aucoin 1996).

Quality has also been variously defined as:

1. Excellence (Long 2003);
2. Value (Long 2003);
3. Conformance to specification (Gilmore 1974);
4. Fit for purpose (Juran 1989);

5. Meeting or exceeding customers' expectations (Parasuraman, Ziethaml et al. 1985);
6. Loss avoidance (Taguchi, Elsayed et al. 1989).

In short, these six definitions show different aspects of quality. All can be applied to project development. Managing the project development, efficiency and effective development processes together helps avoid losses through rework and reducing later support and maintenance budgets. In testing, work is carried out to see that the product conforms to specification.

The PSMA (Power Sources Manufacturers Association) conducted a quality survey of its members in July/August 1998 in which definitions of quality were given as (Mankikar 1999):

1. Describes a product that meets the customers' needs and requirements;
2. Effectiveness in doing the right thing in the right way at the lowest cost;
3. Consistency in producing a product to the customer's requirements;
4. Meeting or exceeding customer requirements.

The push for higher levels of quality appears to be customer driven. Customers are now demanding (Harold 2001):

1. Higher performance requirements;
2. Faster product development;
3. Higher technology levels;
4. Materials and processes pushed to the limit;
5. Lower contractor profit margins;
6. Fewer defects/rejects.

During the past twenty years, there has been a trend towards improved quality. The improvements have occurred not only in product quality, but also in quality leadership and quality project management (Harold 2001).

Table 1 Changing View of Quality (Harold 2001)

Past	*Present*
Quality is the responsibility of blue-collar workers and direct labour employees working on the floor	Quality is everyone's responsibility, including white-collar workers, the indirect labour force, and management staff
Quality defects should be hidden from the customers	Defects should be highlighted and brought to the surface for corrective action
Quality problems lead to blame, faulty justification, and excuses	Quality problems lead to cooperative solutions
Corrections-to-quality problems should be accomplished with minimum documentation	Documentation is essential for "lessons learned" so that mistakes are not repeated
Increased quality will increase project costs	Improved quality saves money and increases business
Quality is internally focused	Quality is customer focused
Quality will not occur without close supervision of people	People want to produce quality products
Quality occurs during project execution	Quality occurs at project initiation and must be planned for within the project

Product Quality

Product quality has been defined in different ways in different contexts. A major definition of product quality consists of eight dimensions: performance, features, conformance, reliability, durability, serviceability, perceived quality, and aesthetics (Ahire and Ravichandran 2001).

Gaither and Frazier (1999) suggest that product quality is typically defined along certain dimensions, and some of the most important dimensions include:

Performance: how well the product performs the customer's intended use;
Features: the special characteristics that appeal to customers;
Reliability: the likelihood of breakdowns, malfunctions, or the need for repairs;
Serviceability: the speed, cost, and convenience of repairs and maintenance;
Durability: the length of time or amount of use before needing to be repaired or replaced;
Appearance: the effects on human senses, i.e. the look, feel, taste, smell, or sound;
Customer service: the treatment received by customers before, during, and after the sale;
Safety: how well the product protects users before, during, and after use.

Roger (2001) gives tips for how to measure software product quality:

1. "Correctness: the degree to which a program operates according to specification;
2. Maintainability: the degree to which a program is amenable to change;
3. Integrity: he degree to which a program is impervious to outside attack;
4. Usability: the degree to which a program is easy to use."

The product is a main point of an organisation's purpose, vision, and achievement, and matches the key requirements of management, employees and customers (Peter 1997). Without this focus, it would be difficult to gain the commitment of employees and top management. This definition of product quality is different from the marketing related "product-oriented" strategy.

Process Quality

In many engineering contexts, process quality is the percentage defective, or the number of defects per hundred units, of products from a given process. The maxim applies that process quality is neither necessary nor sufficient for product quality (Neville 2004). Process quality for IT projects refers to things like applying proper

project management practices to costs, time, resources, and communication etc. It covers managing changes within the project (Neville 2004).
The process needs to be evaluated and measured to see if it meets specific standards and expectations. When it meets the organization's but not the customer's expectations, it is time to recalibrate the product quality definition.

Process quality directly contributes to the cost of production and to the extent of waste such as rework and scrap incurred during processing. For example, if the quality of a process is inferior because of the working conditions or mis-specification of processing parameters, a higher incidence of scrap and rework will result. Clearly, this has an impact on the cost of reduction. It also affects the productivity of workers because of idle time and extra work (Ahire and Ravichandran 2001).

Regarding IT projects, managing quality is about keeping an eye on the bigger picture, which is process quality. During the past twenty years, there has been a trend towards improved quality. The improvements have occurred not only in product quality, but also in quality leadership and quality project management (Harold 2001).

Product Quality vs. Process Quality

Improved product quality and process quality have been identified as primary operational goals of quality management. These outcomes are key determinants of customer satisfaction and long-term profitability of manufacturing firms (Ahire and Ravichandran 2001).

Organizations need to decide how much focus they put on the quality of the process, and how much on the quality of the products (Neville 2004). As:

1. Process quality refers to things like applying proper project management practices to costs, time, resources, and communication etc. It covers managing changes within the project.
2. Product quality refers to the 'fit for purpose' aspect. It covers things like how well it meets the user's needs, and the total cost of ownership.

A high quality project may deliver low quality deliverables and vice versa. It is more likely however that a high quality project will deliver high quality deliverables (Ahire and Ravichandran 2001). It follows that if you were checking project quality you would look at completely different things than if you were looking at the quality of the product.

IT Project Basic Concepts

Warboys (1999) defines organizations as providing the context in which structures and processes are defined to meet customers' needs. The context is aimed at serving some well defined business domain such as to generate a reasonable return on investment for the stakeholders of an organization. Projects may then be defined as the undertaking of an activity to meet some specific goal in this organizational context.

IT projects are defined in two ways (Auditor-General 2000):

1. In business terms, "what it will do for the department and potentially the citizen";
2. In technical terms, "what it is as an IT system".

The definition of project success has been modified to include completion (Harold 2001):

1. Within the allocated time period;
2. Within the budgeted cost;
3. At the proper performance or specification level;
4. With acceptance by the customer/user;
5. When you can use the customer's name as a reference;
6. With minimum or mutually agreed upon scope changes;
7. Without disturbing the main work flow of the organization;
8. Without changing the corporate culture.

IT Project Management

Project management is "the application of knowledge, skills, tools and techniques to project activities in order to meet project success" (PMI, 2000, p.6).

Project Management is designed to manage or control company resources on a given activity, within time, within cost, and within performance. Time, cost, and resources are the constraints on the project as shown below.

Figure 1: Project management constraints

Project Management had its origins in the US defence/aerospace industries in the mid 50s. The core practices - at least as articulated in their current language - were largely formed on the Atlas, Minuteman and Polaris programs, with a huge added boost with the arrival of Robert McNamara at DoD in 1960 and the NASA Man-on-the-Moon programme in the 1960s (Peter 1997).

Project Management as a profession is itself about 25 or so years old. The Association for Project Management was founded in 1972, and the US Project Management Institute in the late 60s. The International Project Management Association was founded in the early 70s. For much of the next 15 or so years, interest focussed primarily on planning and control techniques, and on techniques of project organisation such as conflict management, project leadership, team building and matrix organisations (Peter 1997).

The four core knowledge areas of project management include project scope, time, cost, and quality management. These are considered to be core knowledge areas because they lead to specific project objectives. The four facilitating knowledge areas of project management are human resources, communications, risk, and procurement management. These are called facilitating areas because they are the means through which the project objectives are achieved (Schwalbe 1999).

Project management manages the process of meeting project requirements by applying the appropriate skills, tools, and techniques etc. Process management manages the definition, development and enhancement of processes by applying the appropriate skills, tools, and techniques etc. Project management itself is a process. It can be defined and implemented within an organization as a process (Harrison 2002).

IT Project Quality

Typically, the risks in an IT project are very high both because of its complexity and also because the context of rapidly-developing technology leads to a high degree of uncertainty. IT projects should have comprehensive formal quality management and risk management processes that are fully integrated within all aspects of project management. All personnel should have awareness of risk, and of the consequences of all their decisions and actions.

In an effort to codify project management as a profession, the Project Management Institute (PMI) has published "A Guide to the Project Management Body of Knowledge" (PMBOK). Of the nine knowledge areas outlined in the PMBOK, one is Project Quality Management, which includes the processes required to ensure that the project will satisfy the needs for which it was undertaken (PMBOK 2000).

A KPMG survey undertaken during 1992 found that 56% of companies in the UK believed that 'runaway IT projects' occurred frequently within their organization and 62% of the respondents had experienced such a project within the last five years (Yardley 2002).

The 1994 Standish Group reported a slight decrease in the number of US IT projects that were completed over budget or outside the original deadline. Still the figure does not offer too much hope - 46% of the projects were described as "challenged" (Yardley 2002).

Given the high incidence of IT project failure within the global business community, it should come as no surprise to even the most casual of observers that the subject is a popular and regular discussion topic within many of the current academic and industry journals. What is surprising, however, is the fact that the vast majority of these identify IT project failure purely in terms of exceeding budget, timescale and quality constraints; these are classic symptoms of project management failure, but are not necessarily symptomatic of project failure.

New Zealand has an even worse record than the USA (Anthony 2005). "New Zealand has some of the best talent in the world working on these projects but they're not doing it in any managed business process. While development methodologies abounded, projects often came to grief because of lack of integration between the efforts of those involved" (Anthony 2005).

High IT project quality is the correct and smooth running of an environment (and consequently the quality of the products produced therein). It depends significantly on the quality of the process in place there. Such an environment would simplify the evolution of project processes by providing methods, tools, and engineers to plan, enact, and change them. By tuning processes according to the needs of the project at hand and within impending constraints, there would be explicit control on the quality, budget, and schedules of the system being produced (Talha 2004).

As (Antonis and Ram 2000) illustrate, multiple stakeholders evaluate the quality of various IS products and processes under the influence of environmental, organizational, and departmental factors.

A skilled and experienced project manager is essential for IT projects. There are a limited number of good project managers in the New Zealand marketplace (Small 2000); hence in some instances an agency may have to recruit from overseas. Whilst the price of a good project manager may be high, project failure can be a far more expensive proposition. Project management frameworks and processes are now well understood and a number of educational institutions include project management in their curriculum. For example, many project managers are taking advantage of the PMI's training and certification programme. Chief Executives and

Sponsors should appoint appropriately qualified and experienced project managers for IT projects (Small 2000).

Quality Management (QM)

Quality management (QM) can be defined as systematic organization to ensure efficient execution of appropriate tasks to meet objectives (Taylor and Pearson 1994). Quality is then achieved when all activities are carried out to satisfy the total requirements of every customer, internal and external, present and future.

Quality Management refers to the strategic and widespread organisational adoption of quality techniques and policies. Quality management helps supervisors monitor projects to ensure that they meet their intended goals. Regarding PMBOK (PMBOK 2000), project quality management includes the processes required to ensure that the project will satisfy the needs for which it was undertaken. It includes "all activities of the overall management function that determine the quality policy, objectives, and responsibilities and implements them by means such as quality planning, quality assurance, quality control, and quality improvement, within the quality system. Project quality management must address both the management of the project and the product/service of the project. Quality must be planned in, not inspected in" (Yardley 2002).

The result of one survey done by the Overseas Development Institute (Bristol) (ODI 1987) shows that only two out of ten chief executives considered that their company had done everything to create an environment in which quality work could flourish (Ron 1989). This confirms that quality is much talked about but not always followed through sufficiently to ensure success. Every project should have a plan for quality. In reality, very few do. Two main reasons contribute to this situation (Neville 2004):

1. "It was too complicated to do a plan
2. They were overwhelmed by the jargon of quality in relation to compliance with standards, metrics and a range of acronyms that left them confused."

The major benefit of quality management is finding solutions to problems based on measurement and statistical analysis rather than judgements based on past experience. This is particularly important in a high technology industry where guesswork can lead to extra expense and further problems (Patrick and Gill 1995).
The central theme of QM is that solving problems at earlier "upstream" stages yields important savings for the company (Robert 1999). As one uncovers quality problems downstream, the costs multiply. A major characteristic of the new quality model involves seeing improved quality as a strong competitive strategy. Firms learn to strategically target those specific dimensions of quality that customers highly value, and they gain advantage over competitors in doing so. This could also increase market share, lower costs, and increase profits, with potentially higher wages and employment security for employees.

Juran (1989) describes an approach to quality management with three elements which he calls "the quality trilogy": quality planning, quality control and quality improvement. The three processes are defined as:

1. Planning: preparing to meet quality goals;
2. Control: meeting quality goals during operations;
3. Improvement: breaking through to higher levels of performance.

To improve a company's performance, all three processes of the trilogy must be active in all parts of the company.

By introducing the quality concept in the period from 1955 to 1980, Japan turned high quality into a strong competitive weapon and was extraordinarily successful. They made Japanese goods more competitive on world markets, which entailed removing the image of Japanese goods as cheap and shoddy (Robert 1993).

Since the mid-l980s New Zealand has undergone a revolution in economic terms, moving from a traditional social welfare mentality to one of global competitiveness. In the interests of reducing public debt the government has put in place policies that have halved interest rates, but conversely have increased unemployment to over 10%. As part of the restructuring, organizations have been downsizing their IS

human resources. Many IS staff are now self-employed consultants. (Monin and Dewe 1994).

By 2006, New Zealand is facing different challenges. Domestic developments have pushed quality to the forefront. Quality issues have been placed on the agenda, and quality issues are being discussed, but quality work has not necessarily been formalized. On the other hand, "management of quality" requires that strategies, goals and systems are part of the quality efforts of an enterprise. New Zealand companies have become increasingly aware of the costs of poor quality, but simply imitating Japanese quality approaches would not have real competitive consequences.

The purpose of this project is to provide information on the current perceptions of IT quality project management practice in NZ. The document is organized as follows:

1. First, review the literature for research that has focus on knowledge of IT project management.
2. Based on this review, a survey was carried out. The survey explored the current state of IT quality management in New Zealand.
3. Then, the research study was explained, followed by an analysis of the findings and a proposal for a model that simplifies and improves quality management for IT projects.

Expected Results

This research will, potentially, add to the body of knowledge and improve the state of quality management in NZ IT by:

1. Determining the state of project quality management in NZ IT practice and comparing it with overseas trends;
2. Developing a model or supporting tools that will simplify the initiation and on-going implementation of Project Management Quality Management within an organisation.

Research Questions

1. What is the state of QM in NZ IT projects, compared with other countries?
2. What factors affect the quality of IT projects in NZ and how can overall quality and project success rates be improved?
3. Do NZ organisations realise appropriate cost/benefit ratios from IT project Quality Assurance (QA), and so ensure that they are not 'over-spending' on achieving levels of quality that exceed their needs?
4. Can an improved IT project process quality methodology and/or management tool be developed to simplify the initiation and on-going implementation of Project Quality Management within an organisation?

LITERATURE REVIEW

Development of Quality Management

Lau, Zhao, & Xiao (2004) mention the movement of quality in their research. Inspection is the first step in the move towards quality. In the past, formal inspection procedures were used to make sure mass produced, standardized products were up to standard in terms of quality. Inspectors were specially trained to insure this quality remained high or up to the organisations standards, which were generally simple tasks that focused on narrow activities such as counting items, grading the items in terms of quality and sorting the items.

The second step is characterized by the application of statistical techniques, as process control charts and sampling techniques. The basic idea of using statistical quality control charts is to detect changes during the process with the mean or variability of products while production is still going on. This allowed continuous production, while quality checks were been carried out, if a problem arose, then the production could be stoped, the defect resolved and production then could continue. This reduced the amount of defective units are produced.

Quality assurance, which is the third step in the move towards quality. At this stage, quality professionals recognize the need for total quality control in all areas. All departments in the organization are now required to work together for the aim of quality.

Strategic Quality Management is considered to be the fourth step to develop quality. This stage, we try to recognize management's part in the strategic aspects of quality with the involvement of top management. Quality is playing an important part in

maximizing a firm's competitive opportunities, as international barriers decrease; companies needing more to distinguish themselves from their competitors.

In the early 1980s Hewlett-Packard criticized US chip manufacturers for poor product quality as compared to Japanese competitors which led Total Quality Management (TQM) to be developed. When Edward Deming first introduced TQM, the Japanese adopted the philosophy immediately, and made very successful progress in terns of quality. However till 1995, in the USA, domestic companies was still struggle (Talha 2004). Although TQM came into fruition in Japan almost twenty years ago, its introduction into the United States occurred only as recently as the early 1980's. Widespread recognition of this new management philosophy took place in the late 80s and early 90s (Dellana and Wiebe 1992). The terminology of TQM also brings in expressions such as "continuous improvement", "customer focus", "empowerment of the worker" and "supportive business culture".

Quality Assurance (QA)

QA refers to "the activities performed to provide adequate confidence that a product or service will meet established requirements" (Battikha 2003).

QA is generally taken to refer to the establishment of documented procedures, often based on national or international standards which are designed to ensure that products or services meet specified requirements. The term began to be used in professional journals in 1967 (Patrick and Gill 1995). QA would normally be assigned to a specialist group who would be given responsibility for independent inspection and the removal of items which failed to meet customer specifications. Historically, QA activities have tended to dominate in manufacturing and testing areas and, particularly, in defence-related products (Patrick and Gill 1995).

QA processes are put in place to ensure that processes are followed, it helps ensure that people are doing the right things the right way, it gives guidelines and rules to follow so that if a process fails there are other process in place to correct or address the issue in order to resolve the problem to everyone's satisfaction. The QA team's

job is to see that standards, processes, and policies that are in place are carried out correctly, to recommend, up date, and to ensure that the people involved are aware of the process and changes. Reviews are put in place to determine the efficacy of QA.

Quality Control (QC)

QC is one of the critical components of project quality (other components are quality planning, QA and quality improvement). QC allows monitoring project results in detail to see if they are in line with the relevant standards of quality, they are also there to find and remove the causes of performance that are considered unsatisfactory (PMBOK 2000).

QC became recognized as a discipline during World War Two. In the early 1950s, American industry rejected the concepts of Deming and Juran, who took them instead to the devastated economy of Japan. Deming introduced statistical quality control to Japanese manufacturers. Nearly two decades later, pushed by world competition, Americans began to recognize the need for a new and better understanding of quality. Speaking about the ever-growing competition in the world market, Deming said of America: "The choice is very simple. If we are to become more competitive, then we have to begin with our quality." In 1984, quality reached the height of visibility when President Ronald Reagan proclaimed October as "Quality Month," saying that he hoped it would signal "to the American people the importance of top quality in all we do" (Brenda 1992).

QC is based on the development of statistical techniques for measuring actual quality against established quality standards. In the Post-War period, the use of these quality control methods was limited, with American industry placing an emphasis on quantity rather than quality. British management was reluctant to adopt and adapt these techniques, and Australian manufacturers were concerned about the cost of preventative quality control practices (Patrick and Gill 1995).

Total Quality Management (TQM)

With the continuing development of the principle of QC, researchers claim that quality systems will reduce costs in the long run and that quality should be a responsibility of everyone in the company rather than just a small group of specialists in the QA department.

So, the development of QC has historical connections both with QA and the more recent developments in TQM.

TQM means quality as a system approach, by using all functions of the organisation as a process, and using them at every structure of the organisation (Battikha 2003).

TQM is a term which came about in the 1980s to refer to quality techniques and policies been adopted by the whole organization (Patrick and Gill 1995). TQM incorporates both service and manufacturing industries and is a company-wide change strategy which is no longer the sole preserve of production and/or operations managers or QA departments. The Idea came from America, yet was quickly developed by the Japanese, and it is now a central part of strategic decision-making in companies all over the world including New Zealand (Patrick and Gill 1995). Table 2 presents a comparison between the approaches of TQM and traditional management (Mohanty and Sethi 1996).

Table 2: Contrasting management paradigms (Mohanty and Sethi 1996)

Criteria	Traditional approach	TQM approach
Orientation	End results	Improvement of means
Means of improvement	Hi-tech machines; Better materials; Specialization; Cost reduction.	Involved and trained workforce; Innovation.
Emphasis	Profit; Market share; Turnover.	Quality; Market creation and development.
Strength	Capital; Technology.	Knowledge; Flexibility.

QC *vs.* QA *vs.* TQM

QC *vs.* QA

Many people are confused about QC and QA. QC and QA are different.

The main difference between QC and QA is that QC is about total employee commitment to the achievement of quality from the identification of customers' requirements through to product delivery. QA is about establishing documented procedures to ensure that products or services meet certain specified standards (Patrick and Gill 1995).

"QA is process oriented and QC is product oriented". Testing is QC as it is product oriented. Testing for quality is a detective measure, so it does not insure quality. Insuring that you are doing the right things, the right way is QA. Producing the results that are what they are expected to be is QC (Hillel 2003).

QC is the process of examining your output for minimum levels of quality in some dimension. The QC team does not actually improve the quality; they just stop production when the measured quality drops below a given limit. To restart production, the source of the quality problem must be identified and fixed, but this is beyond the responsibility of the QC team.

What does it mean to say that "assurance" is process-related and "control" is product-related? "Assurance" means everything that was needed to be done to assure things work correctly, was done, "control" means that your actions able to be evaluated until each item is examined. As for software project management, QA means that the code you are writing meets the requirements; finding that the process of the code writing was not adequate to reduce problems along with your features is QC. QA is more strategic and QC is more tactical.

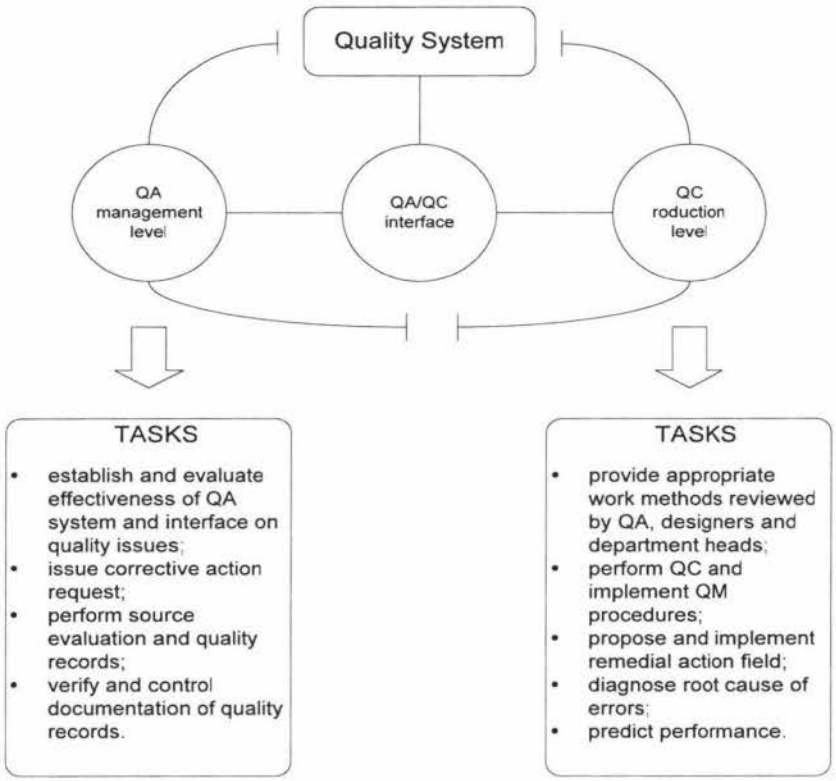

Figure 2: Tasks of QA and QC in quality systems (Battikha 2003)

QC *vs.* TQM

The main difference between QC and TQM is that TQM is a broad application, which is based on a general philosophy for involving employees in pursuing quality objectives, whereas QC rather focus more on manufacturing industries, by the means of statistical techniques. Another difference is that TQM programmes tries to increase employee commitment and tries to produce higher trust relationships by relying on techniques more heavily to achieve this (Patrick and Gill 1995).

QA *vs.* TQM

The main differences between, QA and TQM control processes are where each of them is focused. Conformance is where QA control processes are focused on, and improving customer satisfaction is what TQM processes are focused on. This shows us that the QA process is static in nature, and TQM process is as dynamic as customers' needs. Both QA and TQM processes focus on prevention and they do

this by emphasizing management's role in providing the skills that will "build-in" quality to the organization. However, delegation of authority by management is an important input in the TQM control process which creates reinforcement of supporting TQM cultural values, while in the QA control processes it is restricted to "systems". In QA, supervision and corrective measures are only enforced by managers, in TQM however, employees have been empowered to check performance of themselves and their peers and take corrective actions. Documents and systems are what used to enable workers to conform the standards in the QA processes. Continuous improvement and customer satisfaction and in the TQM process relies heavily on culture (Naceur 2002).

Table 3: Differences between the QA, QC and TQM

	QA	QC	TQM
Focus	Conformance to standards	Statistical techniques	Customer satisfaction; Continuous improvement
Nature	Static	Static	Dynamic
Management Role	Establish documented systems; provide training and resources; supervise employees	Total employee commitment to the achievement of quality	Empower employees by infusing TQM values and providing resources, know-how, systems, and delegating authority
Employee's Role	Conform with document standards	More of using tactical techniques	Participate in setting standards, searching for new improvement, checking performance and correcting actions
Main Enabler	System and process documentation	Product orientation	TQM culture values

TQM Main Elements

TQM now means good management team as seen by top business executives (Schonberger 1992). Getting employees focused on continuous improvement, TQM is now acknowledged as a set of concepts and tools for this purpose, and is stated in the mission and quality statements of many successful businesses around the world.

TQM combines the use of computerised data collection and statistical experimentation with a focus on teamwork, group participation and a culture of continuous improvement in operating systems (Robert 1993).

Customer Focus

Internal Customers

Customers are all those to whom we supply products, services and/or information. They may be internal or external to the organization; external customers include people within an organization to whom we supply or from whom we receive products, services and/or information (Robert 1993).

Deeper and stronger customer relationships are been sort after by companies as it increases the chance that the customers will come back to the same company to do business. As a result of this companies are adopting a new strategy in the way they are marketing themselves and their products, by focusing on a particular target group of people and concentrating been better than their competitors in that target group.

Companies are doing more and more research on their customers, and therefore increasing their database on them. A good sign of an effective database about its customers will allow a company to better understand the customers' needs and wants, and to be more effective than their competitors. There is much data that can be collected about there customers that could give the company a competitive advantage, some of these would be past present trends of customers' business, industry, and market shares profitability etc. This data allows companies to focus its limited resources, such as money for advertising, on today's key customers, while trying to develop new relationships with tomorrow's customers. This data can also allow us to budget for the future by calculating the revenue that future customers will generate, and estimating other future investment opportunities.

Customers expect the firm to do the right thing the first time. If an organisation does not ensure customer's satisfaction, it will have a negative effect and customer confidence will decline and so to will customers in general (Kandampully and Menguc 2000).

According to Deming (1986) the profit is the reason for a firm's existence and to get this you need customer. If an organisation wants to keep its customers, then it should care about them or at least be perceived as to care about them.

It is believed that firms should be giving customers the best product that they produce (Deming 1986). Firms should deliver the best value to customers.

Competition plays an important role in business, and firms need to be aware and understand their competitors, what is attracting customers to them, why are they not coming to your business (Deming 1986).

Firms should continually add real value to their products (Deming 1986). Firms should add value by improving their product. Firms should challenge themselves and their employees in the consistent hunting of improvement in every phase of the business.

Deming's (1986) argued competitiveness depends on customer satisfaction. Quality is the fundamental customer requirement, where their needs and wants are met by continuous improvement of products and services, as well as building an ongoing positive relationship with the customer.

Sunil and David hold the same opinion as Deming. They say that firms should provide their customers with the same quality of service that they would like to receive themselves (Sunil and David 1994).

Some firms ask their customers through various methods such as questionaries and follow up interviews if the product or service that they purchased meets their expectations. Even the most successful companies motivated by listening to their customers about their products (Sunil and David 1994).

Firms should not just satisfy for being as good as their competitors. Being "as good as the competition" is not a winning attitude (Sunil and David 1994).

With the compel for improvement, firms should focus not just on the product they deliver, they should add value by lowering costs (Sunil and David 1994).

Marketing is about how to combine the customer needs, wants and expectations into the design of the product/service while designing a systematic process that will allow the customer business relationship to grow. Companies are in a competitive environment and have to work hard added value as not only are the customer's ideas evolving but also business have to keep up with their competitors. Business have to involve all the stakeholder (e.g. suppliers, end users, and distributors) to find new ways to run the business more efficiently not only for themselves but so as to reduce costs which in turn will be passed down to the customers through a reduction in product and service costs (Mosad and Torbjörn 2001).

The objective of TQM is increasing customer's satisfaction (Dean & Bowen, 1994; Youssef & Zairi, 1995). Deming considers the most important part of the production line is customers (Scherkenbach, 1986). Customers are the cause for product development and improvement. There is no reason to produce high quality product or services if it doesn't meet customers' needs and wants, if they do it be a waste for the organisations time, money and effort.

The company can develop an effective way for establishing and maintaining a relationship with consumers, by renewing or improving their management and marketing and services in a more systematic manner.

As shown in Figure 3, the total quality of a product/service is broke down into three dimensions, which are: technical quality, functional quality, and image and positioning.

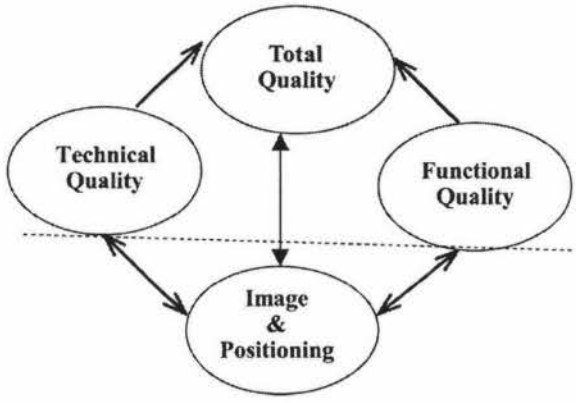

Figure 3: Three quality dimensions and positioning (Mosad and Torbjörn 2001).

The maintenance of the customer relationship is depending on the degree of a product and service measuring up to the customer's expectations. Total quality is a function of these three qualities (Mosad and Torbjörn 2001).

1. Technical quality of the service ('what' quality), i.e. what a customer buys and whether the product/service fulfils its technical specifications and standards. The technical elements concern the manufacturing interface.

2. Functional quality of the product/service ('how' quality). The functional quality concerns how the company delivers the product/service.

External Customers (Suppliers)

Supplier quality has a large and direct impact on the quality positioning of reseller organizations. The growing attention given to this area of quality management reflects an understanding that a firm's quality performance (output) can only be as good as the quality performance of its suppliers (input) (Sonny, Ben et al. 2002). Paradoxically, the impact of supplier quality on quality performance of organizations has received limited attention (Forker 1999). A general graphical interpretation of the foregoing definitions is depicted in Figure 4.

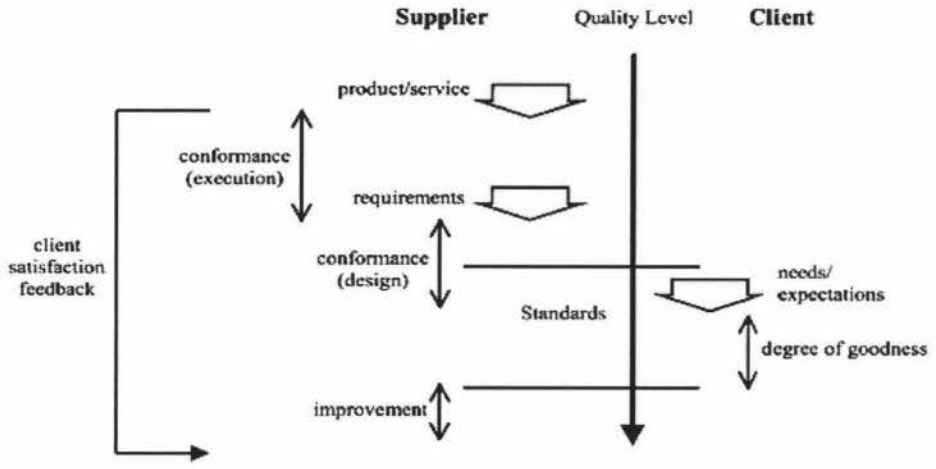

Figure 4: Interpreting quality definitions (Mireille 2003)

Continuous Improvement (CI)

In the mechanistic world, stability is prized because it increases predictability, which, in turn, increases control. Users of TQM, however, endorse a philosophy of continuous improvement (Spenser 1994).

TQM is a philosophy for management which seeks improvement on continuous basis in the quality of the products, services and processes, of an business (Brown 1994). It emphasizes the importance of measurement, the understanding of variation, the role the customer plays and the roles employees play at all levels of the business to pursue improvement.

CI is an organization-wide process focused on constant innovation sustained over a long period of time. It means improve products or services, as well as overall customer relationship. CI is considered an essential part of TQM (Deming 1986). It is also says that continuous improvement increases employee involvement in decision-making (Hill and Wilkinson 1995).

The CI principle is concerned with the elimination and reduction of waste. We define waste as anything used over the minimum amount of equipment, materials, parts, space, and workers' time, which are to produce or add value to the product (Kerry and Ronald 1995).

Businesses should be improving processes and procedures on an ongoing basis to increase or maintain a competitive edge in all areas such as product quality, costs, both to customers and suppliers, delivery times using Just in Time systems (JIT), increase productivity, and a reward and recognition system for employees based on their teams achievements (Hussein 1993).

The global competition has led to even larger interest for continuously improving products, services and processes (Garvin 1987; Flynn, Schroeder et al. 1994; Ahire and Ravichandran 2001). With many existing tools to achieve CI, including statistical methods and benchmarking, but the main requisites is a supporting culture (Hyland, Ala-Kokko et al. 2000), "a conducive structure and supportive leadership" (Hyland, Ala-Kokko et al. 2000). An emphasis on CI is the ultimate test of a world-class organization (Kerry and Ronald 1995).

CI is done by those employees in the process to satisfy an internal customer introduces elements of "bottom up" identification of issues and problem solving which contrasts with "top down" traditional management. When issues require collecting data or change elsewhere in the quality chain, then the quality improvement will have horizontal dimension that will further increase the scope of jobs at any level in the organization (Hill and Wilkinson 1995).

There does not have to be an existing problem to improve something. CI can be used to analyse, innovate and improve administration, service and manufacturing (Gobeli 1991).

As shown in Figure 5, the key elements of CI are (Ghobadian and Gallear 1997):

1. The direction of the organization focus – this should be external, aiming to meet the needs of the customer;
2. A process focus around the outcome requirements rather than the tasks;
3. A people focus; and
4. Communications and measurements.

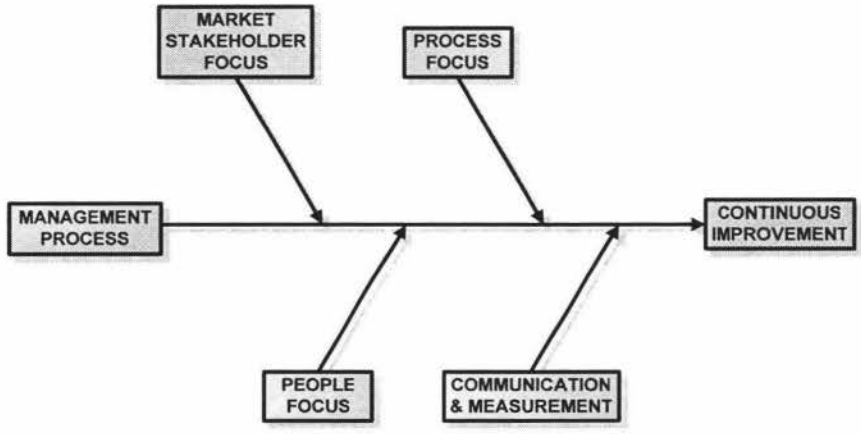

Figure 5: The salient elements of continues improvement implementation (Ghobadian and Gallear 1997)

Process Control

Businesses should eliminate the need for quality inspectors, by transferring responsibility of the quality, to the workers on the line, manage by data and force or encourage compliance, implement statistical process control at every level, try expose problem areas, analyse problems using quality tools , stop the production line to execute corrective actions to reduce waste, and continuously measure quality indices wherever cost effective (Hussein 1993).

Translation of the TQM philosophy into practice normally centres on the use of a few key quality improvement tools. Lists of typical tools associated with TQM and described in the open literature are shown below.

Inspection – "Activities such as measuring, examining, and testing are undertaken to determine whether results conform to requirements" (PMBOK 2000).

Pareto Analysis – "Pareto charts are useful because they allow us to identify factors that will have the largest effect on the system, and thus allow us screen out the less significant factors or irrelevant factors in the analysis. This allows the user to pay more attention on important factors in a process rather than receiving large amounts of data to sort through. This is created by plotting the

cumulative frequencies of the relative frequency data (event count data), in descending order. This will show us, the most essential factors in the analysis, as they become graphically apparent, and in an orderly format "(Leroy 1995). Pareto analysis diagrams are also used to determine the defect of corrective action, or to analyze the difference between two or more processes and methods.

Quality Control Chart – The use of control charts focuses on the prevention of defects, rather than their detection and rejection. There are many costs in labour, materials, facilities, and the loss of customers. The cost of producing a proper product can be reduced significantly by the application of statistical process control charts (Harold 2001).

Six-sigma – ($\overline{X} \pm 3\sigma$) represents the standard deviation for control charts. Some companies like Motorola have embarked upon a six-sigma ($\overline{X} \pm 6\sigma$) limit rather than a three-sigma limit. With a six-sigma limit, only two defects per billion are allowed, but the cost can be extremely expensive (www.motorola.com).

Cause and Effect Diagram – also called as Ishikawa diagram (or fish bone diagram), as you can see by its design, it looks like fish bones, and is used to show multiple possible causes to one single effect. It gives us a way to see a particular effect, and the possible causes for it. (Leroy 1995).

Six steps – Six steps are used to perform a cause and effect analysis (Harold 2001): Step one: Identify the problem; Step two: Select an interdisciplinary brainstorming team; Step three: Draw problem boxes and prime arrows; Step four: Specify major categories; Step five: Identify defect causes; Step six: Identify corrective action.

The purpose of the basic control process is to ensure that something actually conforms to planned activities. Perhaps the most popular definition of control is (Naceur 2002):

> "Management control is a systematic effort to set performance standards with planning objectives, to design information feedback systems, to determine whether there are any deviations, and to

measure their significance, and to take any action required to assure that all corporate resources are being used in the most effective and efficient way possible in achieving corporate objectives."

Many TQM experts have not addressed the control process. The Feigenbaum control process is seen to be more relevant to quality management than this basic control process, though its "roots" in this basic process are obvious. The process includes the following four steps (Naceur 2002):

1. Setting quality standards;
2. Appraising conformance with these standards;
3. Acting when standards are exceeded; and
4. Planning for improvement in the standards.

Manufacturing organizations are under an increasing pressure to increase efficiencies, lower costs, and improve quality due to growing global competition. Organizations have been implementing a lot of different quality improvement processes in order to control and reduce these dynamic pressures. Internationally known quality experts such as Deming, Juran, Crosby, are strongly encouraging all organizations to support and develop a continuous improvement culture to increase total quality. To allow the TQM process to be set in motion, organizations must (Longenecker, Scazzero et al. 1994):

1. Develop a long-term commitment to the process of CI;
2. Provide the resources necessary to improve quality;
3. Establish clear performance standards at all levels in the organization;
4. Train managers and workers in the process of corrective action;
5. Track performance and provide continuous feedback;
6. Fix problems across the organization that have an impact on reliability and quality once they have been identified.

The results of a typical TQM implementation in the organization can usually be observed with relative ease in the form of items such as reduced scrap and fewer customer complaints. If the results are not satisfactory, a modified approach, perhaps using new tools, can be implemented.

Quality Training

Quality training seems to be essential to TQM successful implementation and operation; some even describe it as a cornerstone.

Introducing TQM into an organisation needs an increase in training effort, this is for several reasons. First, to provide training in job roles, equipment use, so that employees can identify improvement opportunities. Secondly, equipping people with the tools and techniques of quality improvement is needed, including establishing quality improvement teams. Thirdly, cultural change is needed to develop appropriate attitudes and values relating to quality. Finally, awareness programmes are needed simply to inform people of what TQM is, how it can be introduced and what it can do (Brown 1994).

The existing survey research suggests that quality training is far from universal. Research by Dale et al. (Dale, Van De Wiele et al. 1993) shows that, from a mainly UK and Netherlands sample of organizations, only 44% actually had a formal TQM training programme.

A UK survey by (Yong and Wilkinson 1999) found 30% of organisation who's managers implemented TQM had felt that their training was inadequate or had no training at all. TQM training and support in service industries lagged behind other sectors, this maybe however due to the high staff turnover that the service industries had which would explain why managers were reluctant to invest in the quality training as it may not have been cost efficient.

Deming has established a 14 points system for managers; this includes two which are directly related to training. The first, point number 6, is "institute training". To quote Deming, "Too often, workers have learned their job from another worker who was never trained properly. They are forced to follow unintelligible instructions. They can't do their jobs because no one tells them how" (Deming 1986). If TQM is introduced into an organisation, it may expose organizational inadequacies in training. The second Point number 13 is, "Institute a vigorous program of education

and training", where "both management and the workforce will have to be educated in the new methods, including teamwork and statistical techniques" (Deming 1986). TQM requires that there is more training every aspect of job competencies and secondly, specific TQM elements (Brown 1994).

There has been much criticism of the nature of TQM training. Much of TQM training in the Europe and UK tends to be concentrated on tools and technique areas (Dale, Van De Wiele et al. 1993). In contrast, Olian & Rynes' (1991) USA research found that the most common training content tended to be, running meetings; interpersonal skills; statistical analyses; teamwork; supplier training, quality improvement processes, problem solving; and benchmarking. The TQM theory seems to be emphasis on scientific method and "management by fact", and such a large emphasis on training programmes is justified. However, teamwork processes and interpersonal skills, especially in services, TQM seams to focus more on yet there is little evidence that employees actually utilise the statistical tools and techniques available to them (Hackman and Wageman 1995).

Employee Empowerment

TQM is often represented by the power it gives employees at work. TQM makes available employees' knowledge about improvements in work processes (Patrick and Gill 1995).

As organizations have grown larger, supervision has become more important and more difficult. Problems of inflexibility and supervision have developed with size and human relationships. TQM is designed to overcome these problems by empowering employees to play a more active role in process improvement and quality monitoring.

According to the mechanistic model, employees follow orders and carry out specialized tasks within narrowly specified positions. TQM practice clearly broadens employees' roles by allowing them to control their own actions and by providing them with accurate data and problem-solving skills. As a result, employees are treated

less like common machine parts, and more of their intelligence and unique human qualities are brought into play (Spenser 1994).

Empowerment is described as a way to enable employees to make decisions by themself (Bowen and Lawler 1992). Empowerment is one of the main elements of TQM (Flynn, Schroeder et al. 1994; Ahire and Ravichandran 2001). Indeed, studies on empowerment expose that it is directly associated with employees' satisfaction (Parker and Price 1994). Empowerment is crucial to pursue external customer satisfaction (Sitkin, Sutcliffe et al. 1994). Empowerment should be sown into the culture and structure of the very organisation, for external customers will not be satisfied if those who they deal directly with can not respond to their needs and wants.

In research done about Chinese companies (Hongyi 2000), the "total" refers to the participation of all staff in the organization. We can see the TQM philosophy here in with employee involvement. However, this has lead to neglected areas such as supplier and customer involvement and participation in the quality management process. This has resulted in many Shanghai companies shifting to customers and suppliers. Participation and involvement should still include managers. It has been found that in many joint ventures there is the lack of experienced and skilled employees, especially managers with a good knowledge of quality management.

TQM's employee involvement represents a sharing of administrative power on matters concerning improvements in work flow and operations management. However, this form of employee involvement can not be regarded as a major extension of industrial democracy. Under TQM policies, employees are not necessarily involved in strategic decisions or major areas of company policy-making. TQM allows employee participation in low levels of decision-making, primarily in an advisory rather than a deciding role (Patrick and Gill 1995).

Top Management Commitment (Leadership)

Leadership involvement is of paramount importance to TQM, since top executives are often committed to the status quo, and also because they ultimately determine the priority of the organization's decisions (Dyba 2005). Dyba also defines involved leadership as the extent to which leaders at all levels in the organization.

Close scrutiny invariably identifies the underlying reason for failure to properly adopt the TQM concept as a lack of support from top management (Laszlo 1997).

A key tenet in TQM is the need for the chief executive and senior management team to create the right organizational climate, values, behaviour and culture for TQM (Crosby 1980; Ishikawa 1985; Deming 1986; Juran 1989).

Each project with in an organisation is organised around a quality management team and the size of each group is corresponding to the size of the organisation structure. There are three important types of people that should be included in team, firstly the executive manager of the company, secondly, middle management of the company that are responsible for the internal project, finally at least one person representing the "workers".

As well as the management group, there should be a programme coordinator, who acts as a connection between the management group and the project activities in the company (Ghobadian and Gallear 1997).

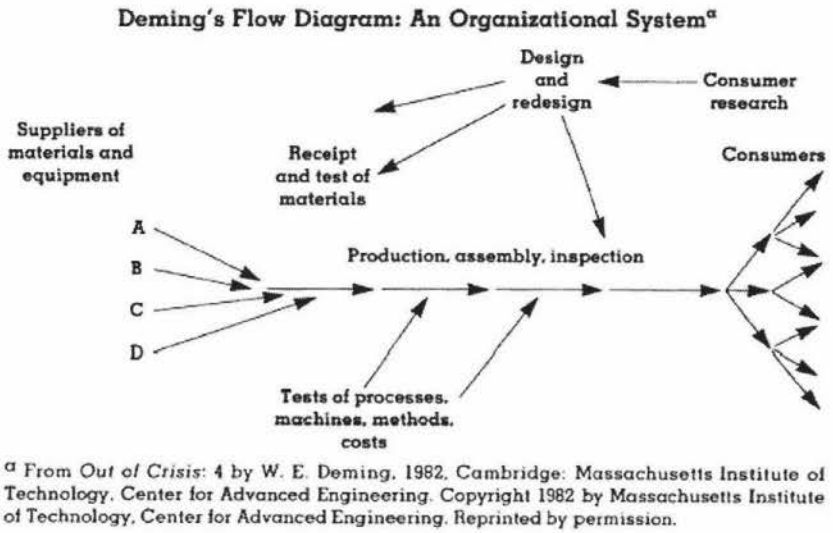

Figure 6: Deming's Flow Diagram (Spenser 1994)

Classical management theorists define management's role according to principles: managers lead rather than plan, empower rather than direct, partner rather than organize, and assess rather than control. Their roles are redefined from directors who give orders to designers who create visions and establish systems (Spenser 1994).

The Management of Culture

Implementing quality management is not just simply installing systems and procedures; it's about the cultural changes within the organization. When TQM is put in place then this idea must be kept in mind. TQM needs a supportive culture to work properly. It needs to emphasize teamwork, continuous improvement, employee participation and empowerment, a customer focus and the appropriate leadership (Brown 1994). However, culture change does not take place quickly.

In the mechanistic model, organizational structure is viewed as a vertical hierarchy or chain of command whose major objectives are accountability and control. Division of labour serves as the primary means of attaining performance goals and ensuring technical rationality. Supervisors attempt to optimize subsystem performance by controlling activities within functional areas. Coordination between functional groups is handled by hierarchical referral (Spenser 1994).

TQM differs from this chain-of-command orientation because it includes a horizontal design based on the flow of work processes across the organization. Boundaries between functional areas are eliminated to ease coordination (Spenser 1994).

The bureaucratic perspective on management focuses on the establishment of administrative controls. Such controls lie at the heart of our ability to build formal organizations with the capacity to co-ordinate the activities of large numbers of people to achieve specified goals. It defines management as a formal structure of rationally designed technical, bureaucratic and financial controls. Management is an instrumental tool, a means to obtain the efficiencies needed to achieve organizational goals (Patrick and Gill 1995).

Management needs construction of moral systems of meaning and value rather than the traditional approach of being concerned with bureaucratic administration, establishing systems or political accommodation (Patrick and Gill 1995). It is important that the culture differences between different organizations and nations be assessed, and their impact on economic performance.

TQM is anti-bureaucratic; it helps to conceptualize organization in non-bureaucratic terms by focusing attention on market and customer relationships, rather than hierarchical administrative ones. It dissolves rigid organizational boundaries and ends the distinction between the extra-organizational world of markets and the inter-organizational world of administration (Patrick and Gill 1995).

TQM is the first managerial movement that has specifically considered culture to be developed in an organization. TQM values the continuous improvement of systems and warns against valuing or judging individual performance. It advocates the use of employees to suggest and implement improvements, rather than leaving managerial problems to be owned by top management alone. These practices are intended to build a more positive and unified culture, embedded with common values of commitment to continuous changes. The intention is to create a homogenous culture which supports managerial innovation, an integrated culture in which distrust and segment competition within the organization is overcome.

TQM implementation situations can be quite different, depending on the varying sizes of the organizations (Ghobadian and Gallear 1997), because of the different characteristics shown by organizations of different sizes. These characteristics are shown below, and will affect the implementation of quality programmes.

Table 4: TQM implementation situations depending on sizes (Ghobadian and Gallear 1997)

Large organizations	Small and medium-sized organizations
Structure	
Hierarchical with several layers of management	Flat with very few layers of management
Clear and extensive functional division of activities. High degree of specialization	Division of activities limited and unclear. Low degree of specialization
Rigid structure and information flows	Flexible structure and information flows
Top management a long distance away from the point of delivery	Top management close to the point of delivery
Normally slow response to environmental changes	Normally rapid response to environmental changes
Procedures	
Activities and operations governed by formal rules and procedures. High degree of standardization and formalization	Activities and operations not governed by rules and procedures. Low degree of standardization and formalization.
System-dominated	People-dominated
Rigid and unadaptable processes	Flexible and adaptable processes
Behaviour	
Mostly bureaucratic	Mostly organic
Strong departmental/functional mind-set	Absence of departmental/functional mindset. Corporate mind-set
Processes	
Extended decision-making chain	Short decision-making chain

Complex planning and control system	Simple planning and control system
Strategic process generally deliberate and formal	Strategic process incremental and heuristic
Formal evaluation, control and reporting procedures	Informal evaluation, control and reporting procedures
People	
Individual creativity stifled	Individual creativity encouraged
Dominated by professionals and technocrats Individuals normally cannot see the results of their endeavours	Dominated by pioneers and entrepreneurs Individuals normally can see the results of their endeavours
Training and staff development is more likely to be planned and large scale	Training and staff development is more likely to be ad hoc and small scale
Specified training budget	No specified training budget
High degree of resistance to change	Negligible resistance to change

Information System Usage

The use of computerised information technology to provide constant up-to-date statistics on performance and the achievement of quality standards can be seen as a technique. It ensures that employee performance is constantly under managerial review. TQM is designed to ease the flow of productivity-relevant information around the organization. Both management and employees should become more informed (Patrick and Gill 1995).

Several studies indicate that poor, incomplete, late or missing information is perceived as the most serious quality problem. Information should not be treated as a mere by-product of various activities but with the same seriousness as products (Paul 2003).

One significant difference between the bureaucratic task controls of TQM and the older methods of measuring performance is in the use of electronic information

processing technology. Computer technology extends the types of data that can be collected and distributed for monitoring performance (Patrick and Gill 1995).

Cost of Quality (COQ)

The cost of quality was originally expressed by Juran and Gryna. Quality costs are essential because each dollar and labour hour can be used for making better products than spent on rework. The costs of quality can be divided into two major types: conformance and non-conformance. The cost of conformance is "the amount spent to achieve quality products". The cost of non-conformance "includes all expenses that are incurred when things go wrong" (Slaughter et al., 1998).

One of the most important tools necessary for the successful implementation of a quality programme is quality cost (Laszlo 1997). A major benefit of employing a quality cost approach to quality improvement is that it provides a method to monitor the pertinence of projects to the overall goals of the organization.

The main goals of quality management are customer satisfaction by delivery of defect-free products, the reduction of defect rates and also of quality costs in the production. Some processes can become uncontrolled and the defect rates may go up. The quality costs are the "measurement system" to compare the different inspection strategies with each other.

Using Cost of Quality is an effective tool in implementation of a TQM approach (William 1989).

Quality costs are defined as (Juran 1989):

1. The costs of prevention;
2. The costs of appraisal;
3. The costs of non-conformance.

Cost of Quality is the systematic identification and classification of the work performed by an organization in terms of what caused it to occur and whether its expenditure and results were productive or non-productive in the pursuit of business objectives (Grunenwald 1989).

Cost of Quality is step one, the establishment of a baseline. A baseline tells us where we are, and provides a benchmark from which to begin.

The baseline should (Grunenwald 1989):

1. Be expressed in terms of effort and costs;
2. Be structured so that the non-value added activities are identified in terms of results (start over, redo) and cause (math errors, failure to communicate);
3. Allow for easy prioritization of areas representing the best "opportunities for improvement";
4. Be useful not only as the factual basis on which to establish an action plan, but also as an ongoing management tool for measuring progress and further identification of opportunities;
5. Provide a total picture of the organization, as well as insight into lower level segments.

Also the goal of quality improvement is to minimize inefficiencies and waste. Rather than focussing on using some measures to cut the costs, it is better for management to apply a value-added approach among staff to challenge each of them to review their own operations to evaluate the benefit provided to internal and external customers. The basis of this concept is to focus attention on adding value in contrast to cutting costs. The inherent benefits associated with the concentration on adding value stem from the direct linkage of such projects to increasing customer satisfaction and shareholder value (Laszlo 1997).

In software development, total quality costs are the sum of conformance and non-conformance costs. As shown in Figure 7, total quality costs and non-conformance costs per line of code decrease over the processes of the project (from $46 and $32 per line of code to $23 and $9 per line of code at the end of the project). While, conformance costs show to be mostly fixed over the project (Slaughter et al. 1998).

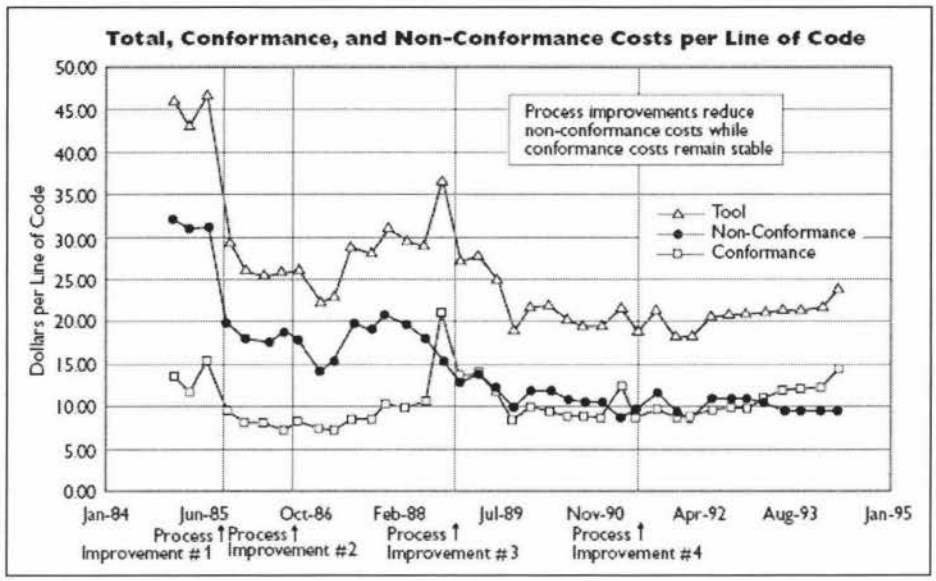

Figure 7: Total, Conformance, and Non-conformance Costs per Line of Code (Slaughter et al., 1998, p. 71)

Quality Management Models

TQM programmes are an essential approach to management for improving overall organization effectiveness (Bishnu & David 2001). Another important character of the new quality model will be all-employee, all-department involvement in quality improvement. All employees, individually and in work teams, are expected to participate in improving the quality of their work processes so that they more efficiently and effectively serve internal and external customer needs (Porter & Parker 1993).

Probably one of the earliest models for quality implementation is the "Deming Circle" (Figure 8) which introduced the "plan-do-check-act" approach. It encourages processes to be planned and audited, and then to be improved the next time around. As a result, a drive for continuous improvement is emphasized (Blades 1995).

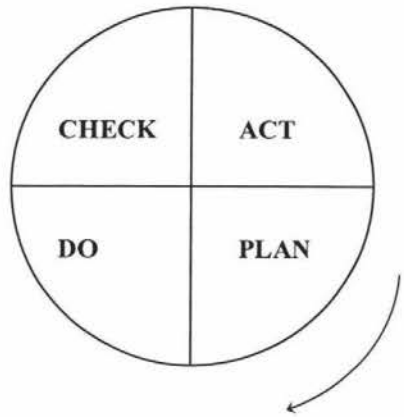

Figure 8: Deming Circle

From the case studies of Ghobadian & Gallear (1997), steps required for the implementation of TQM in SMEs were recognized. Figure 9 describes the ten steps.

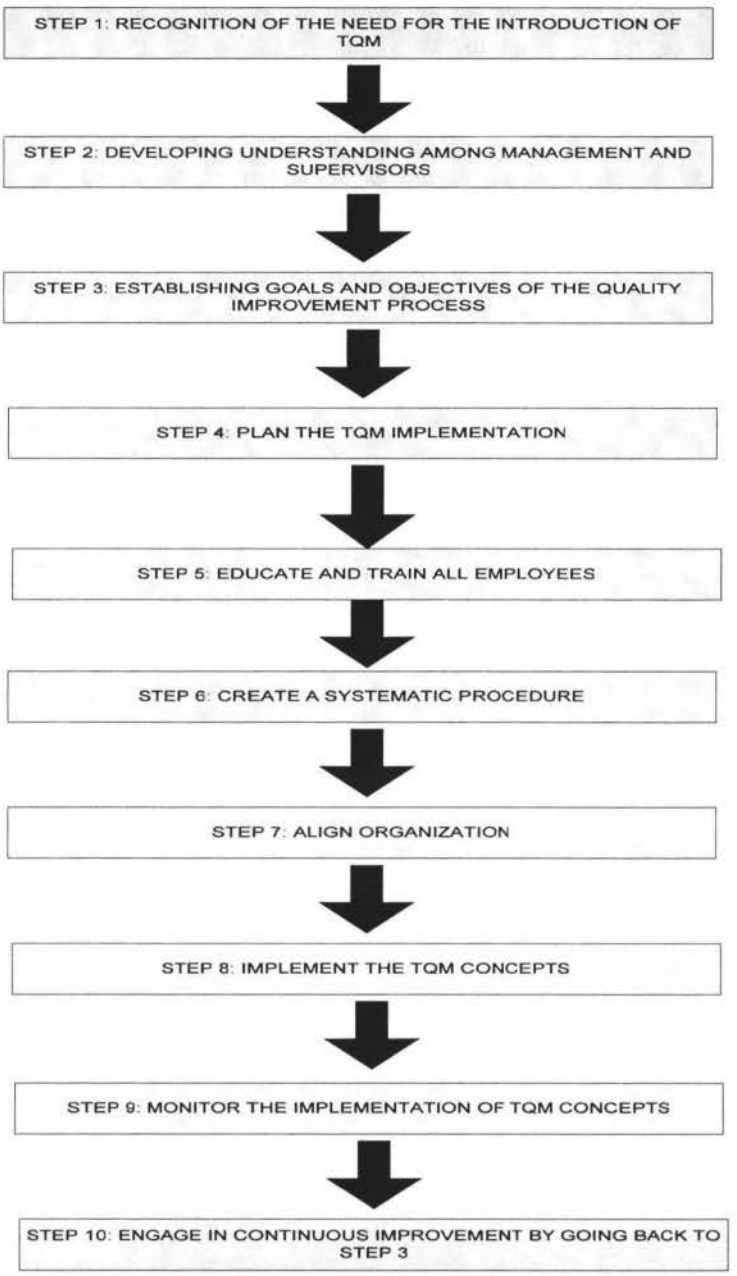

Figure 9: A framework for the implementation of TQM in SMEs (Deming, 1986; Ghobadian & Gallear, 1997, p. 158)

Develop a deep understanding of the TQM philosophy is the first step, and its implementation requirement is the second step. The completion of the second step will enable management to establish the objectives of the quality improvement process more practically. Steps 5, 6 and 7 are part of the implementation process. Step 8 is self-explanatory. Step 9 states the obvious (Ghobadian & Gallear 1997).

CMM

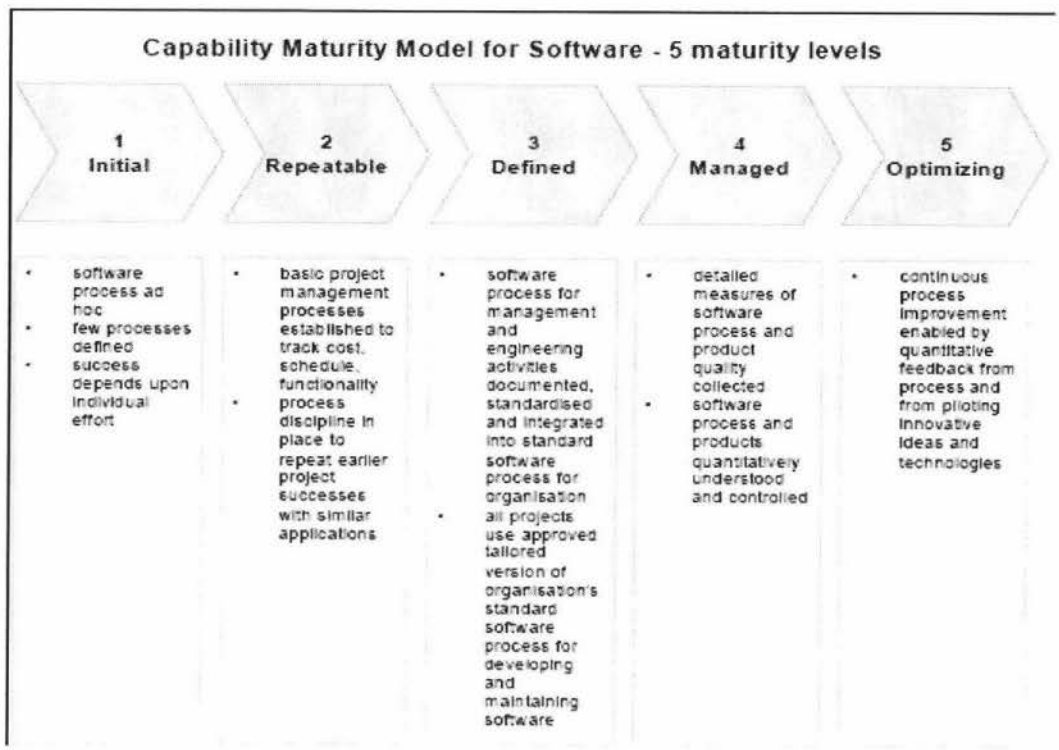

Figure 10: The Structure of the Capability Maturity Model (Mark et al. 1993)

CMM, stands for the Capability Maturity Model for Software (also known as SW-CMM), is shown above in Figure 10, CMM has been used by many organizations to identify best practices to increase the maturity of processes.

The CMM includes five maturity levels. Each maturity level composes several key process areas and common features. The common features specify the key practices to accomplish the goals of the key process area (Mark et al., 1993).

ISO Standards

Of growing interest and importance, managers want to implement TQM to win accreditation through being awarded the seal of ISO 9000 (Robert, 1993). The ISO 9000 series comprises 9000, 9001, 9002, 9003 and 9004. ISO 9000 provides an introduction to the standards and guidelines for the selection and use of one particular ISO standard, or model.

The ISO 9000 series "furnish conceptual guidelines with which to structure and implement the elements of a quality system" by providing guidance and models for QA (Battikha 2003).

The ISO 9000 series has been widely used throughout the world. The series consist five standards. "Two of these, ISO 9000 and ISO 9004, comprise general guidelines. ISO 9001 is aimed at organizations engaged in design/development, production, installation and servicing of products or services. ISO 9002 is aimed at companies that are only involved in production and installation, and ISO 9003 focuses on specification for final inspection and testing" (Peter 1999).

But is ISO 9000 certification prime evidence that a company's products and services are really of the highest quality? No - if the quality of products depends on the quality of suppliers' products, the possession of a ISO 9000 certificate by that supplier would guarantee nothing more than the fact that it will conform to a set of procedures (Letter 1994).

If a company's motivation is to receive an ISO certification purely as a marketing tool, or to conform to a customer's demand for supplier certification, the chances are that they will not move their product or service quality to the right. On the other hand if a company genuinely uses the ISO process as a quality discipline and a stepping stone on the journey of continuous quality improvement, ISO certification becomes a powerful management tool. ISO certification does not create a quality company; neither does it guarantee a quality product or service.

The ISO 9000 series of quality standards provides both guidance and requirements for Quality Systems. The ISO 9001, 9002 and 9003 standards were developed for use in contractual situations between a supplier and a customer. Figure 11 shows the coverage of and relationships amongst these standards.

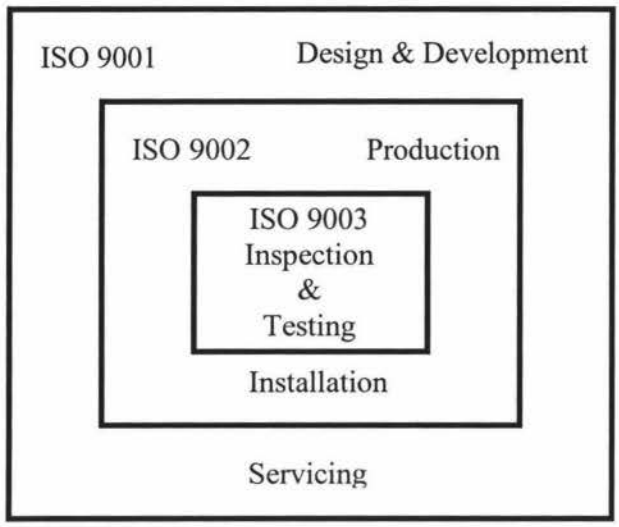

Figure 11: Coverage of IS0 9001, 9002, & 9003 Standards (Fallah 1993)

The ISO 9000-3:1997 quality standard was prepared for IT companies for developing computer software. Use ISO 9000-3 for developing, supplying, installing, and maintaining computer software. ISO 9000-3 1997 has now been replaced by ISO IEC 90003 2004 (Battikha 2003).

TQM vs. ISO 9000

ISO 9000 is the internationally recognized stamp of approval that declares an organization's procedures and systems are up to a specified standard. TQM is a systemic approach to management, usually credited to Edward Deming. It developed through the quality circles and QA movements of the 1960s and 1970s. The example in figure 12 partially shows the relation. As a regional quality-awards assessor, Macpherson put it this way: "TQM ensures organisations do the right thing while ISO 9000 is about doing things right" (NATIONAL QUALITY AWARDS 1994).

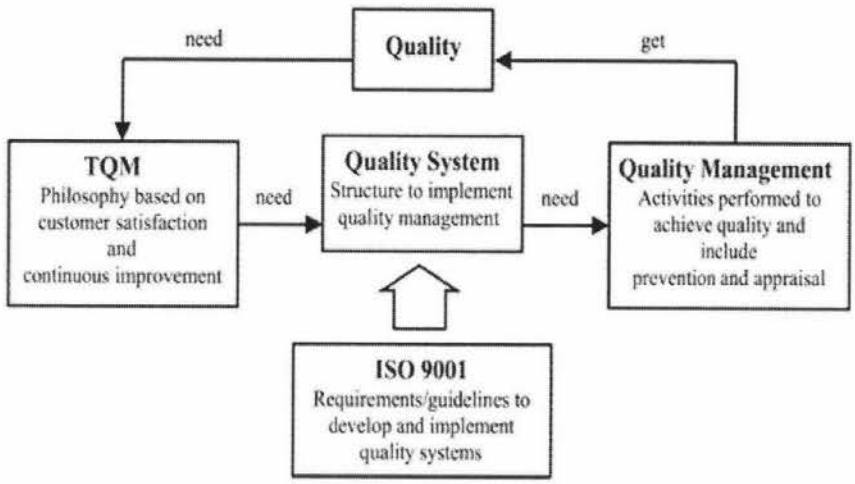

Figure 12: System approach to quality management (Battikha 2003)

Malcolm Baldridge Awards

The Malcolm Baldridge Awards were developed in 1987 by major business and congressional leaders. Baldridge had been Secretary of Commerce, and the awards were supervised by the Department of Commerce with evaluation by the American Society of Quality Control (Patrick & Gill 1995).

The Malcolm Baldridge National Quality Award (MBNQA), as an annual award, recognizes companies that stand out in quality management and success. The MBNQA criteria are broad; cover all operations, processes and work units of a business; and emphasize both an effective total quality system, improvement trends and world class achievements. The criteria assess seven categories of information (Fallah 1993):

1. Leadership;
2. Information and Analysis;
3. Strategic Quality Planning;
4. Human Resources Development and Management;
5. Management of Process Quality;
6. Quality and Operations Results;
7. Customer Focus and Satisfaction.

Each category is assessed on three dimensions: approach, deployment, and results (Fallah 1993). Winning the award requires a company's commitment to and long term investment in TQM. In 1992 AT&T became the first company to win two awards in one year.

Other Quality Models

Table 5: Comparison of different quality models (Gary 2004)

	Capability Maturity Model (CMM)	Six Sigma	ISO 9000	MBNQA
What it is	Measures process maturity, which progresses through five levels: Level 1 (initial), 2 (managed), 3 (defined), 4 (predictable) and 5 (optimizing).	A statistical process-improvement method focusing on quality from a customer's or user's point of view. Defines service levels and measures variances from those levels.	A set of high-level, customer-oriented, auditable standards (ISO 9000, 9001 and 9004) for quality management systems.	A high-level framework for quality in seven areas: company leadership, strategic planning, customer and market focus, information and analysis, human resources, process management and business results.
Strengths	Very detailed. Geared specifically to software development organizations. Focuses on continuous improvement, not just on maintaining a certification.	A data-driven approach to finding the root causes of business problems and solving them. Takes into account the cost of quality.	Well established, mature. Enjoys global prestige. Can be applied enterprise wide. Can cover software development and IT operations and services.	Very broad, holistic scope. Can be used by any organization. Can sit on top of other, more focused IT quality programs.
Limitations	Doesn't address IT operations	Can improve a process but	Focuses on repeatability	Doesn't address

	issues, such as security, change and configuration management, capacity planning, troubleshooting and help desk functions. Sets goals, but doesn't say how to meet them.	doesn't tell you if you have the right process to begin with.	and consistency of processes, not directly on the quality of those processes. Not good for analysing a process and finding root causes of problems.	process details; doesn't say how to achieve quality. Doesn't directly address IT processes and issues.

State of TQM

In the US, the General Auditing Office (GAO) conducted a survey and follow-up interviews about TQM practices; this study found that there was a direct association between TQM practices and corporate performance (General Auditing Office, 1990). In a more recent survey of US Fortune 1000 companies in 1993, 73% of respondents reported having TQM initiatives in place (Lawler et al. 1995).

TQM sees quality as the most important effective strategy for organizational success (Yong & Wilkinson 1999). Quality management proponents like Oakland (1993) went as far as calling TQM the "way for managing for the future". One business magazine, the World Executive's Digest (July 1995), even placed quality as the leading management idea that "has changed the world". Even governments (e.g. in the US, Australia and Britain) have started implementing quality management programmes (Micklethwait & Wooldridge, 1996; Patrick & Gill, 1995).

But on the other hand, Gill & Whittle (1993) placed TQM "at the end of its honeymoon period" and entering the "maturity and decline" phase of its life-cycle. TQM has also been criticized as a "packaged" or step by step process, and for being a "mindless formula for action". Beside academics, businesses and the media have also said that gone are the days of laudatory special issues and cover stories on TQM (Business Week, 1991). Instead, the media are increasingly querying whether TQM is not the latest "emperor to lose its clothes" (Business Week, 1994).

Amongst these diverse opinions, harder evidence from studies and surveys of organizations practising quality management is now emerging (Yong & Wilkinson 1999). Studies done in the UK have found quality management to have varying amounts of success. Management consultants (Kearney 1992), surveying the readers of The TQM Magazine, found that around 80% of TQM initiatives have failed. Although this finding has been much cited in commentaries on quality management, the Kearney figures have to be taken with caution: details of the research were rather vague, and rated companies on unrealistic goals. Since then, other more qualified studies have been conducted. A London Business School study (Wilkinson, 1999) involving managers used self assessment of their company's QM initiatives against the Malcolm Baldrige National Quality Award criteria. The study found that most of the forty-two managers rated their organizations as scoring between 100 and 400 points out of 1000 rated against the American Baldrige Award - with scores of such low magnitude, Cruise & Voss (1992) concluded that these companies' performance would not be sufficient to apply for, let alone win, the Baldrige award. They did, however, add that these ratings should not be seen too negatively as most UK organizations were in the early stages of developing a total approach to quality.

Other, more quantitative studies, like a survey of Scottish companies (Witcher 1993), and a survey of firms in Northern England (Whyte & Witcher 1992) report that at least half of the expected benefits of TQM, especially those pertaining to performance and employee involvement, have been delivered. Another Institute of Management (IM) survey of British managers found that 8% of managers rated their company's quality initiatives as 'very successful', with the majority of respondents claiming a moderate degree of success or being neutral (Yong & Wilkinson 1999). Similarly, the Institute of Personnel Management (IPM) survey of 350 HR managers found that 76% confirmed that their organizations had some experience with quality management; of those companies with QM experience, 65% rated their initiatives as reasonably successful, with only 5% citing them as unsuccessful. Using a different approach to evaluate the effectiveness of TQM, some University of Bradford (UK) researchers studied a five-year span of audited financial accounts of TQM companies against the rest of the industry. Of the twenty-nine TQM companies examined, (Zairi et al. 1994) reported that twenty-two of those companies outperformed their industry averages in profit margin, return on total assets, turnover

per employee, profit per employee, total assets per employee, fixed asset trends and average remuneration.

The practice of TQM has had a known history Asia. Juran had bring the idea to Japan two decades ago and then shipped to USA and Europe. TQM is also well established in Singapore, especially among medium to large sized manufacturing companies (Ghosh & Hua 1996). Since its independence in 1965, the Singapore economy has grown by an average of about 8% a year. By then, the government start introducing the new strategies to build up the capabilities of organisations. In the early 1990s, the government decided to promote TQM and also launched the Singapore Quality Award in 1994 (Kin 2000).

TQM in New Zealand

New Zealand as a nation may have been a latecomer to quality (Deborah 1994). From power firms and seafood processors to couriers and upmarket law firms, companies are becoming aware of quality principles.

The New Zealand National Quality Awards Foundation (NZOQ 2005) was established in 1992, demonstrating that we were joining the international business community in focusing on quality as a competitive strategy. Supported by the government, the award aims to stimulate productivity and quality. It is structured so that applicants are compared against criteria based on the internationally recognised Malcolm Baldridge National Quality Awards in the US. The National Quality Awards Foundation states its commitment to promoting TQM and to a lesser degree to ISO 9000.

In New Zealand, quality management programmes had being sold to many businesses today as a quick means of providing a competitive leg-up and as an assured way of improving productivity and the balance sheet. But recent research has shown that a quality programme is more likely to most immediately improve staff morale and commitment, and that the benefits of implementation take a long time to show up on the balance sheet. TQM is a relatively new management philosophy in

New Zealand (Margie 1995). With long implementation lead times it is understandable that financial results are slower in coming.

Also, a New Zealand survey about the implementation of TQM showing the concept of quality was badly understood and commonly confused with ISO standard compliance. Despite this, those companies that were genuinely practicing TQM principles produced tangible productivity gains (Margie 1995).

There is a tendency in New Zealand's business environment to see quality simply in terms of ISO certification. It is essentially seen by many businesses as a marketing tool - a means by which the sales manager in the field can drum up extra business. But quality management is much more than that. In the survey, 40% of the accredited companies had a negative view of the standard as a means of achieving quality.

The Implications of National Politics

What role have governments played in the promotion of TQM? The research done by Tuckman (1994) notes that governments in Britain and the United States have played a central role in introducing quality management approaches. In Britain this has come through strategies of denationalization as well as though the promotion of enterprise-based employment relations. In the United States, governments have used both the powers of military procurement and the National Quality Improvement Act of August 1987 to promote TQM.

Why do governments intervene to support the adoption of particular managerial techniques? Governments are concerned with promoting industry restructuring to better equip the economy to meet increasing competitive challenges from abroad.

Also, the participative processes within TQM can also build flexibility into existing organizational structures. It can create new alliances in support of change, encouraging attitudes that support organizational goals for improvement, rather than sectional goals for the status quo (Patrick & Gill 1995).

Since 1984, New Zealand has experienced dramatic political, economic and social change. New Zealand governments had played an active role in economic development and in the creation of standards and infrastructure to assure quality in key industry sectors (Houston & McKean 2002).

Barriers to Quality Programme Success

The barriers to quality programme success are various. Most organizations find it hard to install and maintain TQM (Peter 1997) because of reasons such as (Salazar 1994):

1. Large size, diversity and locations of organizations;
2. Resistance to changes in behaviour, habits, and relationships between leaders and employees;
3. A lack of conviction that TQM works;
4. Weak organizational performance ethics and challenges;
5. The reward of individuals rather than the team by organizations, and an intrinsic preference for individual over group accountability;
6. The fact that most organizations do not understand what quality means and how to measure it.

Deming recognized several major obstacles to higher productivity and market position. He explains how most of these obstacles are created by industry's ignorance of statistical quality control principles or their expectations of the impossible. Following is a very brief summary of this obstacle list (Deming 1982):

1. Uniformed management believes that a few days with a quality consultant will produce a complete operating quality system;
2. It is mistakenly supposed the automation, gadgets, and new machinery will transform industry;
3. Some think that blindly copying successful QC programmes from another company will solve their problems;
4. Others think that their company's problems are unique and that principles of statistical QC will not work for them;

5. Some managers fail to verify the competency of statistical QC instructors, thus exposing their employees to inadequate quality training;
6. Under some conditions, the use of acceptance sampling tables may guarantee that some customers will receive a defective product;
7. Management that fails to understand control chats and statistical thinking tends to let the QC department unilaterally handle all quality problems;
8. Poorly conceived quality-related programmes subsequently fail, producing initial dissatisfaction followed by frustration and despair;
9. Installation of a complete QC programme is doomed to failure. Such a programme must be developed slowly over the years to be effective;
10. An inadequately designed computer system will provide little more than a collection of useless raw data;
11. The supposition that it is necessary only to meet specifications is an open invitation to competitors to steal customers;
12. The concept of zero defects does not correspond to the realities of this world. If forced, it will drive losses and costs to the maximum;
13. Inadequate testing of prototypes that fail to match realistic production conditions usually results in a disaster;
14. A QC consultant is expected to know all about the business, but this is not necessary. Improvement can come from other kinds of knowledge and non-related experience.

Successful quality practices should consistently deliver high levels of quality, it must allow a company to build quality into every level of the production (Terry et al. 2002). Some of the most frequently discussed managerial issues include:

1. Management often fails to enlist employee input and energy. Without complete employee buy-in, quality at the source is practically impossible (Deming 1986);
2. Management overlooks the vital linkage between measurement and quality. Seeking quality, while measuring productivity (or anything else), is counter-productive. Measurement systems must support strategic quality initiatives (Fawcett et al. 2000);

3. Management sometimes forgets the importance of clearly communicating programme expectations. Given the need for widespread commitment to the quality initiative, it is absolutely critical that everyone not only catches the quality vision but also understands their individual and specific roles in delivering outstanding quality (Kuglin 1998);
4. Management neglects the central role of training. Quality has never occurred spontaneously. Workers need to know what is expected and they have to possess the functional skills and quality tools needed to build quality into the product as well as the process. Consistent and sustained training is thus a prerequisite to parts-per-million quality;
5. Management fails to look beyond the organization to its own suppliers. The long-held concept of "garbage-in-garbage-out" applies to quality management. Crosby estimated that suppliers account for 50% of product-related quality problems (Crosby, 1980).

Besides the reasons mentioned above, Yong & Wilkinson (1999) also mention 'TQM fatigue'. In senior-level leadership, there can be a lack of long-term strategy or vision, a lack of resources and infrastructure, and a lack of action and consistency.

Identifying and understanding the barriers to successful implementation of quality is an overwhelming task due to the different experiences companies have had. Terry et al. (2002) have captured the essence of the quality implementation challenge, as shown in Figure 13.

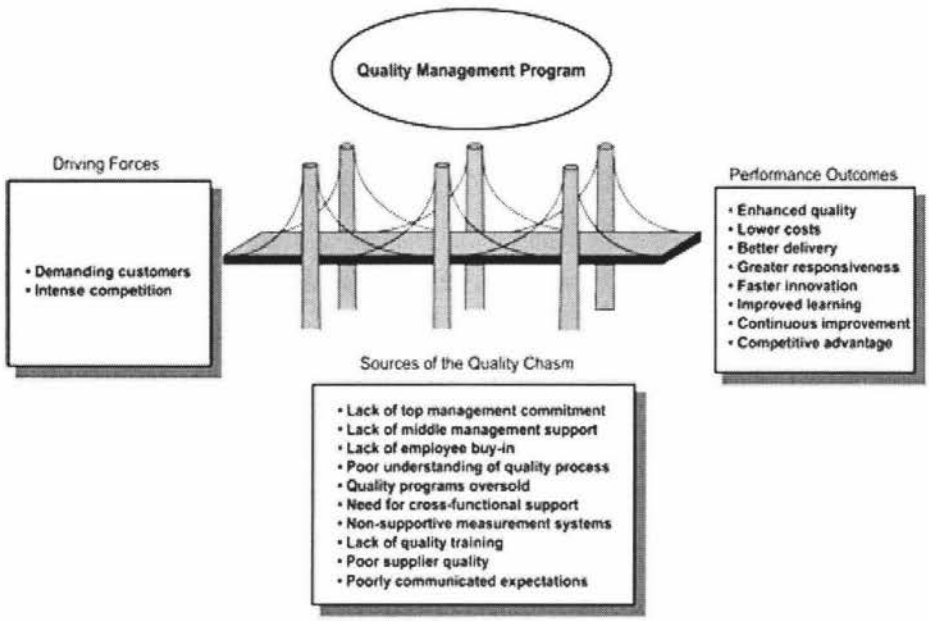

Figure 13: Bridging the quality programme implementation chasm

Most often, managers at companies adopt the quality programme without realizing that success depends on first step, which is to establish a quality infrastructure. Failing to build such "bridge" leads to establish an unrealistic quality goal, with expending great effort wasted.

General Lessons on the Process of Establishing TQM

From the case materials used by Dawson & Palmer (1995, p. 189), main lessons can be drawn from an analysis of introducing TQM into Australian and New Zealand companies:

1. There is no one best way. Be wary of simple prescriptions for the successful management of TQM;
2. Accept the TQM. Change will have its downside and be composed of omissions and unforeseen events. So there is need for constantly flexible and reviewable implementation strategies;
3. Question measurement mania. Do not measure for measurement's sake but consider the practical value of what you do;
4. Do not try to do everything at once. Successful large-scale operational change takes time;

5. Train employees just-in-time. Organise training on a needs basis and include more material on working in teams and interpersonal skills;
6. Tailor your TQM programme. Modify your TQM programme to suit your organizational need. The content of TQM needs to be revised over time and should be evaluated and appraised on a regular basis;
7. Be contextually aware. Take account of external and internal contextual issues and do not underplay the importance of the multicultural workplace in society;
8. Seek support from all quarters. Politics and conflict are often key determinants on the outcomes of change. For example, supervisors are often overlooked in change programmes and they can act as a major barrier or catalyst to change.

METHODOLOGY

Two principal approaches were followed in the research process. The first is a survey methodology used to gather data. It was anticipated that the survey method would provide adequate data within the allocated time period for analysis and interpretation. The second approach involves case studies based on the result of survey; the candidates chosen from the survey's respondents.

Survey

A questionnaire was constructed based on an extensive review of the literature in the area of quality management; this questionnaire is to cover the important variables which affect the implementation of quality management. The format of the questionnaire is attached as Appendix 1.

The research framework is outlined in figure 14 and explained in the pages following.

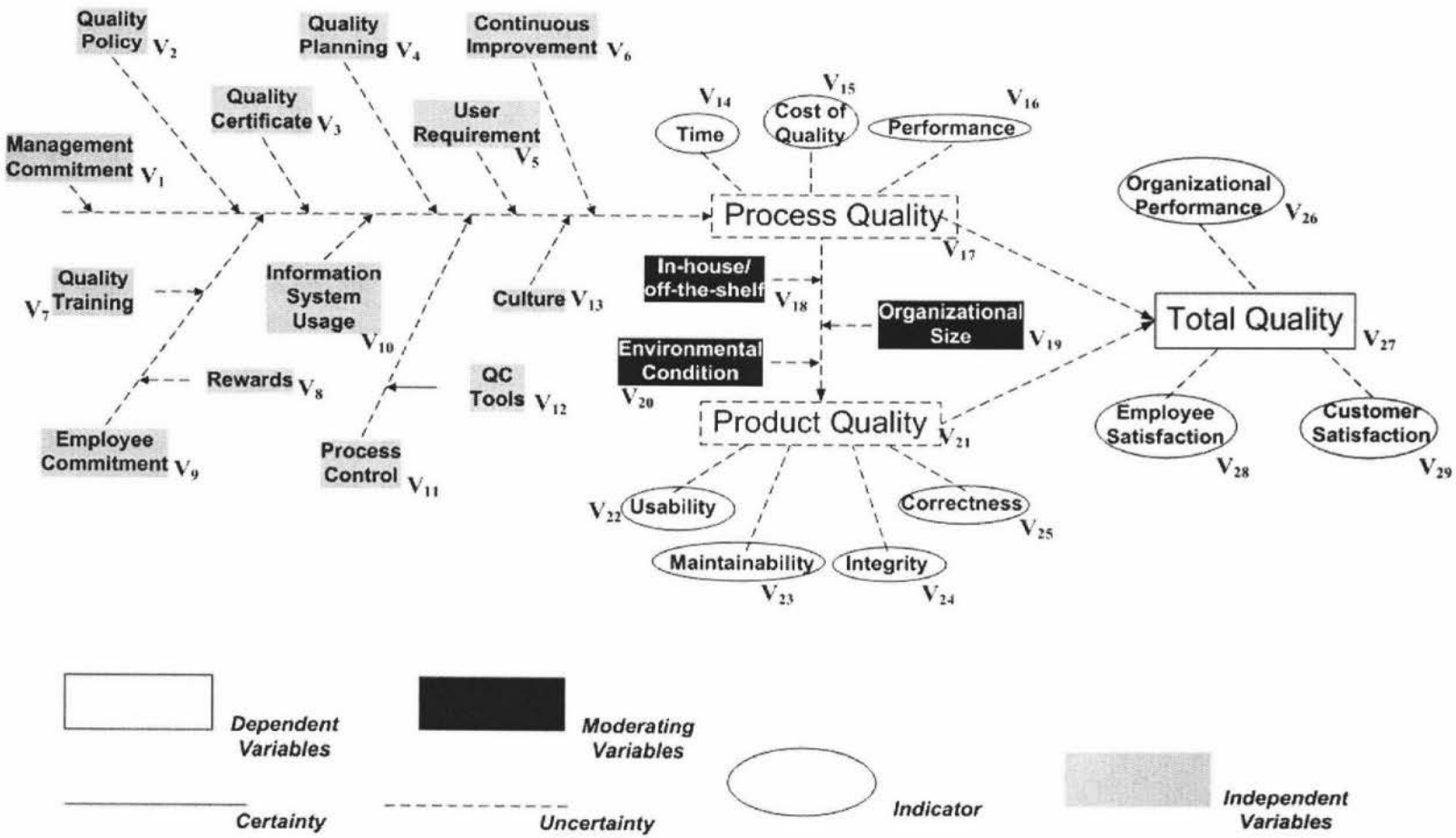

Figure 14: Research theoretical framework

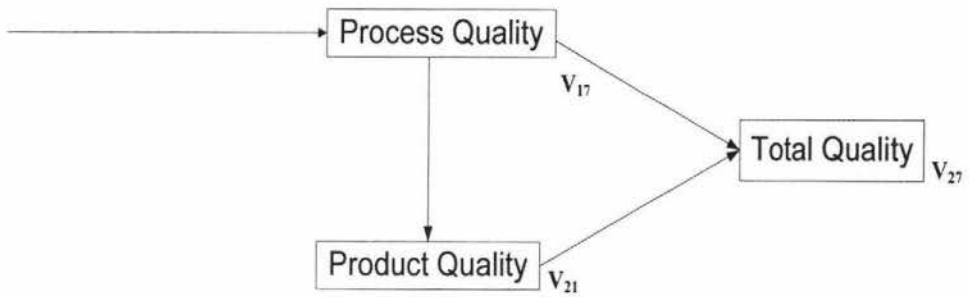

Figure 15

The research model is based on the hypothesis (H_1 , in fact) that a high quality process will deliver high quality deliverables (Ahire and Ravichandran 2001), and that both process quality and product quality contribute to total quality of an IT project (Talha 2004).

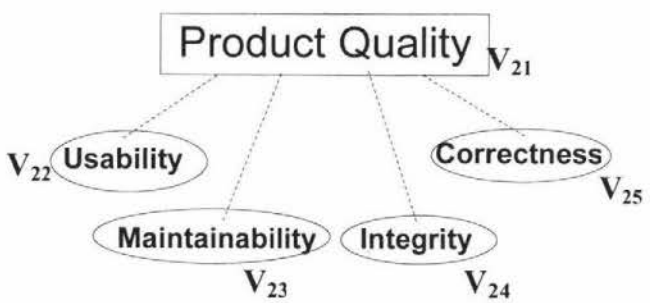

Figure 16: Variables of IT project product quality

Four variables of IT project product quality were chosen and tested by Roger (2001).

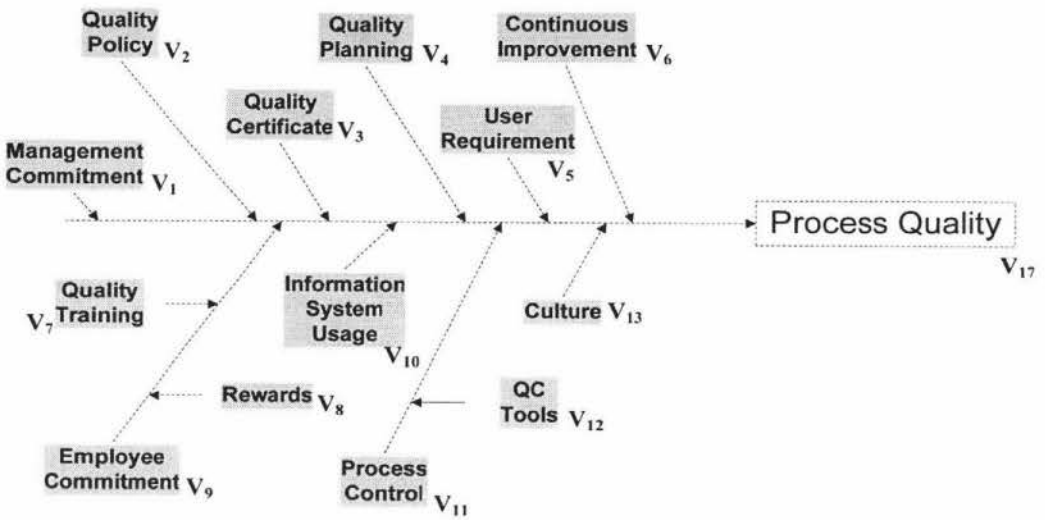

Figure 17: Variables of IT project process quality

Variables from V_1 to V_{13} are selected from the literature review and are believed to be the main elements of TQM. They have been tested by some surveys conducted overseas. During this survey, questions will be asked regarding these variables; the result will help to determine what factors contribute to IT project process quality in New Zealand.

Table 6: Hypotheses

Hypotheses which will be examined by this research:	
H_1	V_{21} is influenced by V_{17}.
H_2	V_{21} is influenced by V_{18} and V_{19}.
H_3	V_{27} is influenced by V_{17} and V_{21}.
H_4	V_{17} is influenced by V_1, V_2, V_5, V_6, V_7, V_9 and V_{11}.
Future research can also examine the following hypotheses:	
H_5	V_{17} is influenced by V_{13}.

H_1 and H_3 try to build up the relation between process quality, product quality and total quality; the assumption is that good process quality can produce high product quality. So in order to improve the overall quality of IT project, it is important to have

sound process management. For research question 4, a quality model needed to be built based on this assumption.

H_2 will examine how the other variables other than process quality contribute to product quality. The analysis of all these variables will be used to explain the quality management state in New Zealand, which is research question 1.

H_4 will examine process quality. Most of the variables are selected from the literature review, and are believed to be the main elements of TQM, and have been discussed in detail during the literature review.

As the exact number of companies in New Zealand which practise quality management was not known, a random sample of 200 company addresses was drawn from the following sources:

(1) MIS 100 (New Zealand);
(2) PMINZ (Project Management Institute, New Zealand); and
(3) NZCS (New Zealand Computer Society Inc.).

Self-administered questionnaires were emailed to the randomly selected groups of organizations. A covering letter which described the objectives of the research and procedures for completing the questionnaire was also enclosed. At the end of the questionnaire, an invitation was sent for a follow up interview. Organizations were asked if they were willing to attend the case study. Candidate interviewees would be selected from people who answered "yes".

A reminder was sent to non-respondents two weeks after the questionnaires were mailed.

The questionnaire was pilot-tested with practising quality consultants to ensure that it was able to be understood by the target population of IT people, and then finalized. Based on the feedback from the pilot-test, the questionnaire was refined and a revised final questionnaire was developed.

The final draft was again tested to ensure that the parts changed or added to were still able to be understood by the target population.

The final copy of the survey consisted of five major sections. The first section involved demographic questions designed to solicit information about the respondents and their projects. The target population for the study was IT project managers. It was estimated that it would take a respondent no more than twenty minutes to answer the entire questionnaire.

In this questionnaire both the Likert scale and Nominal data type question have been used.

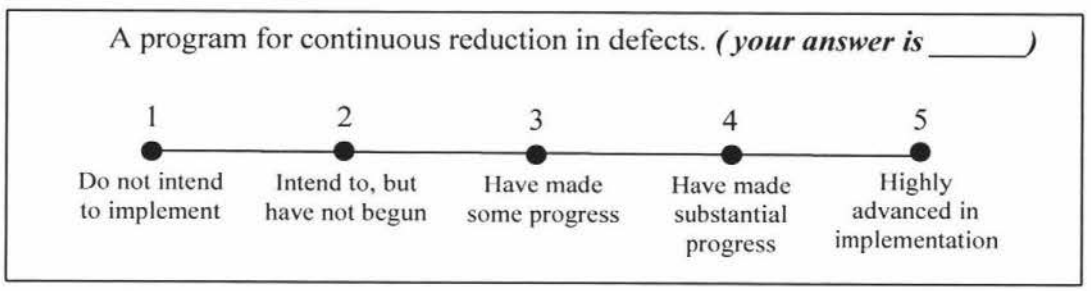

Figure 18: An example of the questionnaire Likert scales

In this particular study, quality improvement initiatives (Q3.1) were measured by 3-point importance scales (1 = extremely important, 3 = not important); important items to achieve quality (Q3.2) were measured by 5-point importance scales (1 = do not intend to implement, 5 = highly advanced in implementation); and factors affecting quality (Q5.1) were measured by 5-point importance scales (1 = strongly agree, 5 = strongly disagree).

Table 7: Questionnaire structure and relevant supporting reference

Questions	Variables or Hypotheses	Data Type	Reference
PART ONE			
1.1 Which primary industry group does your company fit into?		nominal	(Manufacturing Engineer 1997)
1.2 What are the average annual sales at your company?	V_{19}	scale	(Manufacturing Engineer 1997)
1.3 How many full-time employees work at your company?	V_{19} H_2	scale	(Manufacturing Engineer 1997)
1.4 What is your job function?		nominal	

1.5 What is the name of your latest IT project which exceeded NZ$10,000 in budget?	H_1		
1.5.1 How long did it take to complete this project? How long was its estimated time for completion?	V_{14}	scale	
1.5.2 What was the original budget of this project? What was the real cost of the project?	V_{15}	scale	
1.5.3 Did the final outcome meet agreed scope (1→3) and comments?	V_{16}	ordinal & nominal	
PART TWO			
2.1 Does your company have a quality policy, if No, the reason being?	V_2	nominal	(Terry, Stanley et al. 2002)
2.2 Does your company have a quality certification? What is the name?	V_3	nominal	(Peter 1999)
2.3 The percentage of employees involved in quality improvement?	V_9	scale	(Everett, Corbett et al. 1994)
PART THREE			
3.1 What are the drivers to implement quality improvement initiatives within your organization (1→3)?		ordinal	(Manufacturing Engineer 1997)
3.2 What does your firm perceive as being important in achieving quality related objectives (1→5)?	H_4	ordinal	(Bishnu and David 2001)
3.2.1 A programme for continuous reduction in defects?	V_6	ordinal	
3.2.2 Inclusion of quality principles in mission statement?	V_3	ordinal	
3.2.3 Top executive's active involvement?	V_1	ordinal	
3.2.4 Using customer requirements as the basis for quality?	V_5	ordinal	
3.2.5 Programmes to find wasted time and costs in internal processes?	V_{11}	ordinal	
3.2.6 Employee training in quality principles?	V_7	ordinal	
3.2.7 More active employee involvement?	V_9	ordinal	
PART FOUR			
4.1 Was there any quality plan	V_4	nominal	(Peter 1999)
4.2 Who was involved in the	V_9	nominal	(Peter 1999)

planning?			
4.3 What acquisition method was chosen for the project?	V_{18} H_2	nominal	
4.4 Please identify problems relating to the cost of the quality-related plan.	V_{15}	nominal	(Peter 1997)
4.5 What is the likely cost of quality compared with the whole budget of project?	V_{15}	scale	(Laszlo 1997)
4.6 Which QM tools are using in your company at the moment?	V_{10} V_{12}	nominal	(Forza 1995);(Ngai and Cheng 1998)
PART FIVE			
5.1 What factors affect the quality of IT projects in your company (1→5)?		ordinal	(Sonny, Ben et al. 2002; Terry, Stanley et al. 2002)
5.1.1 Management commitment		ordinal	
5.1.2 Employee commitment		ordinal	
5.1.3 Training		ordinal	
5.1.4 Resources		ordinal	
5.2 What do you think are the major benefits QM brings to your company?	V_{15} V_{21} V_{25} V_{26} V_{28} V_{29} H_3 H_1 H_2	nominal	(Peter 1999)

200 questionnaires were sent out in the first week of the September 2005, of which only 26 were completed and returned over a period of three months, achieving a response rate of 13 percent. The response rate was lower than expected, but for a statistical investigation, the results were still significant. As discussed with the statistics faculty of Massey University, the sample is sufficient for an exploratory study at Masters Level.

Case Study (RQ 4)

After the results from the survey had been collected and analyzed, a case study was conducted in the form of interviews plus a post-project investigation report (the NZ Police INCIS Project). The interviewees were chosen from respondents of the survey who were willing to participate into the follow-up study. The people who participated in the interview needed to have solid knowledge of IT project management and sound experience of management of IT projects.

The case study was conducted in the format of an interview, combined with both face-to-face meeting and email. During the interview, more general open questions were be asked to get more information about their experience and ideas about how to maintain or improve IT project quality in New Zealand. The data gathered used to design a quality model through question 4.

RESULTS FROM SURVEY

Discussion of results from survey

1.1 Which primary industry group does your company fit into?

Table 8

	Number	Percentage
Telecommunication	1	3.85%
Education and research	4	15.38%
Government	5	19.23%
Finance and business services	4	15.38%
Retail trade	3	11.54%
Information Technology	7	26.92%
Other	2	7.69%

For the survey, respondents tended to be from a wide distribution of industry groups, but mainly from the IT industry. Even if the company was not an IT company, the IT department or IT manger was contacted to fill in the questionnaire to ensure that the questionnaire was completed by someone with a good understanding of information technology terms.

1.2 and 1.3. What is the average annual sales or income at your company in $NZ? How many full-time equivalent employees work at your company?

Table 9

Number of Respondents	26
Average annual sales (million)	637.32
Average number fulltime employees	543.54

In this research, nearly 20% of the returned questionnaires were from government departments, which often consist of a large number of employees. In this survey, the average number of fulltime employees (543.54) was comparatively high. In New

Zealand, organizations are classified by the number of full time employees as: small (1 to 5); medium (6 to 20); or large (more than 20) (Statistics New Zealand 2005).

Table 10

	Number of companies
Small	14
Medium	8
Large	4
Total	*26*

1.4 What is your job function?

Table 11

	Number	Percentage
CEO	3	11.54%
Quality Manager	0	0.00%
General Manager	5	19.23%
Senior Staff Member	11	42.31%
Other	7	26.92%
Total	*26*	*100%*

For the survey, respondents tended to be from a wide distribution of industry groups, although mainly from the IT industry or the IT department of the organization. The majority of the participants were senior staff (42.31%) or general managers (19.23%), while a few of them were CEOs (11.54%). However, nobody chose to select quality manager (0.00%).

1.5 Investigation of the latest IT project which exceeded NZ$10,000 in budget

1.5.1 How long did it take to complete this project (months)? And how long was its estimated time for completion (months)?

Table 12

	Number	Percentage
Over Estimated Time	23	88.46%
Within or Equals Estimated Time	3	11.54%
Total	*26*	*100%*

1.5.2 What was the original budget of this project ($NZ)? And what was the actual cost of the project ($NZ)?

Table 13

	Number	Percentage
Over Estimated Budget	23	88.46%
Within or Equals Estimated Budget	3	11.54%
Total	*26*	*100%*

1.5.3 Did the final outcome meet agreed scope?

Table 14

	Number	Percentage
Totally Success	23	88.46%
Partial Success	3	11.54%
Failure	0	0.00%
Total	*26*	*100%*

To set the constraint of "latest IT project which exceeded NZ$10,000 in budget", just to make sure, this is a proper IT project with a reasonable budget and effort involved in.

Question 1.5 shows a very interesting phenomenon of IT projects in New Zealand, which in some sense also shows the Project Management situation in NZ.

Project Management is designed to manage or control company resources on a given activity, within time, within cost, and within performance. Time, cost, and performance are the three constraints on the project; that means that if either of

these is poorly estimated, the quality of the project will be affected, and this might not a successful project.

However, in this case, by investigating the IT projects (that exceeded NZ$10,000), there were only three (11.54%) projects running within budget and time constraints. Some of them even were running at double the estimated time. But the majority of them (88.46%) still count the project as "Total Success"; 11.54% think they were a "Partial Success". In total, not even one respondent believed their project was a "Failure".

The State of Quality Plan

2.1 Does your company have a quality policy?

Table 15

	Number	Percentage
Yes	16	61.54%
Under Development	5	19.23%
No	5	19.23%
Total	*26*	*100%*

Most of respondents' companies have a quality policy (80.77%) including 19.23% whose companies were currently developing a quality policy.

Also it is realised that 19.23% do not have a quality policy at all, and at the moment, they do not have an intention to create one. Those respondents were asked for reasons.

If NO, The reason being_____ (check all applicable)

Table 16

	Number	Percentage
Resistance to change	24	38.10%
Lack of conviction that QM works	1	1.59%
Lack of knowledge	15	23.81%
No enough resource (time + cost)	20	31.75%
Other	3	4.75%
Total	*63*	*100%*

The most important reasons were counted as "resistance to change" (38.10%) and "not enough resource" (31.75%). "Lack of knowledge" followed closely (23.81%). However, the reason "Lack of conviction that QM works" was the least popular (1.59%), which might indicate that people still believe in QM.

2.2 Does your company have a quality certification?

Table 17

	Number	Percentage
Yes	1	3.85%
Under Development	1	3.85%
No	24	92.31%
Total	*26*	*100%*

The majority of respondents' companies (92.31%) are non-certified, which was not expected by the researcher. In fact, there was only one company that had a quality certificate, which was "ISO", and another company's quality certificate "CI" was under development. However, in the USA, of organizations with employees from 500 to 999 (to map our mean survey enterprise size), more than 50% of the organizations are certified (Peter 1999).

However, regarding the comments of one respondent (the respondent was unwilling to expose his name and the company name), quality certification should not be counted as prime evidence that a company's products and services are of the

highest quality. In their case, the quality of products depends on the quality of the supplier's products, so they have their own customized quality standards.

2.3 The percentage of employees involved in quality improvement?

Employee empowerment is one of the main constructs of TQM (Flynn, Schroeder et al. 1994; Ahire and Ravichandran 2001). It is positively associated with employees' satisfaction (Parker and Price 1994). TQM's prescriptions for employee involvement represent a sharing of managerial power on matters concerning improvements in work flow and operations management.

Table 18

	Number
Less than 10%	20
Less than 50%	1
100% involvement	2
N/A	3

Here the result of this question shows that only two respondents answered that 100% of employees are involved in quality improvement in their company (one of them having an ISO9001 certificate). For all the other respondents, answers tell that only part of the employees - mainly top management or some of the general managers (averagely around 7.7% of total employees) - are involved in quality improvement.

The Decision to Change

3.1 What were the drivers to implement quality improvement initiatives within your organization?

3.1.1. Pressure from users

Table 19

	Number	Percentage
Extremely Important	5	19.23%
Important	15	57.69%
Not Important	6	23.08%
Total	*26*	*100%*

3.1.2. Pressure from competitors

Table 20

	Number	Percentage
Extremely Important	11	42.31%
Important	10	38.46%
Not Important	5	19.23%
Total	*26*	*100%*

3.1.3. Pressure from top management

Table 21

	Number	Percentage
Extremely Important	3	11.54%
Important	18	69.23%
Not Important	5	19.23%
Total	*26*	*100%*

3.1.4. Deterioration in performance, threatening survival

Table 22

	Number	Percentage
Extremely Important	7	26.92%
Important	8	30.77%
Not Important	11	42.31%
Total	*26*	*100%*

3.1.5. Marketing Tool

Table 23

	Number	Percentage
Extremely Important	5	19.23%
Important	10	38.46%
Not Important	11	42.31%
Total	*26*	*100%*

Analysis

Table 24

Question 3.1	N	Mean	Std. Deviation
Pressure from competitors	26	1.77	0.76
Pressure from users	26	2.04	0.66
Pressure from top management	26	2.08	0.56
Deterioration in performance, threatening survival	26	2.15	0.83
Marketing Tool	26	2.23	0.76

***Note**: The means were derived from a scale "Extremely Important" (1 point) to "Not Important" (3 points)*

The results of this question shows the reasons why companies had implemented quality improvement. Most of the respondents said that their main reason for seeking the improvement was "Pressure from competitors", followed by "Pressure from users" and "Pressure from top management"; the least popular reason was " Marketing Tool".

3.2 What does your firm perceive as being important in achieving quality related objectives?

3.2.1 A programme for continuous reduction in defects.

Table 25

	Number	Percentage
Do not intend to	0	0.00%
Intend to, but have not begun	2	7.69%
Have made some progress	13	50.00%
Have made substantial progress	11	42.31%
Highly advanced in implementation	0	0.00%
Total	*26*	*100%*

3.2.2 Inclusion of quality principles in mission statement.

Table 26

	Number	Percentage
Do not intend to	2	7.69%
Intend to, but have not begun	1	3.85%
Have made some progress	14	53.85%
Have made substantial progress	7	26.92%
Highly advanced in implementation	2	7.69%
Total	*26*	*100%*

3.2.3 Top executive's active involvement.

Table 27

	Number	Percentage
Do not intend to	2	7.69%
Intend to, but have not begun	4	15.38%
Have made some progress	12	46.15%
Have made substantial progress	7	26.92%
Highly advanced in implementation	1	3.85%
Total	*26*	*100%*

3.2.4 Using customer requirements as the basis for quality.

Table 28

	Number	Percentage
Do not intend to	0	0.00%
Intend to, but have not begun	1	3.85%
Have made some progress	8	30.77%
Have made substantial progress	13	50.00%
Highly advanced in implementation	4	15.38%
Total	*26*	*100%*

3.2.5 Programmes to find wasted time and costs in internal processes.

Table 29

	Number	Percentage
Do not intend to	1	3.85%
Intend to, but have not begun	5	19.23%
Have made some progress	17	65.38%
Have made substantial progress	2	7.69%
Highly advanced in implementation	1	3.85%
Total	*26*	*100%*

3.2.6 Employee training in quality principles.

Table 30

	Number	Percentage
Do not intend to	0	0.00%
Intend to, but have not begun	7	26.92%
Have made some progress	13	50.00%
Have made substantial progress	6	23.08%
Highly advanced in implementation	0	0.00%
Total	*26*	*100%*

3.2.7 More active employee involvement.

Table 31

	Number	Percentage
Do not intend to	0	0.00%
Intend to, but have not begun	11	42.31%
Have made some progress	6	23.08%
Have made substantial progress	9	34.62%
Highly advanced in implementation	0	0.00%
Total	*26*	*100%*

Analysis

Table 32

Question 3.2	N	Mean	Std. Deviation
Using customer requirements as the basis for quality.	26	3.77	0.76
A programme for continuous reduction in defects.	26	3.35	0.63
Inclusion of quality principles in mission statement.	26	3.23	0.95
Top executives active involvement.	26	3.04	0.96
Employee training in quality principles.	26	2.96	0.72
More active employee involvement.	26	2.92	0.89
Programmes to find wasted time and costs in internal processes.	26	2.88	0.77

***Note**: The means were derived from a scale "Do not intend to implement" (1 point) to "Highly advanced in implementation" (5 points)*

The items being tested here are the variables that directly affect the process quality of this survey model, using customer requirements as the basis for quality. (V_5), A programme for continuous reduction in defects (V_6), Inclusion of quality principles in mission statement (V_4), Top executive's active involvement (V_1), Employee training in quality principles (V_7), More active employee involvement (V_9), Programmes to find wasted time and costs in internal processes (V_{11}).

Organizations in NZ consider "Using customer requirements as the basis for quality" as the most important approach. This was followed by "A programme for continuous reduction in defects". "More active employee involvement" and "Programmes to find wasted time and costs in internal processes" were the last two.

Planning the Quality Programme for the IT Project

4.1 Was there any quality plan?

Table 33

	Number	Percentage
Yes	12	46.15%
No	14	53.85%
Total	*26*	*100%*

In the survey, 46.15% of the respondents' companies have a quality plan while they established a project, but the other 53.85% (more than half) did not. This poses the question: why not?

4.2 Who was involved in the planning? (Please check all applicable)

Table 34

	Number	Percentage
Top Management	20	40.00%
Quality Consultant	5	10.00%
All Management	5	10.00%
All Employees	4	8.00%
Project Staff	16	32.00%
Others	0	0.00%
Total	*50*	*100%*

This question was about who was involved in the quality planning, as a principle of quality management is overall employee involvement. But from the survey, the majority of the choices were "Top management". A sorting of the responses shows that 40% of the enterprises regarded quality as primarily a top management responsibility, followed by "Project Staff" (32%). However, only 4% of the respondents chose "all employees".

4.3 What acquisition method was chosen for the project?

Table 35

	Number	Percentage
In house development	12	46.15%
Off-the-shelf product	12	46.15%
Both	2	7.69%
Total	*26*	*100%*

From the sample population, there was no special preference of acquisition method. 46.15% chose "in house development", another 46.15% chose "Off-the-shelf product", and the other 7.69% chose the combination of the two methods. It largely depends on what kind of project and the degree of the precision that it asks for. However, in one instance, one respondent said that even though the organization choose off-the-shelf products, those products are "heavily customised" to ensure their quality.

4.4 Please identify problems relating to the cost of the quality-related plan (check all applicable).

Table 36

	Number	Percentage
Responsibilities for dealing with quality costs had not been agreed.	16	40%
Communication – quality data are being "squeezed" i.e. cut back from necessary report requirements and down to basics.	9	22.50%
Getting an accurate cost for the simplest things (e.g. raw materials) is easy. Added-value figures are very difficult.	10	25%
Don't have any method to trace cost to their source? (e.g. suppliers)	5	12.5%
Total	*40*	*100%*

Cost of quality plans have been used widely overseas to control the quality of IT projects. "Responsibilities for dealing with quality costs had not been agreed" was

listed as number one problem relating to the cost of the quality-related plan (40%), whilst 25% of respondents chose "Getting an accurate cost for the simplest things is easy. Added-value figures are very difficult". Communication (22.50%) and "Don't have any method to trace cost to their source" (12.5%) were the last two items.

4.5 What is the likely cost of quality compared with the whole budget of the project?

Most respondents did not answer this question because they do not actually have a system to isolate the cost of quality from cost of project. For the rest of the respondents, of which there were 9 who filled in the blanks, the average for the cost of quality was 15% of the whole budget. The figure is comparably lower than in the USA, where in formal quality management the cost of quality accounts for 30% of all budgets (Laszlo 1997).

4.6 Which QM tools are you using in your company at the moment? (Tick all applicable)

Table 37

	Manual use	Computerized use	Not used at all
Cause and effect diagram	2	2	3
Flow chart	4	4	1
Pareto chart	0	0	5
Run chart	0	1	5
Histogram	0	4	4
Control chart	0	2	5
Scatter diagram	0	1	5

This question tried to investigate the usage of computer based technology (CBT) to support quality in New Zealand. Concerning the frequency with which workers use control charts, different opinions exist between the groups with QM certificates and those without. These results suggest that the different aspects of quality management represented in the statements are practiced to a greater extent in

certified firms than in other firms. Quality is not likely to be well practiced in these types of firms in the sense that employees may not be adequately trained in quality-related techniques such as statistics and process control.

From the results, we can see the "Flow chart" methods are used extensively for QC and improvement, followed by "Cause and effect diagrams". These two methods are particularly useful for detecting the main cause of defectiveness. Other tools which are more extensively computerized are used mainly for QC.

Effects of Change

5.1 What factors affect the quality of IT projects in your company?

5.1.1 Management commitment

5.1.1.1 Lack of managerial understanding regarding quality management.

Table 38

	Number	Percentage
Strongly Agree	2	7.69%
Agree	11	42.31%
N/A	9	34.62%
Disagree	4	15.38%
Strongly Disagree	0	0.00%
Total	*26*	*100%*

5.1.1.2 Lack of quality leadership among senior management.

Table 39

	Number	Percentage
Strongly Agree	1	3.85%
Agree	14	53.85%
N/A	3	11.54%
Disagree	8	30.77%
Strongly Disagree	0	0.00%
Total	*26*	*100%*

5.1.1.3 Impatience among managers, as focusing on financial returns.

Table 40

	Number	Percentage
Strongly Agree	2	7.69%
Agree	11	42.31%
N/A	3	11.54%
Disagree	8	30.77%
Strongly Disagree	2	7.69%
Total	*26*	*100%*

5.1.2 Employee commitment

5.1.2.1 Employees resist change in work habits.

Table 41

	Number	Percentage
Strongly Agree	2	7.69%
Agree	16	61.54%
N/A	4	15.38%
Disagree	3	11.54%
Strongly Disagree	1	3.85%
Total	*26*	*100%*

5.1.2.2 Employees continue to try to find short-cuts.

Table 42

	Number	Percentage
Strongly Agree	2	7.69%
Agree	16	61.54%
N/A	4	15.38%
Disagree	4	15.38%
Strongly Disagree	0	0.00%
Total	*26*	*100%*

5.1.2.3 Poor worker/manager relations.

Table 43

	Number	Percentage
Strongly Agree	0	0.00%
Agree	8	30.77%
N/A	8	30.77%
Disagree	9	34.62%
Strongly Disagree	1	3.85%
Total	*26*	*100%*

5.1.3 Training

5.1.3.1 Costs (money and time) for training prevent establishment of adequate training programmes.

Table 44

	Number	Percentage
Strongly Agree	2	7.69%
Agree	14	53.85%
N/A	2	7.69%
Disagree	7	26.92%
Strongly Disagree	1	3.85%
Total	*26*	*100%*

5.1.3.2 Workers lack quality skills and training.

Table 45

	Number	Percentage
Strongly Agree	1	3.85%
Agree	15	57.69%
N/A	2	7.69%
Disagree	8	30.77%
Strongly Disagree	0	0.00%
Total	*26*	*100%*

5.1.3.3 Managers lack necessary training in quality philosophies and techniques.

Table 46

	Number	Percentage
Strongly Agree	3	11.54%
Agree	14	53.85%
N/A	2	7.69%
Disagree	7	26.92%
Strongly Disagree	0	0.00%
Total	*26*	*100%*

5.1.4 Resources

5.1.4.1 Unwilling to allocate rewards to employees.

Table 47

	Number	Percentage
Strongly Agree	0	0.00%
Agree	9	34.62%
N/A	3	11.54%
Disagree	14	53.85%
Strongly Disagree	0	0.00%
Total	*26*	*100%*

5.1.4.2 Unwilling to allocate resources to areas that do not immediately generate profit.

Table 48

	Number	Percentage
Strongly Agree	1	3.85%
Agree	11	42.31%
N/A	2	7.69%
Disagree	11	42.31%
Strongly Disagree	1	3.85%
Total	*26*	*100%*

Table 49

Question 5.1	N	Mean	Std. Deviation
Management commitment			
Lack of managerial understanding regarding quality management	26	2.58	0.86
Lack of quality leadership among senior management	26	2.69	0.97
Impatience among managers, as focusing on financial returns	26	2.88	1.18
Employee commitment			
Employees continue to try to find short-cuts	26	2.38	0.85
Employees resist change in work habits	26	2.42	0.95
Poor worker/manager relations	26	3.12	0.91
Training			
Managers lack necessary training in quality philosophies and techniques	26	2.50	1.03
Costs (money and time) for training prevent establishment of adequate training programmes.	26	2.65	1.09
Workers lack quality skills and training.	26	2.65	0.98
Resources			
Unwilling to allocate resources to area that do not immediately generate profit.	26	3.00	1.10
Unwilling to allocate rewards to employees	26	3.19	0.94

***Note**: The means were derived from a scale "Strongly Agree" (1 point) to "Strongly Disagree" (5 points)*

Problems encountered in achieving desired quality results were chosen from a US survey (Terry, Stanley et al. 2002).

The implementation difficulty runs through four categories (Management Commitment, Employment Commitment, Training, and Resources) that have been tested and identified. From the management side, responses indicate that managers are intent on improving quality, but they do not know how to improve effectively. This is the same for most of the employees; they are just looking for a quick fix designed attempt.

Management Commitment

"Lack of managerial understanding regarding quality management" is the most popular factor here, followed by "Lack of quality leadership among senior management" and "Impatience among managers, as focusing on financial returns".

Employee Commitment

"Employees continue to try to find short-cuts" was listed as the first reason, which was closely followed by "Employees resist change in work habits"; the last factor was believed to be "Poor worker/manager relations".

Training

This result shows that there is a shortage of managers trained in quality improvement techniques in New Zealand IT organizations. Reasons of "Cost" and "Workers lack quality skills and training" are less important.

Resources

The factor "Unwilling to allocate resources to area that do not immediately generate profit" was closely followed by "Unwilling to allocate rewards to employees".

5.2 What do you think are the major benefits QM brings to your company (please check all applicable)?

Table 50

	Number	Percentage
Stay in business;	10	8.77%
Reductions in user complaints;	16	14.04%
Increased product quality;	18	15.79%
Increased profitability;	12	10.53%
Lower costs.	16	14.04%
Reduction in incidents and errors	20	17.54%
Employee satisfaction	9	7.89%
Greater customer loyalty	13	11.40%
I don't know	0	0.00%
Total	*114*	*100%*

Results indicate that it is largely the traditional benefits from quality control, a decline in errors and product quality improvements, that the enterprises have gained and expect to gain in the future.

All these benefits are the variables of product quality and process quality. From the feedback to this question we can see the relation between total quality and product quality and process quality:

Table 51

Reduction in incidents and errors	1
Increased product quality;	2
Reductions in user complaints;	3
Lower costs.	4
Greater customer loyalty	5
Increased profitability;	6
Stay in business;	7
Employee satisfaction	8

Table 51 lists the ranking of the major benefits QM brings to companies as believed by respondents.

Hypothesis Tests

H_1 is tested through question 1.5 and 5.2.

H_1: V_{21} (Product Quality) is influenced by V_{17} (Process Quality).

To test the hypothesis, MINITAB was used to analyse the data, and Pearson Chi-Square was used to calculate the P-Value.

Here the result of question 1.5 was used to indicate the process quality (V_{17}), and since the pattern of answer question 1.5.1 and 1.5.2 is exactly same, the answer of 1.5.1 was used to analyse the P-Value. Also, in question 5.2 the answer for increased product quality was used to indicate product quality (V_{21}). MINITAB was used to calculate the P-Value. The result is shown as below.

Table 52

Tabulated statistics: C1, C2

Rows: C1 Columns: C2

	N	Y	All
N	8	15	23
	34.78	65.22	100.00
	100.00	83.33	88.46
Y	0	***3***	3
	0.00	100.00	100.00
	0.00	16.67	11.54
All	8	18	26
	30.77	69.23	100.00
	100.00	100.00	100.00

Cell Contents: Count
% of Row
% of Column

Unfortunately, there were only 26 samples, and in question 1.5.1, only 3 out of 26 chose the "YES" answer (3 projects running within time and budget) as highlighted in Table 52. In MINITAB, 2 cells with expected counts were less than 5, so it was not possible to get significant results to prove this hypothesis.

But from the literature review, Ahire & Ravichandran (2001) proved that it is more likely that a high process quality project will deliver high quality deliverables. So even

though this research could not prove that the hypothesis is true, the research model will still be based on a relation between process quality and product quality.

H_2 is tested through question 1.3; 4.3 and 5.2.

H_2: V_{21} (Product Quality) is influenced by V_{18} (In-house/ Off-the-shelf) and V_{19} (Organization Size).

H_{21}: V_{21} is influenced by V_{18};

H_{22}: V_{21} is influenced by V_{19}.

H_{21}: V_{21} is influenced by V_{18};

The result of question 5.2 (increased product quality) was compared with question 4.3 (In-house/ Off-the-shelf acquisition method).

Two methods (In-house/ Off-the-shelf acquisition method) were also tested separately as:

H_{21}: V_{21} (Product Quality) is influenced by V_{181} (In-house)

Table 53

Tabulated statistics: inhouse?, product

Rows: inhouse? Columns: product

	N	Y	All
N	2	10	12
	16.67	83.33	100.00
	25.00	55.56	46.15
Y	6	8	14
	42.86	57.14	100.00
	75.00	44.44	53.85
All	8	18	26
	30.77	69.23	100.00
	100.00	100.00	100.00

Cell Contents: Count
% of Row
% of Column

Pearson Chi-Square = 2.081, DF = 1, P-Value = 0.149
Likelihood Ratio Chi-Square = 2.162, DF = 1, P-Value = 0.141

* NOTE * 2 cells with expected counts less than 5

H_{21}: V_{21} (Product Quality) is influenced by V_{181} (In-house) can not be proved in this survey due to limited data.

H_{21}: V_{21} (Product Quality) is influenced by V_{182} (Off-the-shelf)

Table 54

Binary Logistic Regression: product versus off-shelf?

```
Link Function: Logit


Response Information

Variable  Value  Count
product   Y         18  (Event)
          N          8
          Total     26


Logistic Regression Table

                                                    Odds     95% CI
Predictor       Coef    SE Coef      Z      P  Ratio  Lower  Upper
Constant   0.0000000  0.577350   0.00  1.000
offshelf?
 Y           1.79176  0.957412   1.87  0.061   6.00   0.92  39.18


Log-Likelihood = -14.059
Test that all slopes are zero: G = 3.978, DF = 1,
P-Value = 0.046
```

P-value = 0.046 <0.05, means that there is a direct influence of off-the-shelf method and product quality. H_{21}: V_{21} (Product Quality) is influenced by V_{182} (Off-the-shelf) can be proved.

In conclusion, H_{21} can only partially be proved as the off-the-shelf acquisition method seems be able to relate to product quality. This was to be expected, as off-the-shelf products have been subjected to refinement and debugging over a significant period of time.

H_{22}: V_{21} (Product Quality) is influenced by V_{19} (Organization Size).

Here the number of full-time employees was used as the indicator of V_{19} (Organization Size). MINITAB was used to calculate the P-Value.

Results of question 5.2 (increased product quality) were compared with question 1.3 (number of full-time employees). Organization size was categorized as S (small), M (medium) or L (large), as shown in table 10.

Table 55

Tabulated statistics: Size, product

```
* NOTE * Fisher's exact test available only for 2 x 2 tables.

Rows: Size   Columns: product

             N        Y      All

L            2        2        4
         50.00    50.00   100.00
         25.00    11.11    15.38

M            3        5        8
         37.50    62.50   100.00
         37.50    27.78    30.77

S            3       11       14
         21.43    78.57   100.00
         37.50    61.11    53.85

All          8       18       26
         30.77    69.23   100.00
        100.00   100.00   100.00

Cell Contents:       Count
                     % of Row
                     % of Column
```

Unfortunately, a significant result could not be obtained due to the limited data sample. So H_{22} is not able to be proved here.

H_3 is tested through question 5.2.

H_3: V_{27} (Total Quality) is influenced by V_{17} (Process Quality) and V_{21} (Product Quality).

H_{31}: V_{27} is influenced by V_{17};

H_{32}: V_{27} is influenced by V_{21}.

Variables: Stay in business (V_{26}); increased profitability (V_{26}); Employee satisfaction (V_{28}); Greater customer loyalty (V_{29}) are the variables related to Total quality (V_{27}).

Variables: Reductions in user complaints (V_{16}); Lower costs (V_{15}); Reduction in incidents and errors (V_{25}) are the variables related to V_{17} (Process Quality).

Variables: increased product quality (V_{21}) is the variable related to V_{21} (Product Quality).

Their relation has been verified by using Chi-Square Analysis. H0 (null hypnosis) is that the row variable is unrelated to the column variable. P-Value < 0.05 rejects H0 and allows us to conclude that row and column variables are related. P-Value > 0.05 does not reject H0.

Table 56

Regression Analysis: Total versus Process

The regression equation is
Total = 1.571 + 0.0417 ProcessBen

S = 1.11510 R-Sq = 0.1% R-Sq(adj) = 0.0%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	1	0.0417	0.04167	0.03	0.856
Error	24	29.8429	1.24346		
Total	25	29.8846			

Fitted Line: Total versus Process

Correlations: rankProcess, ranktotal

Pearson correlation of rankProcessBen and ranktotal = 0.053
P-Value = 0.798

H0 (null hypothesis) here is that people are no more likely to tick "total" boxes just because they tick more "process" boxes. We are unable to reject H0 because of limited data.

So, H_3 can not be proved by this survey.

H_4 is tested through question 1.5.1 and question 3.2.

H_4: V_{17} (Process Quality) is influenced by V_1 (Management Commitment), V_2 (Quality Policy), V_5 (User Requirement), V_6 (Continues Improvement), V_7 (Quality Training), V_9 (Employee Commitment) and V_{11} (Process Control).

H_{41}: V_{17} is influenced by V_1;

H_{42}: V_{17} is influenced by V_2;

H_{43}: V_{17} is influenced by V_5;

H_{44}: V_{17} is influenced by V_6;

H_{45}: V_{17} is influenced by V_7;

H_{46}: V_{17} is influenced by V_9;

H_{47}: V_{17} is influenced by V_{11}.

Based on the respondents' Likert scale ratings for question 3.2, t-tests were calculated on the pooled sample variance. A statistical significant alpha level of 0.05 was applied, and the hypothesized mean difference is 0.

P-values measure how likely the data are if the hypothesis is true. Here in these two questions, if the p-value > 0.05, it does not reject the hypothesis; if the p-value < 0.05, it is likely that data might reject the hypothesis.

Table 57

Rows: process Columns: 3.2.2 Inclusion of quality prin

	1	2	3	4	5	All
N	1	1	12	7	2	23
	4.35	4.35	52.17	30.43	8.70	100.00
	50.0	100.0	85.7	100.0	100.0	88.5
Y	1	0	2	0	0	3
	33.33	0.00	66.67	0.00	0.00	100.00
	50.0	0.0	14.3	0.0	0.0	11.5
All	2	1	14	7	2	26
	7.69	3.85	53.85	26.92	7.69	100.00
	100.0	100.0	100.0	100.0	100.0	100.0

Cell Contents: Count
% of Row
% of Column

Pearson's r -0.347524
Spearman's rho -0.318171

Unfortunately, we can not get a significant result to calculate the P-Value because of limited results.

H_4 is not able to be proved by using this survey sample.

CONCLUSIONS

Research Question 1

What is the state of QM in NZ IT projects compared with other countries?

New Zealand's economic dependency on its food industries brought with it a major quality focus; the food export industries pioneered quality control and assurance well before the 1980s interest in QM. Much of this early awareness came from both an active drive for higher standards from the government and from unavoidable customer demand (Houston and McKean 2002). The concept of quality management in IT projects started at a much later stage in New Zealand as was discussed during the literature review. Through this survey we still find that most New Zealanders hold the strong belief that quality management is not just a term – it does work, and it can help organizations gain a competitive advantage over the competition.

By investigating IT projects (exceeding NZ$10,000) in New Zealand (Q1.5), this research has found that more than half of the projects (88.46%) run over time and budget, compared with an early survey done in the USA (Peter 1999) that found a failure rate of 46%. New Zealand had a worse record than the USA. But "New Zealand has some of the best talent in the world working on these projects but they're not doing it in any managed process." (Anthony 2005). What New Zealand needs is a good process to manage the people to do the right thing and get good results.

However, still 88.46% of respondents think their projects are a success (Q1.5.3). The assumption is that project managers or stakeholders are just concerned about the result of the projects; the result may have benefited their department and hence they would say that the project is a success. The conclusion is not based on the whole picture of the project.

The interesting thing in Q1.4 is that no one had chosen the job title "Quality Manager". Through the following interview, this phenomenon has been investigated; the answer by one of the interviewees is:

"Yes, it is unlikely we specially set a quality manager position, I think the position is either QA Manager or it could be part of the User Acceptance Testing Manager Role/Test Manager Role in some organisation."

It is likely that some small organizations would not establish this position at all; the CEO or some general manager would be responsible for all the quality issues.

Q2.1 tried to investigate the quality policy for IT projects in New Zealand; 19.23% of respondents answered that they do not have a quality policy at all. In an investigation of the reasons for this, 38.10% chose "Resistance to change", which listed as number one. People are unwilling to see changes, because change means that they need to spend time and energy to learn and become familiar; they feel more comfortable staying in the old pattern.

Table 58

Reasons checked	Importance Ranking	
	NZ	USA (Terry, Stanley et al. 2002)
Resistance to change (38.10%)	No. 1	No. 3
No enough resource (31.75%)	No. 2	No. 2
Lack of knowledge (23.81%)	No. 3	No. 1
Lack of conviction that QM work (1.59%)	No. 4	No. 4

The reasons listed here are the main obstacles for TQM implementation. In New Zealand, the responses to this question showed a big difference from the sample survey in the literature review; here "Resistance to change" listed as number one.

In the USA the respondents chose "Lack of knowledge" as the most common reason (Terry, Stanley et al. 2002). But in New Zealand, only 1.59% chose "Lack of conviction that QM works". People stay in the old pattern of quality processes, even

though they believe there is a big difference between having an IT methodology and having a repeatable, managed process that gives you predictability and control.

Since TQM is an organization-wide concept, it requires substantial investments in both time and money. Surveys of IS managers found that a marginal of IS managers (41%) understood the basic principles of TQM (Antonis and Ram 2000). In New Zealand, as small to medium sized companies count for the majority of businesses, there may be logistical difficulties in releasing employees from their jobs to attend training sessions or to act as facilitators or project managers due to not having enough time.

But also, we could see that New Zealanders still hold the belief that QM does work, as "Lack of conviction that QM work" ranked as the last for this question. So in the future, with more training and proper allocation of resources, we can see that there is more room for the development of QM techniques.

In Q2.2, the majority of respondents' companies (92.31%) were non-certified. However, in the USA, with employees from 500 to 999 (to map our survey enterprise size), more than 50% of the organizations are certified (Peter 1999). Not enough attention has been taken to address formal QM issues. Also, customers seem to not care whether or not the suppliers have a quality certificate.

In Q2.3, only two respondents said 100% of employees are involved in quality improvement (as a total employee involvement). This could mean that most of the companies are still running an old fashioned quality programme; the majority of employees are just getting the order and finishing the mission, and rarely have they been given all the information about what is going on.

TQM is designed by empowering employees to play a more active role in process improvement and quality monitoring. TQM practice clearly broadens employees' roles by allowing them to control their own actions and by providing them with accurate data and problem-solving skills. In contrast to other projects, IT projects invlove lots of different skills in the development process. The various roles speak different languages, almost; they certainly use different tools. It needs enough

communication, very clear visibility and certainly a lot of collaboration when you step through the lifecycle.

The results of question 3.1 show the reasons why companies implemented quality improvement.

Table 59

Question 3.1	NZ	USA (Manufacturing Engineer 1997)
Pressure from competitors	1	N/A
Pressure from users	2	1
Pressure from top management	3	N/A
Deterioration in performance, threatening survival	4	3
Marketing Tool	5	2

Most of the respondents said that their main reason for seeking improvement was "Pressure from competitors". In one survey done in 1997 in the USA, more than half (51.3%) chose "Pressure from user" (Manufacturing Engineer 1997), followed by "Marketing tool" (33.3%). But in this survey "Marketing tool" has been listed as the least important item. Using QM techniques in some senses does not result directly in higher quality performance (Ahire, Waller et al. 1995), but American companies still invest time, money and effort on it for marketing effect, to chase more customers to exceed their competitors. In New Zealand, most people do not count this as an important intention; this could mean that QM in some stages still has not been recognised enough by the public, so there is no need for them to invest in this as an "advertisement". But at the same time, they would more likely keep an eye on their competitors' actions.

Table 60

Quality management approaches (Q3.2)	Importance Ranking	
	NZ	Australia (Bishnu and David 2001)
Using customer requirements as the basis for quality.	1	4
A programme for continuous reduction in defects.	2	1
Inclusion of quality principles in mission statement.	3	2
Top executives active involvement.	4	3
Employee training in quality principles.	5	6
More active employee involvement.	6	7
Programmes to find wasted time and costs in internal processes.	7	5

Organizations in NZ consider customers' requirements more important than organizations in Australia (Bishnu and David 2001). In New Zealand, businesses believe that the customers' requirements are the most important factor, especially in order to keep their current customers. Companies with the deepest and strongest customer relationships will stand the best chance of retaining a customer's transactions. However simply reacting to customer demands or competitive threats fails to link quality to strategy and leaves the company without a firm foundation on which to build a quality culture.

Many companies are selecting a few key market targets and concentrating on trying to serve them better than their competitors. Many companies do their best at figuring out how to provide high quality at low cost (Mosad and Torbjörn 2001). Customer satisfaction is the objective of TQM. Deming also considers customers to be the most important part of the production line, as discussed in the literature review. Producing a high quality product or service that does not meet customers' needs and expectations will be a waste of resources for the organisation.

New Zealanders seem to realise the importance of quality, but the problem is they do not know how and who is to implement it. The most urgent things to improve the situation are more training activities and increasing top management's commitment to quality implementations.

Part four of the questionnaire is about the quality plan. The purpose of the IT project quality plan is to define how to deliver products that meet the customer's quality expectations and the supplier's quality standards. The document will be part of the text in the project initiation document. Without a quality plan, it will be hard to control the quality process and also hard to trace who is responsible when something goes wrong.

There is no obvious preference of in house development or off-the-shelf products being chosen by IT projects in New Zealand (Q4.3). It is more often than not dependant on what kind of functionality it needs.

Table 61

Q5.2	Importance Ranking	
	NZ	USA (Peter 1999)
Reduction in incidents and errors (V_{25})	1	1
Increased product quality (V_{21});	2	3
Reductions in user complaints (V_{16});	3	2
Lower costs (V_{15});	4	7
Greater customer loyalty (V_{29})	5	5
Increased profitability (V_{26});	6	6
Stay in business (V_{26});	7	4
Employee satisfaction (V_{28}).	8	8

From question 5.2, we can see one significant relationship between the approaches and the financial performance of the New Zealand respondents. The profit growth was influenced by quality improvement through reduction of errors and customer feedback, but there is not an emphasis on employee satisfaction. This pattern is similar with the literature question (Peter 1999); the major difference is on item "Lower costs", which ranks 4th, while in the USA it ranks 7th.

Research Question 2

What factors affect the quality of IT projects in NZ and how can we improve overall quality and project success rates?

Table 62

Question 5.1	Mean	p-value
Management commitment		
Lack of managerial understanding regarding quality management	2.58	0.777378
Lack of quality leadership among senior management	2.69	0.462724
Impatience among managers, as focusing on financial returns	2.88	0.292518
Employee commitment		
Employees continue to try to find short-cuts	2.38	
Employees resist change in work habits	2.42	0.8298
Poor worker/manager relations	3.12	**0.043333*
Training		
Managers lack necessary training in quality philosophies and techniques	2.50	1
Costs (money and time) for training prevent establishment of adequate training programmes.	2.65	0.294547
Workers lack quality skills and training.	2.65	0.269086
Resources		
Unwilling to allocate resources to area that do not immediately generate profit.	3.00	0.103916
Unwilling to allocate rewards to employees	3.19	**0.0437*

After doing a t-test for the factors that affect the quality of IT projects, Poor worker/manager relations (V_{13}) and Unwilling to allocate rewards to employees (V_8) do not seem to significantly influence product quality in New Zealand.

The implementation difficulty runs through four categories (Management Commitment, Employment Commitment, Training, and Resources) that have been tested and identified. From the management side, responses indicate that managers

are intent on improving quality, but they do not know how to improve effectively. This is the same for most of the employees; they are just looking for a quick fix designed attempt.

Management commitment

Managers are intent on improving quality, but they do not know how to make progress along what they see as a long and challenging implementation journey. So what is happening is that managers talk about quality management but just do the same old things, which are not effective or efficient.

Quality techniques cannot be implemented if management do not want to. This is where leadership is needed and the empowerment of employees for TQM in order for it to be successful. Leaders must do more than just talk, they must change conceptually and structurally to bring leadership to life at all levels. Quality cannot be delegated by top management but must start with them in the boardroom, and cross-functional teams can play an important role in deciding how and where to start the TQM effort. For QM to work, the workforce must not only be trained and educated, but must be "trusted" to make informed decisions on how to improve the work process continuously.

QM is most successfully implemented in organizations where commitment, involvement, and sponsorship of the top management team are high. By being involved in the implementation process and periodic reviews, managers will be able to see if the improved process is producing the desired results. Close scrutiny invariably identifies the underlying reasons for the failure to properly adopt the TQM concept, as this shows a lack of support and monitoring from top management (Laszlo 1997).

Employee commitment

Management sometimes forgets the importance of clearly communicating programme procedures and expectations. Given the need for widespread commitment to the quality initiative, it is absolutely critical that everyone not only

sees the same quality vision but also understands their individual and specific roles in delivering outstanding quality.

Also workers were often found to lack the "motivation" and "discipline" to make a quality programme successful, due to the resistance to change in work habits and a lack of buy-in to a new philosophy. They fail to understand the benefits that TQM will provide to them personally, making their job easier. Workers also have a fear of new technology, as it may have the impact of making their job redundant.

Employees are the engine of a business – they determine how far and how fast the business will grow. Employees in organizations need to know clearly what is expected of them and how they can contribute to the attainment of their organizations' goals. Establishment of effective communications is an important factor in this respect.

Training

This result is consistent with prior findings that there is a serious shortage of managers trained in quality improvement techniques in New Zealand IT organizations, suggesting that the managers feel that a formal QC department would do a better job of improving quality than they would.

Management tends to neglect the central role of training. Workers need to know what is expected of them, such as the functional skills and quality tools needed to build quality into the product as well as the processes. Consistent and sustained training is thus a prerequisite to quality. The problems tend to increase when training programmes lag behind strategic initiatives as well as when insufficient resources are dedicated to the quality programme.

It is also important to recognize that QM also might have implications for management development. Given the likely impact of quality management's introduction on management style, with an emphasis on empowering service workers and thus on interpersonal skills and new styles of leadership, many developmental needs are likely to arise.

Resources

From the results of the survey, it needs to be realized that successful employee training programmes demand a significant investment in terms of both financial and human resources. They can also take up a great deal of time which can adversely affect production schedules and deadlines. Management should be aware of these factors and therefore tend to question the necessity of employee training programmes when revenues are scarce and/or production demands are at a peak.

Recommendations for Improvement

Based on this research, the following items should be taken into account by IT quality management in New Zealand.

1. A position of Quality Manager should be set for each IT project. This is an independent position, reporting directly to the Executive Manager instead of the Project Manager. The Quality Manager's role includes being responsible for managing the company's quality systems, and through liaising with the company's management leadership team in the continuing improvement and development of these management systems. The role includes ensuring that project staff personally understand quality procedures and are implementing them in a consistent and practical manner.

2. CI is driven through the understanding that change is inevitable in all aspects of the project (Small 2000). Proposals for change should be included in a quality plan which requires thorough investigation to ensure that benefits are substantiated prior to implementation. Drivers for change may derive from market forces, the need to reduce costs, innovative technical approaches to existing ways of doing things, problem solving, or correcting errors that may have occurred.

3. An incident control system is in place to encourage all staff members to submit their input to the continuous improvement of the company's management systems. The new problems and solutions should be added into the database for the future reference.

4. To ensure client satisfaction, specific Client Project Quality Plans should be tailored to suit a client's particular applications. Where appropriate, training and audits should be programmed to ensure compliance with the project procedures. An integral element of enhancing client confidence is through the application of various checking and verification activities (e.g. client satisfaction surveys) that are arranged through the management system. The "client", in this regard, could be internal (i.e. the intended users, or stakeholders, of a new information system) or external.

Research Question 3

Do NZ organisations realise appropriate cost/benefit ratios from IT project QM, and so ensure they are not 'over-spending' on achieving levels of quality that exceed their needs?

Not enough data was obtained from the survey to analyse the costs incurred in applying quality assurance techniques in NZ IT projects.

Question 4.5 investigated the ratio between the cost of quality and the whole budget of the project. Most of the people did not answer the question, the reason being that they are unable to isolate the cost of quality from the cost of the project. In an investigation of the problems relating to cost of quality plans, the number one issue listed was "responsibilities for dealing with quality costs had not been agreed", which could possibly relate back to question 1.5. Once the position of quality manager is set, the responsibility of measuring the cost of quality could then be allocated. Also 25% of the respondents believe that "Getting an accurate cost for quality" is very difficult. The proper tool or process to monitor the actual cost of quality should be included into the processes of IT projects.

The current economic conditions make it necessary for all organizations to review and tightly control costs and expenditure. At such periods of time, management often has the tendency to put quality on the back burner due to financial constraints. Ironically, those are the occasions which present the greatest opportunities for minimizing operational losses by the judicious pursuit of quality improvement projects (Laszlo 1997).

Since TQM is an organization-wide concept, it requires substantial investments in both time and money. In New Zealand, because most organizations are of small to medium size, there may be difficulties in releasing employees from their jobs to attend training sessions or to act as facilitators, while for the larger companies there is the need for a large training budget, not just for TQM training, but for all training throughout the organization. Many companies find that the enormous cost of introducing TQM is caused by the long periods of time needed to introduce TQM throughout a large organization.

Research Question 4

Can an improved IT project process quality methodology and/or management tool to simplify the initiation and on-going implementation of Project Management Quality Management within an organisation be developed?

A case study followed the survey after the results had been analyzed. Initial contact with interviewees was made by telephone and then by e-mail. The interviewees were identified through feedback to the survey; following the initial telephone discussion the aims and the likely duration of the interviews, then objectives of the case study were outlined. The objective of the interview was to develop an improved model to simplify the initiation and on-going implementation of a quality management programme. The format for the interview is shown in Appendix 2.

NZ Police Integrated National Crime Information System (INCIS) Project

Before the interview started, a readily available case, the INCIS project, was investigated. In 1993, New Zealand Police developed and implemented an Integrated National Crime Information System (INCIS) to provide improved crime related information, to provide investigation and analysis capabilities, and to enhance the efficiency and effectiveness of operational policing. INCIS provided total lifetime benefits of $533.7 million. These benefits would start to be achieved in Year 3 of the project (1995/96). A further $1.8 million would be saved from other costs, for a total

of $74.1 million. 1.9 million hours represented approximately 11% of the 17 million hours worked by Police staff over a twelve month period (Small 2000).

Even though INCIS was a failed project, some lessons and recommendations based on INCIS are still quite valuable to this research. Here, only some key points which contribute to the research model are listed.

Table 63

INCIS
- Ensure Independent Quality Assurance (IQA) - Monitoring of the project - Clear business case and quality plan

To endeavour to ensure effective IQA (Independent Quality Assurance), Cabinet or a Minister should give consideration to directing that the Monitoring agencies (Small 2000):

1. "In consultation with the Chief Executive establish the criteria against which IQA is to be measured.
2. Endeavour to arrange, through the applicant's contract with the provider, for the person or organization conducting IQA to have access to the relevant records of the provider.
3. In consultation with the Chief Executive, settle the terms of reference and appointment of the person or organisation who is to conduct the IQA.
4. Require the person or organisation conducting the IQA to report to the Monitoring agencies and to the governance and management of the project. "

The approval and monitoring regimes should be made more robust.

> "Specifying the requirements for an application and attaching directions to any approval. The Monitoring agencies should be sufficiently resourced to enable them to participate effectively in the approval and monitoring regimes."

Very clear and detail business cases and quality plans should be made.

> "Stakeholders should require a proper business case, baselines and milestones that provide a base from which effective monitoring can be performed."

Summary of interviews key findings:

Table 64

Interviewee 1
- Formalise the QA process; - Stakeholder should be involved in each stage of project; - Independent quality audit process should be set; - Continues improvement should be planned in; - Define the IT organization and relationships; - Good communication is important.

Table 65

Interviewee 2
- Quality plan should be included - Continues monitor of the project process; - Deliverables and Measurement Activities; - Manage changes; - Resource Management Plan. - Schedule Plan;

QA refers to the activities performed to provide adequate confidence that a product or service will meet established requirements. Questions were asked about what are the most important methods/factors to ensure QA effectiveness in IT projects:

> "...the requirement to formalise in some way the QA process – it needs to be structured to ensure that all elements of process analysis and development are covered and checked..." (Interviewee 1)

As a very important TQM element which also been widely discussed during literature review, it is believed by both interviewees that CI is important in an effective IT project quality management. Regarding the detail of what measures or methods to implement CI, they offered some ideas.

> " ... by monitoring on quality of deliverable/product – less errors ... Time to market... the monitor of new technology ... the change of requirement..." (Interviewee 2)

And the idea had also been agreed as:

> "... the adaptation or modification of the methodology to suit the project..." (Interviewee 1)

A sound quality plan is very important for the success of the IT project. It is essential to have a quality plan in every IT project. Besides from the items which usually should be included in the quality plan, some more suggestions are believed necessary to be included in IT project quality plan.

> "...the project plan needs to be of a level of complexity which parallels the size of the project – in other words, the issue is not the specific items, they should all be there, the issue is the depth to which they are taken..." (Interviewee 1)

Also, it was said that:

> "Change Management Plan, Resource Management Plan, Schedule Plan are very necessary to be included into quality plan" (Interviewee 2)

IT project quality is the correct and smooth running of a system. It depends significantly on the quality of the process in place. It is necessary to have an appropriate structure for effective monitoring of IT project process quality.

> "This is a stakeholder issue. Each stakeholder should be represented, if at all possible by people who are not actively involved in the project,

so that they can be impartial. Each should know what is expected from their part of the project, and study project planning and activity to ensure that the work leads to them getting what they require from the project. In theory that will result in all interests being met. In practice, there will inevitably be a need for compromise and the function of the QA group is to ensure that the compromises do not threaten the success of any part of the project." (Interviewee 1)

Also

"...process mmeasurement activities should be incorporated in the planning process..." (Interviewee 2)

Proposing the quality management model

The model is based on the "Deming Circle", and has been modified by interviews and the results from survey. Also, another source of case material, the INCIS Project, was reviewed. The model has been modified several times during the interviews, with more detailed actions explained and added into the circle. The interviewees had years of working experience in IT project management and quality management.

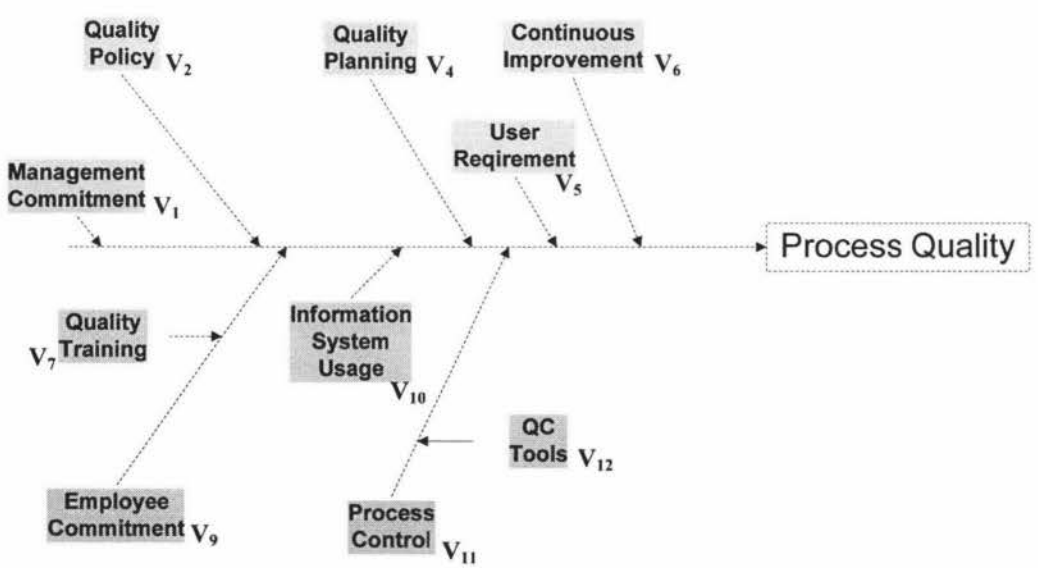

Figure 19

The research is trying to improve the quality of prediction; thus it needs to obtain sufficient knowledge to understand where we can achieve these improvements. One of the best ways to do so is to build a model. The model should:

(1) Include the important aspect of NZ IT project quality management;
(2) Suit any IT organization;
(3) Be easily understood by those involved.

The proposed quality model is:

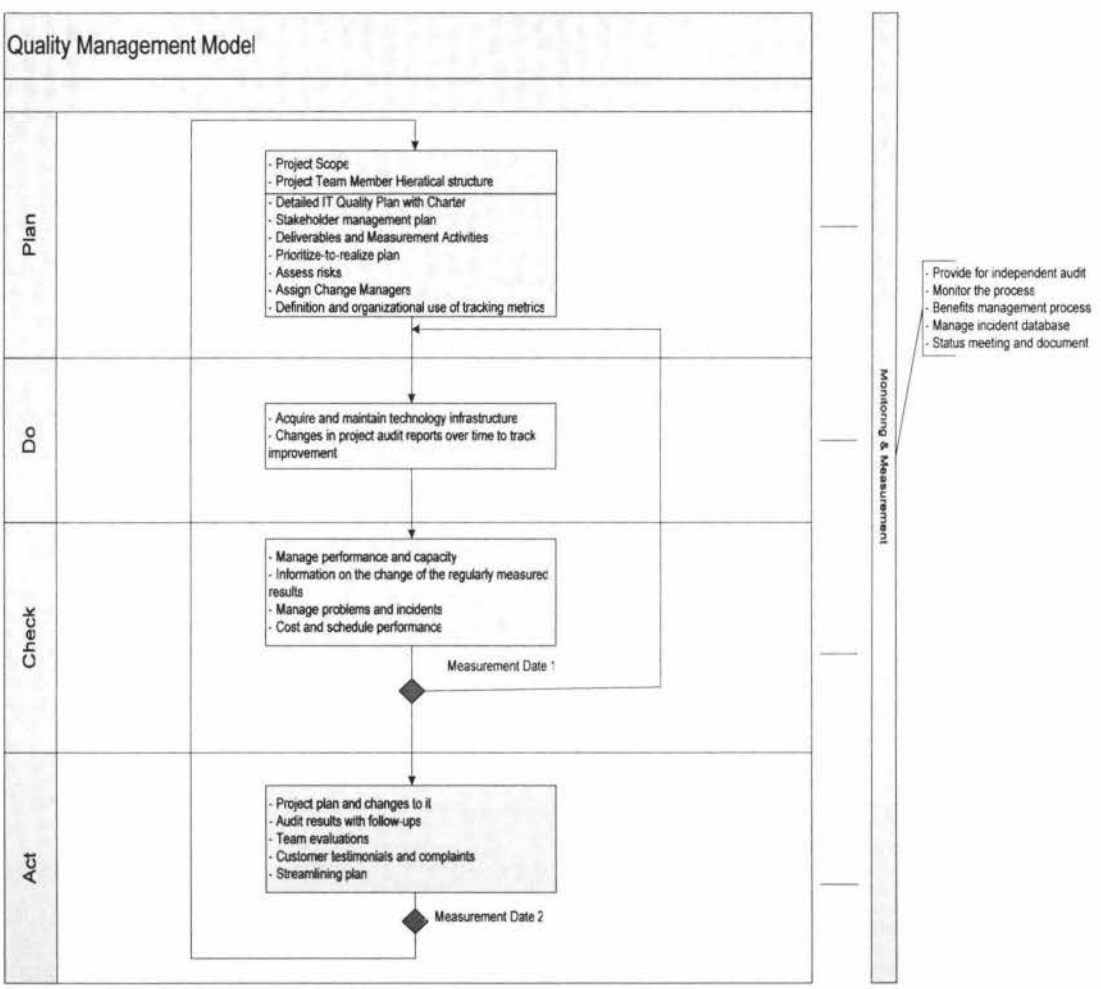

Figure 20: TQM implementation and improvement model

In the Plan stage, the team (which often includes customers) defines the overall goal, and the strategic direction, and then writes the vision of the desired future state. Each stakeholder should be represented; each should know what is expected from

their part of the project. Project plan needs to be of a level of complexity which parallels the size of the project – in other words, the issue is not the specific items, they should all be there, the issue is the depth to which they are taken. Use the tracking metrics to assign the responsible of team. Encourage change managers, find those willing to make a stand and push for change and give them voice (Harrison 2002). Establish an enterprise wide prioritization process that objectively and continuously evaluate project to help maximize and realize the value from investment (KPMG 2005).

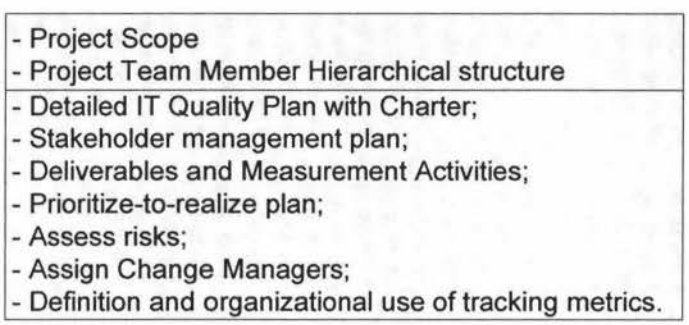

Figure 21

In the Do stage, this is the stage where the work is realised, executing the improvements, inserting the technology, and reducing the cycle time, etc - whatever goals and plans have been determined. The deliverables of each phase of the project are measured (project audit). The measured results are stored in a database for future reference.

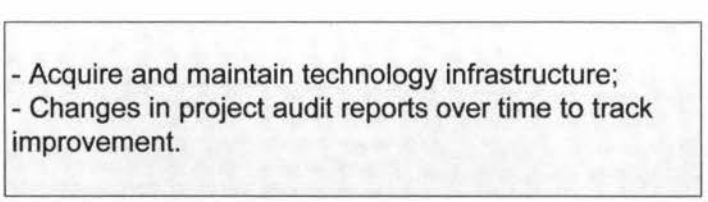

Figure 22

In the Check stage, analysis the data collected from DO stage by using the different QC tools; errors' causes are identified and removed to maintain the performance. All actions and information of the changes should be recorded into incidents database. Monitor the time and cost performance.

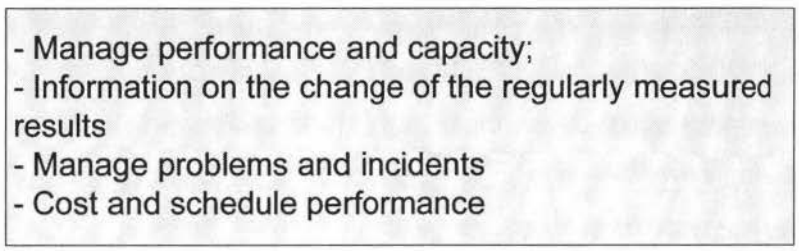

Figure 23

In the Action stage, the developer and tester improves the problems found during the review activities, and studies project planning and activities to ensure that the work leads to them getting what they require from the project. At the end of this stage, good communication with clients should be conducted to ensure their satisfaction. Streamlining plan is the modest adjustment of processes to address problems and introduce optimal methods for performing the work.

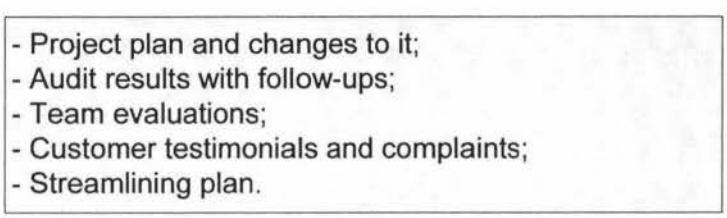

Figure 24

In this quality management model, CI is ensured by two measurement circles as indicated in figure 20 with two measurement date. CI is largely a process rather than a product, but there is a mix of the two outcomes which leads to adaptation or modification of the methodology to suit the project.

Also, there is an independent process to "audit" the whole project process, which is the "Monitoring and Measurement" process. People who are in charge of this process should independently report to general manager. Monitoring and measurement efforts consist of scope, budget control and acceptance activities. The benefits management process compares the benefits with both time and cost budget to indicate the performance. This critical process transcends the entire project management process to help ensure on-time project completion within estimated cost parameters, along with properly managed and approved schedule and scope

changes. The process should record all correspondence and key documents, minutes of meetings and all the decisions. The errors which have been identified during each stage should be added into an incident database, so the process keeps changing.

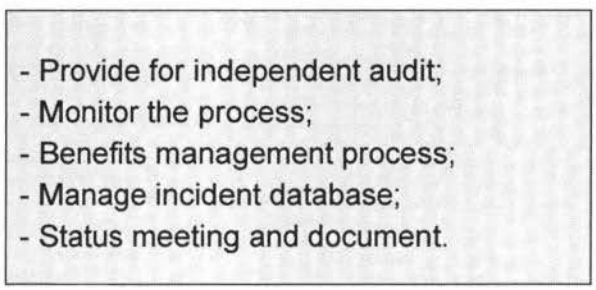

Figure 25

From this research, it is suggested that the following are keys for successful implementation when applying this quality model:

1. in-depth knowledge of the quality process;
2. formal training;
3. good documentation;
4. appropriateness of tools selected for use;
5. the quality process should be monitored by quality management;
6. applying the same model at all levels in the organisation to aid communication and learning.

Summary

In summary, the result of this quality management investigation in New Zealand is an awareness of the scarcity of full or proper TQM and the widespread adoption of TQM practices in a partial fashion. Large firms were found to be more systematic in the way that they managed quality. Smaller firms may have limited long term perspectives, so they focus on immediately relevant issues such as quality control.

Companies seem to pick up fragments of TQM and then report that they are operating TQM, when in reality most schemes appear an ill-matched mixture of quality circles, employee involvement, quality tools and long-established QA systems.

This exploratory study of the extent of quality management in IT projects in New Zealand has raised several practical issues for managers and front-line supervisors to consider. It is to be hoped that documenting it in this way will contribute in its own way to international knowledge about quality practices.

This research was conducted as an exploratory study, and hence did not seek statistically significant empirical evidence. It is thus suggested that future research overcome this limitation. Also a more systematic survey should be conducted for stronger evidence.

Limitations and Future Research

This research is limited by the survey response limited rate and the small number of cases (two case studies). So, the results do not support the research strongly.

1) Unwilling participant organizations. For the survey 200+ questionnaires were sent out, but the response was only 26, and only two of the respondents were willing to participate in the case study. So for future research, a wider survey population should be planned in advance. Also it is suggested that experiment may be better methodology to test the quality model.
2) Limited resource available to the researcher. No funding for direct research costs, such as data collection, travel, or transcribing interviews etc. was available.
3) Future research might also consider including more than one implementation cycle approach to optimise knowledge building and data collection.

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APPENDICES

Appendix 1: Survey Questionnaire

A Preliminary Survey of an Investigation into the Use of Quality Management Techniques in NZ IT Projects

September 2005

Summary:

This study is aimed at gathering information to analysis the usage of quality management techniques in NZ IT projects, following development of the improved and simplified quality management model.

Any organisation that returns a completed questionnaire, and provides contact details, will be eligible to have a study conducted within their organisation at no cost. The research results will be used to complete a Maser thesis. All outputs will be available as open source information, although survey respondents' details will be treated as confidential if respondents so wish. The study will be overseen by the principal researcher, Lynn (CV available if required).

Although the survey size may appear daunting, some of it will not be applicable for most respondents. Estimated time to complete is 15 minutes.

Contact Details

If you have any questions or comments about the survey, please feel free to contact the principal researcher: Lynn, Massey University Albany Campus, Ph [redacted] email [redacted], or the research supervisor, David Wilton, Massey University Albany Campus, Ph (09) 4140800 ext 9594, email d.r.wilton@massey.ac.nz,

You are under no obligation to participate in this study, if you decide to participate, you have the right to:

- *decline to answer any particular question;*
- *withdraw from the study, within three months of returning the questionnaire;*
- *ask any questions about the study at any time during participation;*
- *provide information on the understanding that your name will not be used unless you give permission to the researcher;*
- *be given access to a summary of the project findings when it is concluded.*

This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researcher named above is responsible for the ethical conduct of this research.

If you have any concerns about the conduct of this research that you wish to raise with someone other than the researcher, please contact Professor Sylvia Rumball, Assistant to the Vice-Chancellor (Ethics & Equity), telephone 06 350 5249, email humanethicspn@massey.ac.nz.

Even if your answer to most questions would be "no", this is still valuable information. Thank you for your assistance.

Confidentiality

Your contact Details:

Phone: _____

Email: _____
Mailing address:

_____

Identifying details will be treated as confidential if respondents wish. Do you require that any details that could possibly identify your organisation be treated as confidential?

Yes/No

Comments:

_____

_____

_____

PART ONE – Background Information about the Firm

1.1 Which primary industry group does your company fit into? (please check the right answer)

_____ A. Telecommunication

_____ B. Education and research

_____ C. Government

_____ D. Finance and business services

_____ E. Retail trade

_____ F. Information Technology

_____ G. Other_____

1.2 What is the average annual sales or income at your company in $NZ? _____

1.3 How many full-time equivalent employees work at your company? _____

1.4 What is your job function (Please check your answer)?

_____A. CEO

_____B. Quality manager

_____C. General Manager

_____D. Senior staff member

_____E. Other_____

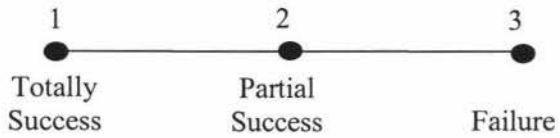
1.5 What is the name of your latest IT project which exceeded NZ$10,000 in budget

_____

1.5.1 How long did it take to complete this project (month)? _____; How long was its estimate time to complete (month)? _____

1.5.2 What was the original budget of this project ($NZ)? _____; What was the actual cost of the project ($NZ)? _____

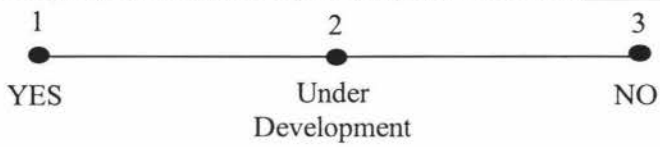
1.5.3 Did the final outcome meet agreed scope? (***your answer is*** _____)



Comments (Optional):_____

PART TWO – The State of Quality Policy

2.1 Does your company have a quality policy? (***your answer is*** _____)



If NO, The reason being_____ (check all applicable), then go to question 2.2

_____A. Resistance to change

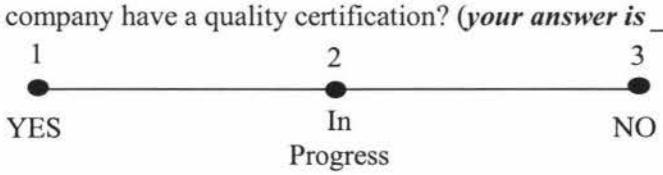
_____B. Lack of conviction that QM works

_____C. Lack of knowledge

_____D. No enough resource (time + cost)

_____E. Other _____

2.2 Does your company have a quality certification? (***your answer is*** _____)



If YES, please indicate the name_____;

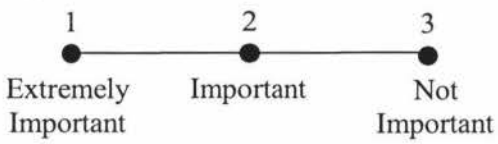
When was it issued? _____; and go to question 2.3

2.3 The percentage of employees involved in quality improvement? (%)____

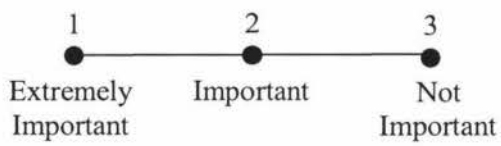
PART THREE – The Decision to Change

3.1 What were the drivers to implement quality improvement initiatives within your organization?

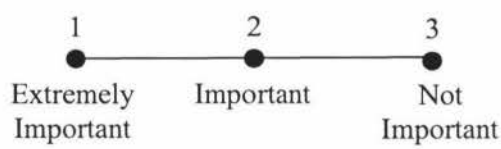
3.1.1. Pressure from users *(your answer is _____)*



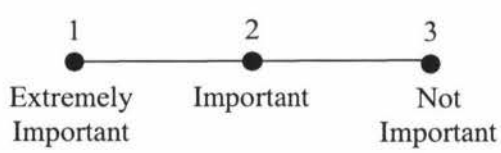
3.1.2. Pressure from competitors *(your answer is _____)*



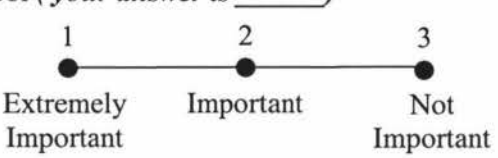
3.1.3. Pressure from top management *(your answer is _____)*



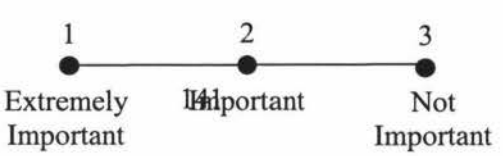
3.1.4. Deterioration in performance, threatening survival *(your answer is _____)*



3.1.5. Marketing Tool *(your answer is _____)*

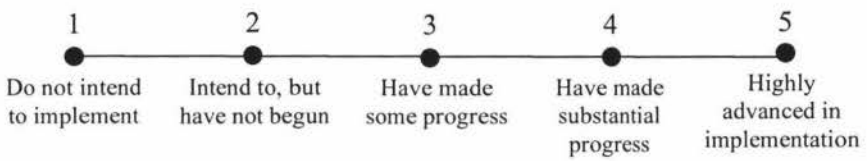


3.1.6. Others (please describe) _____ *(your answer is _____)*

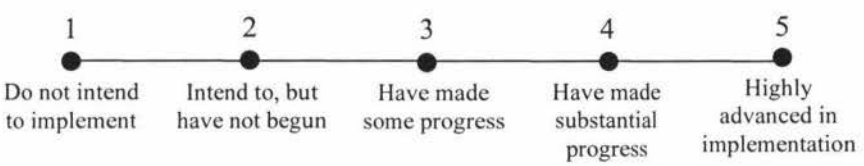


3.2 What does your firm perceive as being important in achieving quality related objectives? (Please circle most appropriate number to answer each question.)

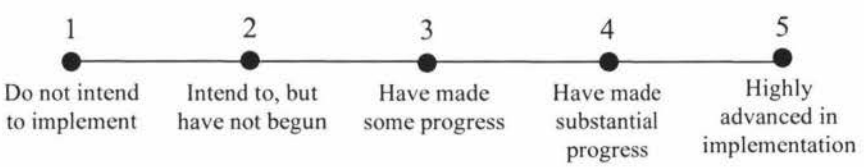
3.2.1 A program for continuous reduction in defects. ***(your answer is _____)***



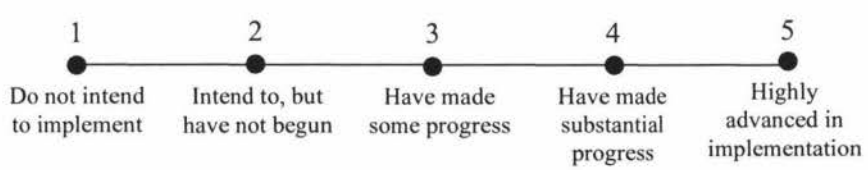
3.2.2 Inclusion of quality principles in mission statement. ***(your answer is _____)***



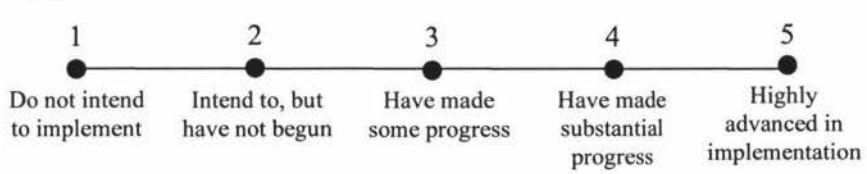
3.2.3 Top executives active involvement. ***(your answer is _____)***



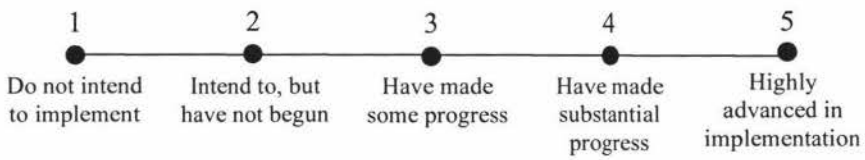
3.2.4 Using customer requirements as the basis for quality. ***(your answer is _____)***



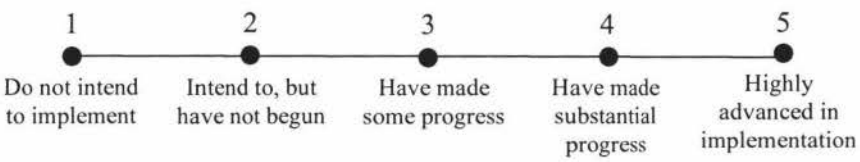
3.2.5 Programs to find wasted time and costs in internal processes. ***(your answer is _____)***



3.2.6 Employee training in quality principles. ***(your answer is _____)***



3.2.7 More active employee involvement. ***(your answer is _____)***



PART FOUR – Planning the Quality Program for the IT Project

4.1 Was there any quality plan? ***(your answer is _____)***

4.2 Who were involved in the planning? (please check all applicable)

_____A. Top management

_____B. Quality Consultant

_____C. All the management

_____D. All the employees

_____E. Project Staff

_____F. Other _____

4.3 What acquisition method was chosen for the project? ***(your answer is _____)***

A. In-house development

B. Off-the-shelf product

4.4 Please identify problems relating to the cost of the quality-related plan (check all applicable).

_____A. Responsibilities for dealing with quality costs had not been agreed.

_____B. Communication – quality data are being "squeezed" i.e. cut back from necessary report requirements and down to basics.

_____C. Getting an accurate cost for the simplest things (e.g. raw materials) is easy. Added-value figures are very difficult.

_____D. Don't have any method to trace cost to their source? (e.g. suppliers)

4.5 What is the likely cost of quality compare with the whole budget of project? ____%

4.6 Which QM tools are using in your company at the moment? (tick all applicable)

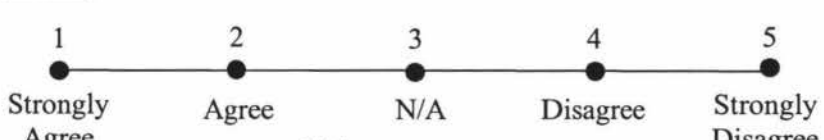
	Manual use	Computerized use	Not used at all
Cause and effect diagram			
Flow chart			
Pareto chart			
Run chart			
Histogram			
Control chart			
Scatter diagram			

PART FIVE – Effects of Change

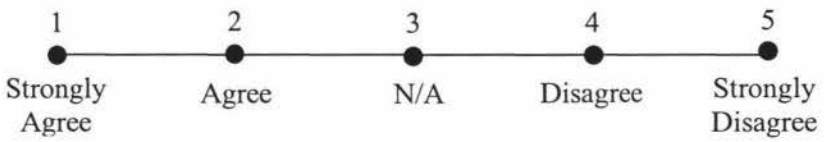
5.1 What factors affect the quality of IT projects in your company?

5.1.1 Management commitment

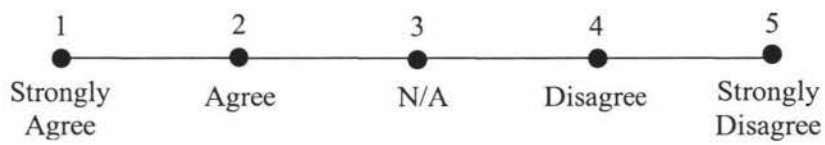
5.1.1.1 Lack of managerial understanding regarding quality management ***(your answer is _____)***



5.1.1.2 Lack of quality leadership among senior management ***(your answer is _____)***

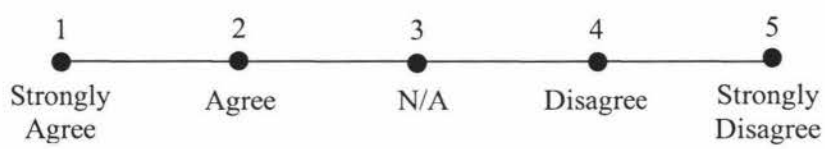


5.1.1.3 Impatience among managers, as focusing on financial returns ***(your answer is _____)***

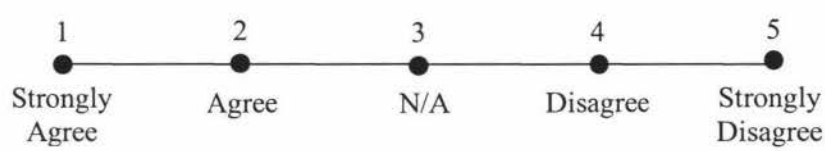


5.1.2 Employee commitment

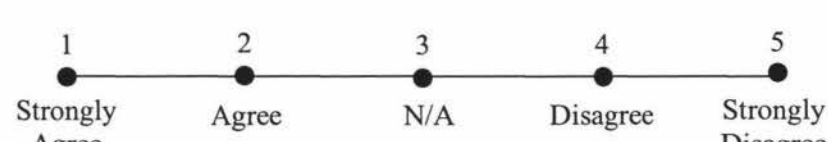
5.1.2.1 Employees resist change in work habits ***(your answer is _____)***



5.1.2.2 Employees continue to try to find short-cut ***(your answer is _____)***

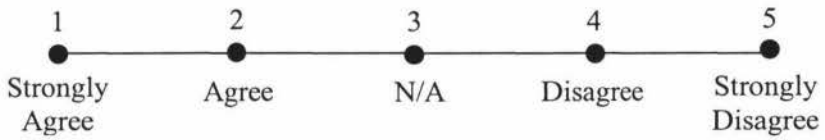


5.1.2.3 Poor worker/manager relations ***(your answer is _____)***

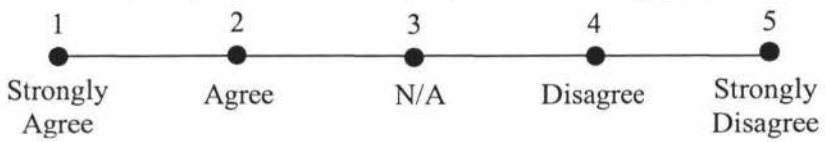


5.1.3 Training

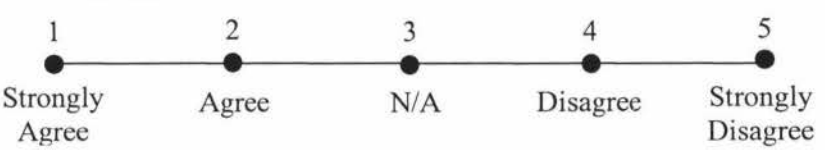
5.1.3.1 Costs (money and time) for training prevent establishment of adequate training programs. ***(your answer is _____)***



5.1.3.2 Workers lack quality skills and training. ***(your answer is _____)***

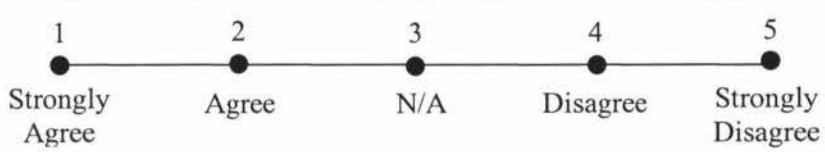


5.1.3.3 Managers lack necessary training in quality philosophies and techniques ***(your answer is _____)***

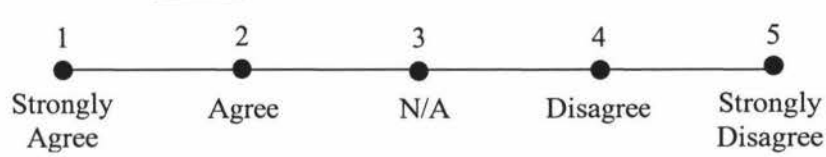


5.1.4 Resources

5.1.4.1 Unwilling to allocate rewards to employees ***(your answer is _____)***



5.1.4.2 Unwilling to allocate resources to area that do not immediately generate profit. ***(your answer is _____)***



5.2 What do you think are the major benefits, QM bring to your company (please check all applicable)?

_____A. Stay in business;

_____B. Reductions in user complaints;

_____C. Increased product quality;

_____D. Increased profitability;

_____E. Lower costs.

_____F. Reduction in incidents and errors

_____G. Employee satisfaction

_____H. Greater customer loyalty

_____I. I don't know

"The End"

Thank you for your time!

The information gathered from this survey will assist in the development of an improved and simplified model to implement quality management. The methodology will be open-source; that is, freely available for enterprises or individuals to use.

If you have provided contact details, a summary of research findings will be made available. Do you wish to receive such a summary?

Yes/No

Do you wish to be included on the list of organisations eligible for a no-cost consultancy effort involving action research on the improved methodology?

Yes/No

Appendix 2: Interview Questions

1. What IT project quality management processes do you use currently?

_____

_____

Are these enough/satisfactory?

_____

_____

2. What do you think are the most important methods/factors to ensure QA effectiveness in IT projects?

_____

_____

_____

3. Do you think "continuous improvement" (CI) is important in IT project quality management?

YES/NO

If "YES", what measures or methods do you think are required to implement CI?

_____

_____

_____

_____

4. Do you think it is essential to have a quality plan in every IT project?

YES/NO

If "YES", what items do you think are necessary to be included in IT project quality plan?

_____

_____

_____

_____

5. Do you think it is necessary to have an appropriate structure for effective monitoring of IT Project process quality?

YES/NO

If "YES", what do you think should be identified under this process?

_____

_____

6. Do you think it is necessary to have an appropriate structure for effective monitoring of IT Project product quality?

YES/NO

If "YES", what do you think should be identified under this process?

_____

_____