QUALITY MANAGEMENT
IN
COMPUTING SERVICES

A STUDY TO DETERMINE THE CURRENT STATE OF QUALITY MANAGEMENT PRACTICES OF COMPUTING SERVICES IN NEW ZEALAND'S INDUSTRIES

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ABSTRACT

This thesis reports the results of an empirical investigation into the general perception of quality management practices, the direction the New Zealand industry is taking in quality management and the current status of quality management practices in computing services of organisations and companies.

Computing services is a complex and multi-disciplinary field. It encompasses a broad range of technologies and activities and it involves other disciplines or skills to deliver those services. The range of technologies, activities and disciplines involved in computing services depend largely on the level of complexity and size of the computer systems implemented and of the complexity of the company. The computing services field also involves the understanding of other fields that utilise the computing services.

Adopting a quality management approach for the provision of computing services represents a different from but complementary approach to the traditional information systems engineering methods employed to achieve quality. It ensures that the processes used in the development and management of computing services are designed with the customers' requirements in mind and that the outputs of Information systems and information technologies (IS/IT) are serving the needs of other organisational functions.

It is in this context that the study focused on the use of quality management in the development and management of computing services. Quality management provides a framework (for all those methods and procedures) and the systematic approach for computing services to make IS/IT development more successful. It also incorporates the computing service providers into the overall quality system of a company.

The study involved a national survey. A questionnaire was mailed to 411 companies, 140 of which returned useable questionnaires, giving a 34% response rate. Descriptive statistics, cross-tabulation and chi-square significance tests were used to analyse the research survey data. The results of the study indicated that a large percentage of

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1. INTRODUCTION

Information systems and information technologies (IS/IT) are playing an ever increasing role in the management of all types of industry. Ultimately their usefulness and viability depend upon the quality of their performance, that is their ability to satisfy the needs of customers of the systems.

Achieving "quality performance" will not only provide a system that is far more likely to meet the customer's needs first time, it will also be more likely to gain a competitive commercial advantage for the organisation. Without "quality performance", the supplier and purchaser will spend increasing amounts of time and money on coping with error-prone and inefficient systems. Consequently, any poorly designed systems will be under-used and unproductive.

In their landmark book 'In Search of Excellence', Peters and Waterman (1984) identify a number of key factors that set the very successful companies of the world apart from the less successful ones. One of those key factors is the commitment to quality evident in the very successful companies.

The complexity of IS/IT, coupled with the frequent changes that have to be incorporated during the development, means that continuous attention to the quality of the system under development is needed to realise satisfactory products. The need is strengthened by the increasing penetration of IS/IT into everyday life. Low-quality products will leave customers dissatisfied and will make users neglect the systems that are supposed to support their work.

It is in this context that this research study focused on the use of quality management in the development and management of computing services that provide IS/IT. According to Willborn and Cheng (1994), the primary objectives of quality management are consistent conformance to customer's expectations and building the organisational strength through continuous quality improvement. Quality management provides a framework (for all those methods and procedures) and a systematic approach for

computing services to make IS/IT development more successful. It also incorporates the computing service providers into the overall quality system used to implement a company's quality policies.

This thesis reports the results of an empirical investigation into the general perception of quality management practices in the New Zealand industry, the direction the industry is taking in quality and the current status of quality management practices in computing services. The following is the overall research thesis structure.

1.1 THE THESIS STRUCTURE

Chapter 1 Highlights the need for a better understanding of the use of quality management in computing services and presents the overall structure of the thesis.

Chapter 2 Identifies the objectives and research questions.

Chapter 3 Reviews some of the definitions, background, problems, other research studies and the current state of understanding of quality management in computing services. The research context is also described.

Chapter 4 Presents an overview of the survey, approach and methodology, design, data collection technique, sample design, data collection, data analysis and interpretation of the findings.

Chapter 5 Concludes the study, discusses the limitations of the research and provides suggestions for future work.

2. OBJECTIVE

The primary objective of this study was to gain an understanding of the current state of quality management practices of computing services in New Zealand industries. In particular, the purpose of this research was to gain familiarity and/or achieve new insights into the current situation. The research included identifying the development of computing services, choosing an empirical measure and performing the empirical measurements of various factors that may affect quality management practices of computing services. An expected important contribution of this study is that other researchers may use the results for more extensive future research in the area of quality management and computing services.

A better understanding of the factors influencing computing services success could contribute to internal computing service departments or computing service companies becoming more competitive. Since today's companies are very vulnerable to any failure in their IS/IT activities, it is valuable to determine the relative impact of various individuals, technical and organisational factors on computing services' success. The focus of this study is quality management and it will be of special interest to computing services managers. In order to plan and manage quality management activities, computing services managers must have an adequate knowledge of their system, the overall environment and knowledge of quality management. The results of the research will also be of interest to quality managers and researchers involved with computing services.

Essentially the current state of quality management practices in computing services in New Zealand may be investigated by asking what departments or companies are doing to ensure the quality of the service they provide. In particular, the present research looked for general features, as evident in, personal perceptions, company philosophy, customer-supplier relationship, and good practice in the area of quality management. The research also explored several variables that may affect across company comparisons.

The study was designed to provide information helpful to the computing services industries and quality practitioners. More specifically, the study was an attempt to provide answers to the following research questions:

1. What is the current status of quality management practice of computing services in industry?

2. What is the level of acceptance of quality management standards?

3. What are some of the common quality standards adopted in industry?

4. What are some of the factors that may influence quality management practice?

3. BACKGROUND

This chapter reviews various definitions, concepts, theories and other empirical studies relevant to the research. It has four main objectives:

1) To identify the specific areas of interest for this study - namely, computing services, quality and quality management.
2) To give a background of and relate various concepts to the main areas of interest.
3) To identify key variables which could potentially influence quality management practices in computing services (as in the fourth research question).
4) To review the current situation and place the study in their context of previous studies.

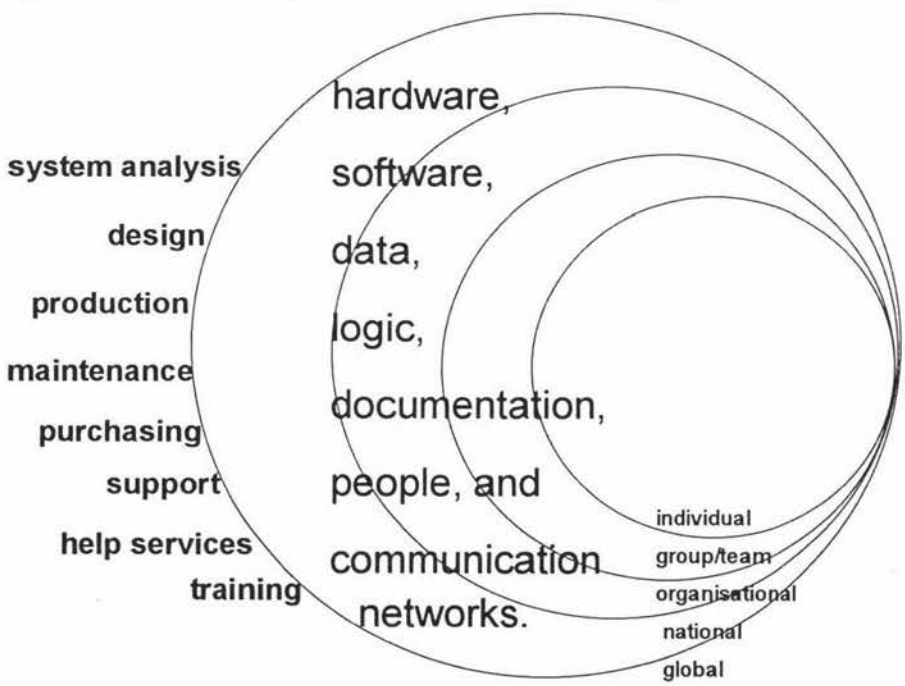
Section 3.1 reviews the literature to clarify the definition of Computing Services. Section 3.2 reviews the role of computing services in a changing environment. Section 3.3 examines the emergence of "End User Computing". Section 3.4 reviews some of the problems in software development and describes the software crisis. Section 3.5 reviews the importance of the relationship between customer and supplier. Section 3.6 clarifies some of the definitions of quality. Section 3.7 reviews the definitions and objectives of quality management. Section 3.8 reviews some of the quality standards that are relevant to computing services. Section 3.9 describes certification of quality system. Finally, section 3.10 summarises the nature and importance of computing services, their role and place within organisation and the problems while remain.

3.1 DEFINING COMPUTING SERVICES

Computing or IS/IT services are all those activities and functions supporting the IS/IT. Evans (1989) defined such services using the information system life cycle, including activities such as planning, development, system studies and requirement analysis, design, production, implementation, testing, maintenance, purchasing, usage, support, help service, and training. These services may be acquired from an external source or developed internally.

According to Gilb (1988), software is more than program code. It includes design specifications, user documentation, data, test cases, codes and human interfaces. Therefore, in a broader perspective, IS/IT may be illustrated in a general framework. Refer to Figure 3-1. It encompasses hardware, software, data, logic, documentation, people, and communication networks. The field is multi-disciplinary. It involves system analysis, design, production, maintenance, purchasing, support, help services and training programmes. It can be segmented into different levels of application, that is, individual, group, organisational, national and global. It is further fragmented by the levels of complexity of the systems that are used. Trying to extract common features from the literature is difficult as different studies deal with different technologies. Some studies deal with mainframe applications, others with office automation and still others with decision support systems and microcomputer applications.

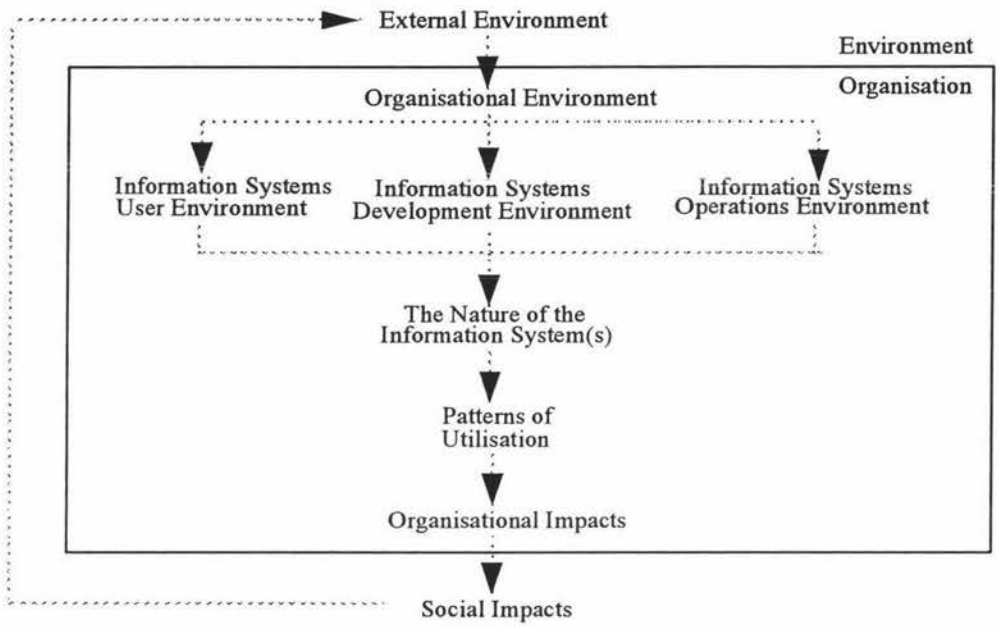
Figure 3-1: Information Systems and Information Technology



Another general framework, defined by Kraemer and Dutton for information systems research, is presented in Figure 3-2 (Kraemer and Dutton, 1991). As pointed out by Kraemer and Dutton, this general framework reflects those identified in earlier frameworks for the study of information systems.

This general framework has provision for a broad range of computing services. It also includes the consideration of computing services provided within the organisation and between organisations.

Figure 3-2: A Conceptual Framework for the Study of Information Systems *



* Adapted from Ives, Hamilton, and Davis (1980) and Kraemer, Dutton, and Northrop (1981).

Kraemer and Dutton, have identified nine major conceptual categories:

1) the external environment, including the political-administrative, socio-economic, cultural, and technological environments within which organisations are embedded;
2) the organisational environment, including such characteristics of organisations as size and industrial sector;
3) the information systems environment of users, including users' characteristics and the tasks for which they employ information systems;
4) the information systems development environment, which incorporates characteristics of development staff as well as how organisations develop information systems;
5) the operations environment, particularly the way in which the management of information systems is organised;
6) the nature of information systems, including such features as the quality and form of information provided to users;

7) patterns of utilization, including the ways organisations have adopted, implemented, and used information systems;
8) organisational impact, which refers to consequences for individuals, groups, and the organisation as a whole (eg., impacts on decision making); and
9) social impacts, outcomes of information technology that extend beyond the boundaries of an organisation (eg., to the organisation of work at home, employment, and implications related to individual privacy, civil liberties, and property rights).

Hence, from the various definitions of computing services (or IS/IT services) in the literature review, it was recognised that the field is complex and diversified. Meta-research studies have found that several IS/IT research studies were fragmented or have not dealt with some of the more important variables and issues (Kraemer and Dutton, 1991).

3.2 COMPUTING SERVICES AND THE CHANGING ENVIRONMENT

Over the past twenty years there have been tremendous changes in both IS/IT and the business environment. New ways of thinking about the corporate possibilities in the use of computer technology are forcing computing services personnel to re-evaluate their position, direction, and management style (Pang and Smith, 1992).

From the organisational perspective, computing services are no longer restricted to Electronic Data Processing (EDP). The role of computing services now includes provision of resources to aid policy management, functional directions, support of hardware, software, training, communications, security, support to end-user computing and other operational areas. Computing services have grown, now encompassing support to the whole organisational structure and the flow of information through the organisation. Figure 3-3a and 3-3b illustrate the dimensions of such structures.

The growth of end user computing and the availability of computer-based information systems to organisation functions has had significant consequences for the role of the computing services. Traditionally the role of isolated computerised systems was

peripheral to the main business of the organisation. The new computing services role is much broader and more complex, comprising provision and maintenance of the IS/IT infrastructure of the organisation, support of end-user computing and a long term strategic function. Consequently, this places computing services much more within the mainstream of the organisation.

Figure 3-3a: An Adaptation of New Organisational Structure - Levels of Data Usage (Remenyi, 1990)

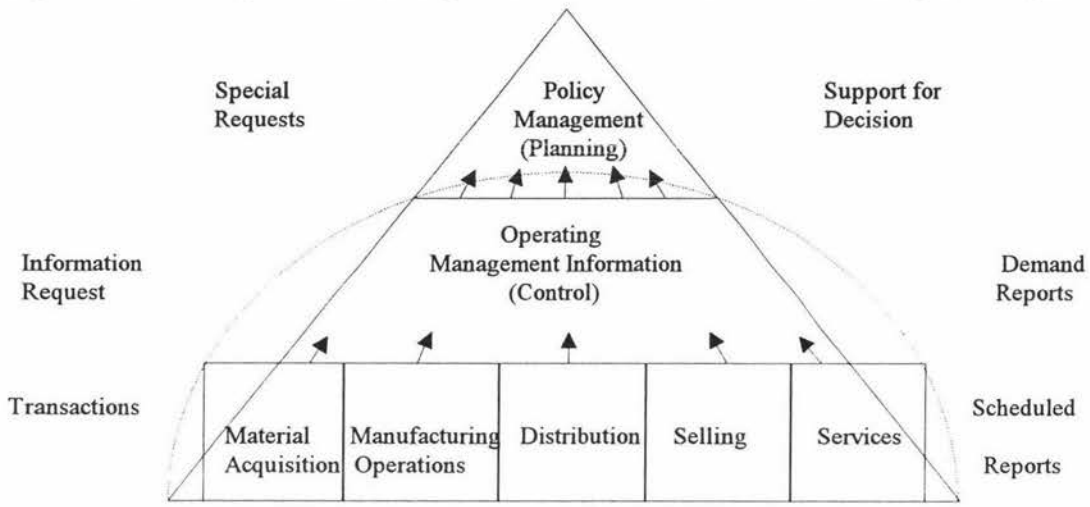


Figure 3-3b: An Adaptation of J. Parnaby (1991) - IT Support for Business Operations

The IS/IT infrastructure function revolves around the development and operation of the network of corporate systems that cross departmental boundaries and the involvement in inter-organisation systems. This infrastructure links together departments and provides communication with suppliers, customer and external services. The aim is to provide the most reliable, secure and cost-effective services to user departments, through the use of networks, central databases and central mainframe computers. The growing demands mean that capacity planning is becoming more important to ensure that the infrastructure can cope with fluctuations in levels of traffic. Such fluctuations have to be catered for, if service quality is not to deteriorate to a point where the users themselves are under the most pressure. Capacity planning implies monitoring the usage and performance of both individual components and the whole system.

Management of this changing environment or infrastructure requires a more sophisticated approach than has traditional operations management. It has also to incorporate the demands of both network management and database management within the notion of providing a range of services to users (eg. electronic mail, computer fax, computer groupware, etc.).

3.3 END USER COMPUTING

One of the most significant current trends in IS/IT is that of "end user computing" (EUC). EUC is comprised of: the purchase, development and operation of computer based systems by the users. It is relatively independent of any computer department. EUC already represents the major proportion of IS/IT budgets in many organisations. Rather than spending large sums on expanding the central mainframe system, operated by a computer department, budgets are now beginning to be dominated by networks of user work-stations. Users can now "Leap to Freedom"; freedom from a computer department widely perceived to be centralised, unresponsive and expensive. EUC has been facilitated by the availability of inexpensive microcomputers with powerful, task-based, user friendly software packages and an increasing user knowledge and familiarity with IS/IT. There are opportunities and risks attached to this area. Organisations developing EUC have the demanding task of navigating their way through some very

complex issues. This task is too difficult for management to carry out alone. It requires an equal contribution from an enlightened user management in order to strike an appropriate balance between the end-users and support functions, that is, the computing services.

In many respects EUC is a cost-effective, immediate solution to the software backlog, reducing the demands on hard-pressed IS/IT departments. User developed systems should have more relevance, matching user requirements more closely and providing a means of incorporating their knowledge and values into the system. This reduces the problem of communication between user and analyst that undermines traditional requirement's analysis, and smooths the final, frequently stressful, stages of replacing the old system with new. It benefits users, increasing their control over both the development process and the shape of the new system, as well as providing an invaluable learning mechanism. The resulting system may be less costly to develop as users can avoid many of the more cumbersome and expensive IS/IT department procedures.

In the past, either the IS/IT department or IS/IT departments were only a provider of goods, such as transaction data and reports. The IS/IT department is now also a provider of services. The services are diverse and include hardware, software, software support and data management assistance, training and education, consultation and functional (applications development) support. The specific types of service change over time according to the needs of the end user and the organisation. In most organisations, the IS/IT function has even changed its organisational structure to better support EUC (eg. Information centres). Recently, with the growing amount of resources consumed by EUC, the IS/IT support function is under increasing pressure.

3.4 THE SOFTWARE CRISIS

As business and industry becoming increasingly dependent on IS/IT to compete domestically and internationally, attention has focused on problems associated with the development of software. Software is often delivered too late and suffers from cost over-runs. Programs do not always behave as the user expects. Programs are rarely adaptable

to changed circumstances and many errors are detected only after the software has been delivered to the customer. This is commonly referred to as the 'software crisis' (Sommerville, 1989), a term which emerged in the late 1960s. It resulted directly from the introduction of third generation computer hardware and the subsequent crisis in the initial experience of building large software systems. (Sommerville, 1989)

Now, 25 years later, the 'software crisis' is still with us. Although there have been real improvements in our approach to software engineering, in the tools used for system development and in the education of development staff, the demand for software has increased at a faster rate than improvements in the productivity of software engineers.

The concern is not only the cost of developing the software, but also the cost of keeping the software operational once it has been delivered to the customer. The real costs of software development are immense. Although precise, up-to-date figures are very difficult to establish, it has been suggested (Boehm, 1987; Sommerville, 1989) that in 1985, worldwide software development costs were in excess of $140 billion. Furthermore, the costs are growing at a rate of 12% per year. If this trend continues, by 1995, worldwide annual software development costs will exceed $435 billion. Even small improvements in software productivity can result in a significant reduction in absolute costs.

In 1983, Jay Arthur, in his book entitled 'Programmer Productivity' presented an optimistic view of the state of the software factory:

> *"Programming is approaching the software factory concept, where program modules are the engines, tires, and transmissions produced; design documents are the blueprints; and operational documents are the shop repair manuals. In the software factory, analysts design while programmers manufacture and repair software systems. Analysts no longer create - they manufacture, and quality control is an important part of that process. Software metrics help provide that quality assurance."* (Arthur, L.J. *Programmer Productivity: Myths, Methods and Murphology*, New York: John Wiley & Sons, 1983. 127 p.)

The promise of an integrated environment for the development and support of software approaching the 'software factory' has to date been an elusive goal. The integrated environment was first envisioned by Jack Munson while at Systems Development Corporation during the late 1960s. Subsequent work by Thomson Ramo, Woolbridge, IBM (Wasserman, 1981; Manley, 1984), Jay Arthur and Michael Evans (1989) advanced this concept, yet the promise of a more predictable software development workplace has not been fulfilled. Even the Japanese, who have invested heavily in the development of this concept, have yet to fully realise the benefits (Tajima and Matsubara, 1984; Cusumano, 1991).

Recently, Gillies (1992) pointed out that an effective solution for the "software crisis" must consider not only the engineering aspects, but also the management of software development. He suggested an emphasis upon 'hybrid' management of software in its support of the business objectives of organisations.

Meanwhile the software crisis is still present. The "silver bullet" is yet to be found (Brooks, 1987). Some of the recent larger international efforts include: The STARS program (Software Technology for Adaptable and Reliable Systems) (STARS, 1983) (van Vliet, 1985; Lieblein, 1986), The Leonardo project (Myers, 1895; Frenkel, 1985), The Software Productivity Consortium (SPC) (Doe, 1986), ESPRIT (European Strategic Programme in Information Technology) (Kuntzmann-Combelles, 1989), Alvey (Alvey, 1985), and SPICE (Software Process Improvement and Capability dEtermination) (Dorling, 1993).

Many studies have shown the quality of computing services is also a question of perception (Pinto and Mantel, 1990). A service may be perceived as having failed in one environment but succeeded in another. Hence, computing services' success or failure is related not only to the development objectives, but also to the perceptions of the customer.

Whether computing services are provided inside an organisation or contracted to external suppliers, there are issues that should be addressed. These include recognition of

who their customers are, what their customer needs are, and what are their customer's perceptions of the service.

3.5 CUSTOMER-SUPPLIER RELATIONSHIP

Computing services had their origin in Electronic Data Processing (EDP). Because of the high level of expertise required to understand computers and the high cost of equipment there was often a tendency for EDP departments to distance themselves from users. A typical scenario might have been:

> *Each system was built from scratch with little or no reference to existing systems. Each project started off with a quick visit to the user department to see what they wanted, or tell them what they needed. The EDP department then went away for a few weeks or months and came back with 'The Spec'. This document, which the users often could not follow, claimed to describe the users' requirements. The users were expected to 'sign-off' this document to 'validate' that it met their requirements. The 'Spec' was then 'frozen' so that the EDP department could go away and build it.*
>
> *After a long pause (during which the business needs or the available technology may have changed) the system was delivered for testing. It did not work properly, it was so difficult to use as to be a step backwards, or it was no longer needed.*

The difficulty is that many computing services providers still operate in such a manner. Computing services providers often fail to define and measure quality in their customers' terms. High costs are associated with this communication failure. Having failed to work with end users to define 'application quality' in customer terms, computing services are often not included in the early stages of the line-of-business system planning activities of an enterprise. As a result, computing services providers miss the opportunity for effective partnership with other functional groups and often do not provide to the enterprise with the full value of which they are capable.

Being a customer focused organisation is probably the single most important principle of modern quality management. Whether the customers are internal or external, the provider listens carefully in order to be clear about what their customers needs are. The information gathered is in turn used as input to drive the design of product and services.

The Malcolm Baldrige National Quality Award (also reflected in the New Zealand National Quality Award) (New Zealand Quality Awards Foundation, 1994) addresses the areas of "Customer Focus and Satisfaction". For example, how the organisation:

- "determines current and near-term requirements and expectations of customers",
- "addresses future requirements and expectations of customers", and
- "evaluates and improves its processes for determining customer requirements and expectations".

The following paragraphs review some aspects of customer focus within an organisation.

A key clause in the ISO standards (ISO 9001) is clause 4.3 covering Contract Review. This clause asks for procedures that:

- ensure the supplier knows exactly what the user expects,
- identify how an amendment to a contract is made and correctly transferred to the functions concerned, and
- maintain a record of the contract reviews.

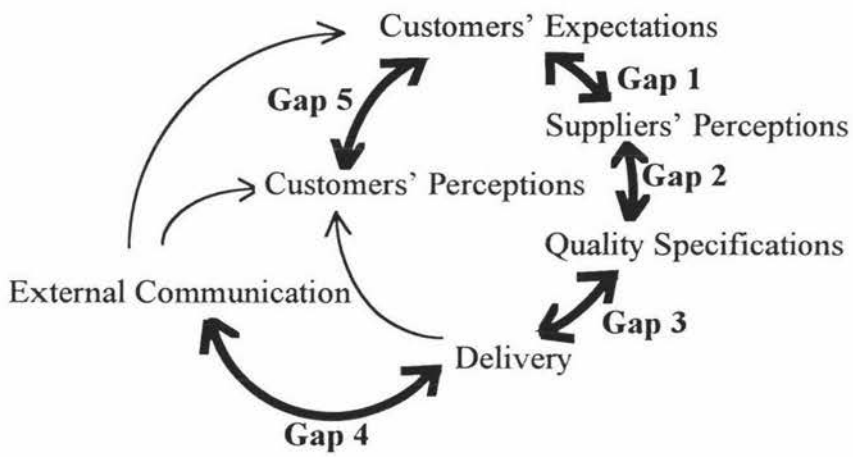
The customer is thus brought right to the forefront.

Zeithaml, Berry and Parasuraman (Zeithaml et al, 1990) have identified a model in which quality is defined as the discrepancy between customers' expectations and perceptions of the services. The model focuses on the relationship between customer and supplier. Five discrepancies or gaps within the whole customer-supplier framework were identified. (Refer to Figure 3-4) This model is very similar to the Service Quality loop described in ISO 9004.2, but with the advantage that it focuses our attention on the causes of quality failure.

In the broadest sense, this model provides a measure by which we can look at quality as the degree to which our customers' perceptions of an outcome matched the customers' expectations. Of course, the customers' satisfaction is ultimately determined by the processes and the mechanisms put in-place to reduce or to bridge the "Gaps" between suppliers' perceptions, quality specifications, delivery, communications, and customers' perceptions.

The customers' expectations are built up from what they hear and read about what computing services provide elsewhere. In addition, customers' expectations may arise from their past experience of what has been provided and from the communications of their own computing service provider. That is, what services the providers can provide or are providing. The provider's perceptions are, in this case, what the management of computing services understands about what their customers expect. The Contract Review clause of ISO 9001 is meant to address this gap. The remaining gaps that produce poor quality are also addressed by the relevant clauses in the standards.

Figure 3-4: A simplified conceptual model of customers' expectations and perceptions *



* Adapted from Zeithaml, Parasuraman and Berry 's SERVQUAL model (1990).

It is important for the operations personnel of computing services to know how well they are serving their customers so that they can improve and maintain the quality of their product or services. Zeithaml, Berry and Parasuraman (1990) suggest the following methods for measuring customers' expectation:

- using complaints strategically,
- researching what customers want in similar industries,
- researching intermediate customers,
- conducting key-client studies,
- creating customer panels,

- tracking satisfaction in individual cases, and
- engaging in comprehensive customer-expectation studies.

Any definition of quality has also to address the products or services that IS/IT deliver, the software processes and the support services it uses to deliver them. It must be a cost-effective, timely and effective solution to business and operational needs of the organisation. So, what is the definition of quality and quality management?

3.6 QUALITY

The International Organization for Standardization (ISO) defined quality as "the totality of characteristics of an entity that bear on its ability to satisfy stated and implied needs" (New Zealand Standards, 1994). Juran (1974) defined quality as "Fitness for Purpose", while others preferred a more customer oriented definition. Zeithaml et al (1990) proposed "Consistent conformance to customers expectations", which can be measured directly by the degree to which customers' perceptions are matched with the customers' expectations.

In the last decade, quality has become a major preoccupation of business. Our understanding of how to ensure quality has changed radically. It is now known that cost over-runs, missed deadlines and unfulfilled requirements are all symptoms of poor quality. In the consideration of IS/IT development, it was not until recently that quality control, quality assurance, quality management and "customers' focus" were all considered essential means of ensuring quality.

As defined by ISO, quality control is the activities and techniques employed to achieve and maintain the quality of an entity. The entity, as defined by ISO, may be an activity, a service, hardware, software, a system, value-added products, processed materials, or any combination thereof. Quality control involves a monitoring activity, that is measuring the characteristics of that entity. It also includes finding and eliminating causes of quality problems so that the requirements of the customer are continually met.

Quality assurance involves planned and systematic actions necessary to provide adequate confidence that an entity will satisfy given requirements for quality. It is a management tool. The objectives of a quality assurance program are to, maintain the conditions to achieve "right the first time" systems or services, eliminate correction and reworking, and make sure that quality standards are maintained. Quality assurance activities include the establishment of a good quality system and the assessment of its adequacy, the audit of the operation of the system, and the review of the system itself.

ISO 8402 defines quality management to include "both quality control and quality assurance, as well as the additional concepts of quality policy, quality planning and quality improvement." Quality management operates throughout the quality system. Modern quality management includes all the historical elements of: inspection, statistical process control, acceptance sampling, quality control, quality assurance and quality standards. It extends to all parts of an organisation. It is more concerned with the economics, human behaviour, and organisational issues of a company, and its competition in the marketplace. "Quality Management establishes and implements strategies and policies concerning quality and quality assurance. It is a body of knowledge, a function in a company, and a career for a person." (Willborn and Cheng, 1994)

3.7 QUALITY MANAGEMENT

Adopting a quality management approach for the provision of computing services represents a different from but complementary approach to the traditional information systems engineering methods employed to achieve quality. It ensures that the processes used in the development and management of computing services are designed with the customers' requirements in mind and that the outputs of IS/IT are serving the needs of other organisational functions.

Quality management is the overall framework of strategies, policies, procedures and functions. It is directed by the objectives of "process improvement", "consistent conformance" and "customer focus". It builds its strength through continuous quality

improvement. Perhaps the most important factor is that quality management incorporates the computing services providers into the overall quality system that implements a company's quality policies. The provision of computing services becomes part of the organisation's overall quality system.

Gillies (1992), in his use of 'hybrid' management for the treatment of the 'software crisis', and Bennatan (1992), in his recommendations for high technology project management, suggest that different talents and skills are required for the development and management of computing services. These skills, processes and functions are mentioned in the ISO 9000 quality management standards (New Zealand Standards, 1994).

A quality management standard provides a basis from which computing service providers may develop their quality management systems. The quality management standard is a set of requirements which may be referred to or included in a provider-customer contract. It also provides the baseline requirements for assessment and certification of processes that provide those computing services.

3.8 QUALITY STANDARDS

There are many good practices, quality-related standards and guidance documents which are relevant to building quality management systems into a computing services' environment. Some are general purpose, some are specific, some are external standards and others are guidance material.

There are standards for quality management, quality planning and configuration management. Standards accompany the development cycle from beginning to end; there are design standards, documentation standards, coding standards, testing standards, and standards for submitting and evaluating a proposal.

One of the main challenges facing the computing services manager is the selection of the right quality system standard and guidance documents. There are quality systems

standards such as: the ISO 9000 (NZS 9000) series standards, the AQAP (Allied Quality Assurance Publication) standards and the MIL-STD (Military standard) series. Software development standards include the NZS 3563 and the US DOD standard 2167 (DOD, 1988).

There are guidance documents which assist in the use and interpretation of standards. These include: the ISO 9004 guidelines, the ANSI/IEEE series, the STARTS handbook, the Electronic Engineering Association (EEA) guide series, the Central Computer and Telecommunications Agency (CCTA) infrastructure library and the TickIT guide.

The provision of computing services encompasses a wide range of activities, it includes: planning, development, system studies and requirement analysis, design, production, implementation, testing, maintenance, purchasing, usage, support, help service and training. A general standard such as the ISO 9001 (which is also reflected in NZS 9001) would appear to be an appropriate quality system standard to use. The ISO 9001 quality system requirements are grouped under the following headings:

1. Management responsibility
2. Quality system
3. Contract review
4. Design control
5. Document and data control
6. Purchasing
7. Control of customer-supplied product
8. Product identification and traceability
9. Process control
10. Inspection and testing
11. Control of inspection, measuring and test equipment
12. Inspection and test status
13. Control of nonconforming product
14. Corrective and preventive action
15. Handling, storage, packaging and delivery
16. Control of quality records

17. Internal quality audits
18. Training
19. Servicing
20. Statistical techniques

The above standard (New Zealand Standards, 1994) is applicable in situations when

a) design is required and the product requirements are stated principally in performance terms, or they need to be established; and
b) confidence in product conformance can be attained by adequate demonstration of a supplier's capabilities in design, development, production, installation and servicing.

Clause a) indicates that the model still applies if the requirements are not completely specified in advance. This is very useful for computing services development, since requirements are usually not stable. Clause b) specifies that we must be reasonably sure in advance that the supplier possesses sufficient capabilities to reach the goals set forth.

ISO 9001 is a general standard addressing the overall quality system, and it may not be suitable for organisations that are particular about information systems development methodology. The problem is partially addressed through guidelines such as ISO 9000-3 or the TickIT scheme (TickIT, 1992; Avison, 1994). Both attempt to interpret the quality system elements around the information systems life-cycle.

An alternative contrasting approach, yet complementary to the ISO 9001 standard, is the NZS 3563: Software Quality Management System standard. This was especially designed for IS/IT development (Wilson, 1993). It establishes the key elements ("software quality system requirements") required to implement and operate an effective quality management system in the development of computer systems, (Avison, 1994). However, where a computing services department is primarily concerned with building a quality system to improve their own operations, then ISO 9004.1 and ISO 9004.2 are more appropriate starting points.

The two ISO 9004 standards cover all aspects of quality-related work required in a commercial or professional situation. These include the technical, quality, management and support practices. The supplier organisation would normally build a specific quality system to cover its own set of products, services and working practices, based on the elements given in these standards. ISO 9001 may then be used to verify that the minimum expectations of a quality system are in place, or to prepare the organisation for accreditation.

Perhaps, and more significantly, the reason for using the ISO 9000 standards is that the series are recognised internationally, and many companies have used the standards as a cornerstone for their quality management program, (Willborn and Cheng, 1994).

Recently, in recognition of a need in process assessment to complement the ISO 9001 and 9000-3 coverage of IS/IT quality systems, an international project Software Process Improvement and Capability dEtermination (SPICE) (Dorling, 1993) has been set up to design a new standard. The proposed standard is based on the major assessment methods already in use in the USA, Canada, Europe and the United Kingdom, (Paulk et al, 1993; Bell Canada, 1992; Compita, 1993). These methods are in turn based on principles of Total Quality Management, Capability Maturity Model (CMM) and Software Engineering.

3.9 CERTIFICATION

Certification is a way of providing assurance to buyers that a supplier has an adequate quality system. The knowledge that a supplier has a quality system is of value in selecting computing service providers, and this is particularly true for smaller buyers. Studies in the United Kingdom have shown the benefits in the use of quality system standards and certification for computing services. (Logica Study Team, 1988; Management Consultants, 1988).

In New Zealand, schemes exist through which an independent assessor will assess a company's system or sub-systems and certify that the company is meeting the specific

quality system requirements. Some of the commonly used standards for certification are the NZS 9000 (an equivanlent of ISO 9000) and NZS 3563 standards. Other schemes and awards include:

- Telarc's certification programmes: Q-Base quality management system and certification programme - Telarc New Zealand,
- New Zealand's Business Development Quality Awards - New Zealand Business Development Board,
- New Zealand National Quality Award - New Zealand National Quality Awards Foundation, and
- New Zealand Quality Improvement Prize - New Zealand Organisation for Quality and Telarc New Zealand.

Quality system certification is now a worldwide phenomenon. (Bell, 1993) Fifty seven countries have adopted the ISO 9000 standards. In New Zealand the number of certification bodies for ISO 9000 is growing rapidly. The two major certification bodies are Telarc New Zealand and Standards New Zealand (SANZ). Other certification bodies include: Bureau Veritar, SGS New Zealand, KPMG Peat Marwick, Quality Society of Australasia (QSA), Lloyds, Det Norske Veritas (DNV), and International Certifications Ltd (ICL).

The regional authority in both Australia and New Zealand that oversee, audit and accredit Australasian ISO 9000 certification bodies is the Joint Accreditation System - Australia and New Zealand (JAS-ANZ). The task of JAS-ANZ is to ensure that those ISO 9000 certification bodies comply with the requirements of the European Standard EN 45012.

3.10 SUMMARY

The provision of computing services involves complex and multi-disciplinary fields. It encompasses a broad range of technologies and activities, and it involves other disciplines or skills in the delivery of those services. The range of technologies, activities and disciplines involved in computing services depend largely on the level of complexity

and size of the computer systems implemented, and on the complexity of the company. The provision of computing services also involves an understanding of other fields that utilise such services.

Computer systems development has been a "black art", but with the introduction of more formal techniques such as software engineering and project management, a more professional engineering approach has evolved. It is only recently that industrialists and academics are beginning to recognise the diversity and the applied engineering nature of the computing services field.

As IS/IT penetrates the various areas of the business environment, the role of computing services becomes much broader and more complex. The role of computing services includes: providing and maintaining the IS/IT infrastructure of the organisation, supporting end-user computing and playing an active role in organisational strategy. The function of computing services is now much more within the mainstream of the organisation.

There are several unsolved problems related to computing services. These include:

- coping with the rapid growth and advancement in IS/IT,
- managing End-User computing,
- the lack of knowledge and experience in building and managing large computer systems,
- managing interdisciplinary activities, interface and communication problems,
- the lack of a relationship with long term business planning, and
- the lack of a 'customer focus' and, in particular, the difficulty of establishing user needs.

The problems that relate specifically to software development are the:

- lack of effective formal methods,
- productivity of software developers not being sufficient to cope with the faster rate of software demand,

- lack of understanding and knowledge of software quality,
- lack of sufficient data and appropriate metrics for benchmark measurements, and
- use of outdated tools, methods and procedures in software development.

In the last decade, quality has become a major preoccupation of business and it is the basis of competition in commerce and industry. It is a generally held belief that improved quality leads to increased productivity and cost reduction. This is particularly true in the area of hardware and processed materials. It was not until recently that organisations applied the same principles and techniques of quality to the service and software development industries.

Our knowledge of methods to ensure quality have changed. We now know that quality control, quality assurance, quality management and "customer focus" are all essential means of ensuring quality. Adopting the quality management approach should ensure that the processes used in the development and management of computing services are designed with the customers' requirements in mind while at the same time the outputs of IS/IT are serving the needs of other organisational functions.

4. RESEARCH PROGRAMME

4.1 INTRODUCTION

The computing services market is an emerging sector in New Zealand, and an increase of these services in the coming years is expected. From 1987 until 1992, there was an increase of 72% in the number of computing services businesses in the Business Directory (Edwards, 1993). In 1991 and 1992, according to IDC Research, the Information Technology (IT) expenditure in New Zealand was NZ$2,604 millions and NZ$2,700 millions respectively. The projected figure for 1996 was NZ$3,755 millions (with a compound annual growth rate of 7.5%). In 1992, NZ$ 1,980 millions (73% of the total New Zealand IT expenditure) was spent on computing services. (ComputerWorld, 1993)

In recent years, hardware costs have decreased dramatically. In 1992, the hardware costs comprised only 27% of the total New Zealand IT expenditure (ComputerWorld, 1993). As a result the industry is concerned about the high costs of computing development and supporting services, and is probably less worried about the cost of hardware. The costs of computing development and supporting services includes the costs of management, analysts, programmers, user training, secretarial help and other help services.

There were very few research investigations on computing services (or IS/IT services) as a whole. Most of the studies identified in the literature were focused on software quality development and software quality standards. However, during the early stage of the present research, these software oriented studies were used as a guide. These are described briefly below.

A) The Department of Trade and Industry (United Kingdom) commissioned several consultants between 1988 and 1991 to undertake a series of research surveys, examples of which follow:

- CSC Index (1991), "Key Issues Affecting Quality in Information Systems", reviews issues affecting software quality and systems development,
- Logica Study team (1988), "Quality Management Standards for Software" (1988) investigates whether Quality Management Systems and other standards help improve the quality of software in practice,
- The Management Consultants (1988), "Software Quality Standards: The Costs and Benefits - A review for the Department of Trade and Industry" examines the costs and benefits of implementing quality systems and other standards for the production of software.

B) Information Processing Limited (United Kingdom), in 1989, completed a survey ("Information Systems, Standards and Quality") which identified the needs for standards in building quality systems;

C) The PC Magazines (USA) 1992 Service and Reliability survey was a mail survey of selected subscribers of the PC Magazine concerning their experiences with their personal computer vendors.

Some of the above research findings indicated that, in spite of national and international efforts to introduce quality management and quality standards to all industries, many organisations and companies show weaknesses in their application, (CSC Index, 1991; Logica Study Team, 1988; Management Consultants, 1988). This is especially so in the area of IS/IT (I/S Analyzer, 1994). There is a general lack of knowledge of the more technical side of modern quality management in industry and commerce, particularly in quality assurance methods and the new standards for quality management. In addition, the use of quality management was not without its problems. Avison (1994) and Bell (1994) found that there were difficulties in:

- interpretation of terms in quality standards (generic differences in hardware/software products),
- interfacing traditional practices (computing services methodologies) with the quality management framework,

- adopting a general standard for specialised purposes,
- the high cost involved in adopting quality management practice, and in
- the suitability of implementations (company size and critical level of the products or services supplied).

These difficulties lead to a concern about the usefulness of quality management practices. It was decided to begin the study with a review of the current status of quality management of computing services in New Zealand organisations and businesses. This is because there appeared to be:

- variable levels of knowledge of quality systems within the New Zealand industry,
- difficulties observed with effective implementation of quality systems, and
- doubts about the general applicability of quality systems to all aspects of computing services.

4.2 RESEARCH APPROACH

After reviewing some of the literature and the background studies, it was recognised that the research area was broad and the research study was exploratory in nature. To answer the research questions (as defined in Chapter 2, Objectives), three main areas of consideration were identified. The first area was to determine the various potential factors that have an association with good quality management practices. Some factors may be related to perception and organisational orientation towards quality management. The second area was related to good quality practices, that is, the use of an appropriate quality health check, quality system standards or formal quality management system in the computing services area. The third area was concerned with how to perform the measurement and the use of measuring techniques.

The data gathered were a mixture of attitudes, opinions and facts. In order to make completing the survey easier for the respondents, it was decided to use a very structured questionnaire, that is, closed questions with 5-point response alternatives and comments where appropriate.

As the objectives were to find out the current status of quality management practices of computing services in New Zealand industry, the survey methodology was regarded as appropriate.

The survey instrument was developed with two conflicting requirements in mind. First, it needed to be comprehensive enough to ensure that the required data would be provided. Second, it needed to be relatively short so that potential respondents would not be discouraged from participation.

The survey process can be summarised into the following steps:

- Design of the Survey: designing the survey questionnaire (include refining objectives to specific structure and questions),
- Sample Design: defining the sampling procedures,
- Data Collection: collecting the data, and
- Analysis: analysing the data.

4.3 DESIGN OF THE SURVEY

A questionnaire was developed in accordance with generally accepted survey research principles and employing the "funnel approach," (Green et al, 1988) which resulted in ordering questions from the most general to the most specific.

The first task was to identify potential factors, such as, demographic, organisational and general operational behaviour. Some initial research hypotheses were formulated. The hypotheses were based on the fact that those potential factors had no associations with quality management practices. There should be no difference on whether the respondents:

- were in the "Top 200 companies" or not,
- were from different geographical regions - Auckland, Wellington, and others (Canterbury, Otago, Waikato, Hawkes Bay, Manawatu, Marlborough, Taranaki, Bay of Plenty, Wanganui, Coromandel and Northland),

- had a different total number of staff,
- had a different number of computing staff,
- had their products or services exported,
- had any of their systems or sub-systems certified to a standard,
- were working towards certification for their computing services,
- were in different industrial sectors - NZSIC breakdown,
- were in IT businesses (IT organisations or companies),
- were an internal, external or both oriented organisations or companies,
- were providers or customers of the computing services,
- were interested of quality management practices,
- were involved in quality management practices,
- had knowledge of ISO 9000,
- had their developers or customers to identify the products or services - internally,
- had their developers or customers to identify the products or services - externally (outside customers),
- had their developers or customers to specify the requirements - internally, and
- had their developers or customers to specify the requirements - externally.

4.3.1 Questionnaire Design and Content

The style of questioning was kept fairly consistent. Questions were designed to obtain responses of categorical or simple rating scale response alternatives. The categorical types were general direct questions. In areas that involved attitude or opinion, data were collected by using a simple 5-point rating scale.

The simple 5-point rating scale is commonly used in both marketing research and behaviour sciences (Green et al, 1988). It is especially useful when dealing with a relatively large amount of data. The data collection method involves a respondent rating their responses along a continuum or in one of an ordered set of categories. This rating allows a respondent to register a degree of characteristic or attribute directly on a scale. There are many problems associated with the application of this rating method. Studies of their use are inconclusive and indicate small differences in quality and reliability of the

data obtained (Green et al, 1988). However, it was noted that certain assumptions would have to be made on the scale properties when statistical techniques are used to summarise and interrelate the response data (Sudman and Bradburn, 1983; Guilford, 1954). As for the purpose of this research, which is exploratory in nature, the choice of a rating method was made on the basis of practicality. Therefore, the method of measurement is based on the ease of questions, ease of coding and interpretation, ease of production and display, and cost.

In relation to the use of an appropriate quality management measure, several good quality practices were considered. They included standards or guides such as: ISO 9000, NZS 3563, TickIT and CMM. However, background studies indicated that ISO 9000 was suitable to be used as a measure to indicate if good quality management practices were being used or contemplated. It is a recognised standard (nationally and internationally) and it is general enough for use in a multi-disciplinary field such as computing services. Using the ISO 9000 standard, an achievement-based 5-point scale was designed, which involves respondents indicating the extent of agreement with statements. The terms such as quality, quality policy and quality system (as used in the ISO 9000 standard) were defined at the beginning of the questionnaire. This was to improve the validity of the questionnaire and not to let terms open to individual interpretation.

The decision to use a mailed questionnaire was based largely on minimising cost. The questionnaire could reach a large sample of the population at a relatively low cost. On the other hand, it was recognised that postal surveys generally have a low response rate.

An initial survey instrument was designed. It consisted of four main sections: (Refer to Appendix A for detailed questionnaire.)

Section A: Quality Management Perception (5-point rating scale of measurement) sought information on respondents interest, involvement and knowledge of quality management in the area of computing services. There were 3 questions (A1-3). The response alternatives used were:

(1) Not interested, (2) Vaguely interested, (3) interested, (4) Quite interested, and (5) Very interested; or

(1) Never heard of them before, (2) Heard of them, but unfamiliar, (3) Familiar, but don't use them, (4) Use them occasionally, and (5) Use them regularly, please specify areas(s);

Section B: Company Profile (nominal level of measurement used) included questions about, the nature of business of the company, number of staff in the organisation, number of staff in the computing services and number of customers (external and or internal). The final three questions of this section related to whether any of the company's system or sub-systems and their computing services department were certified to a quality system standard. If they were not certified to a quality system standard it was asked whether the company is working towards a quality system standard. This section consisted of 10 questions (B1-10).

Section C: General (nominal and 5-point rating scale of measurement) included categorisation and measurement of the relationship between the customers community and the people who develop and support the computing services, the level of computer literacy in the customers/users community, the degree of interaction between developer and user, senior management commitment to quality, staff acceptance of quality and the level of customer satisfaction. This section had 9 questions (C1-9). Question 1 to 4 used nominal response alternatives and question 5 to 9 used the 5-point rating scale of measurement. The response alternatives used for the questions were:

(1)Low-(3)Medium-(5)High.

Section D: Quality Practices (5-point rating scale of measurement) asked the respondents to react to questions about the extent of implementation of some key features in their quality system for the management of computing services. A set of guidelines was used to gauge the level of achievement (or a scale of implementation and documentation) for each feature on a 5-point response alternatives consisting of:

(1) Quality system feature does not exist, or is handled in an ad-hoc manner,

(2) Aware of need for the quality system feature and planning commenced,

(3) Quality system feature partially implemented and documentation in progress,

(4) Quality system feature fully implemented and documented. Not yet fully effective, and

(5) Quality system feature fully implemented, documented, regularly audited and highly effective.

The quality system features were organised into the following categories:

(DI1) - "management of computer services" - 3 questions,

(DII1) - "customer requirements of computer services" - 4 questions,

(DIII1) - "design and development of computer services" - 5 questions,

(DIV1) - "maintenance of computing services" - 4 questions, and

(DV1) - "provision of computing services" - 7 questions.

A draft or pilot questionnaire was used as an instrument to seek feedback and recommendations from experts in the fields of interest. Guidance was sought from several specialists in the areas of quality systems, information systems and statistics in preparing the final questionnaire.

The respondents to the pilot questionnaire were concerned about the use of language, the interpretation of the questions and potential misunderstanding by someone who is unfamiliar with the subject of quality management principles. Other concerns included the misrepresentation of the questions and therefore the quality of the data to be collected, the size of the questionnaire, consistency of terms used, format, readability and fluency of the whole questionnaire. The questionnaire was modified until it was believed to be satisfactory.

4.3.2 Sampling Issues and Procedures

There was a conscious decision to keep the sample size to a minimum in order not to overburden the industry, but at the same time a sufficient sample size was needed to obtain valid results. The sample design is discussed further in section 4.4. A single questionnaire was prepared for a selected list of companies to be completed by the computing services manager. The questionnaires were sent to organisations and companies of various sizes. The total staff number, number of computer staff and customers' size were used as a measure for company size rather than using the company turnover.

There were concerns about the problem of non-response bias because the typical response rate for mail questionnaires was only 33% (Green et al, 1988). Additional efforts were made to increase the response rate by improving the questionnaire format, altering its length, personalising the cover letters and assuring the confidentiality of the responses.

Respondents were encouraged to contact the researcher, should they have difficulty with any part of the questionnaire. Organisations and companies were urged to return the questionnaire, even if they were not able to complete it fully (with a note about why they were unable to complete it). This was done to enable the researcher to gain a more complete picture of the whole survey and also to help improve the response rate. However, due to the additional costs, no follow up letters were sent to help elicit late replies.

Other issues considered were biased results due to the fact that the respondents may have stronger feelings about the subject than the non-respondents and the misunderstanding of questions asked in the questionnaire.

Individual case studies were not considered at this point, as this would have involved high costs and considerably more time on the part of the respondents. However, the survey questionnaire did seek permission and an expression of interest for an extended study later. A more detailed analysis on selected respondents could be undertaken.

4.4 SAMPLE DESIGN

The development of the sample was based on geographical regions and the business activities found in those regions. Samples were selected using published data from the Department of Statistics. The primary sampling element was the company. The sampling frame (mailing list) included organisations and companies with IS/IT functions, computing services departments, or IT organisations of various types and sizes. Samples were sought from a cross-section of regional locations and busines types (as in question 1 of section B of the questionnaire).

A key aspect of the survey was the need to ensure that an indicative response and a cross-sectional view throughout New Zealand was obtained. This includes companies and organisations that have something to do with IS/IT and computing services. They may be of various sizes and from within different industry sectors and geographical locations. Details of the organisations and companies were obtained from a number of sources. They included:

- participants of two of New Zealand's major computer conferences (NZCS, 1993; UNIFORUM, 1993),
- "top 200 companies" listed in the New Zealand's "Management" journal from 1991 to 1993 (Management, 1991; Management, 1992; Management, 1993), and
- a selection of companies listed in the New Zealand Computer Industry Directory (ComputerWorld, 1993).

The organisations and companies selected for the mailing list were in accordance with the proportion of their regional and industry sector distribution (business activities). Hence, the data collected was expected to be respresentative of the business population.

Clearly there were other type of classifications, such as contribution to GDP or annual turnover, which may also be relevant. However, obtaining accurate financial data of this kind from a mailed survey, was expected to be extremely difficult. Therefore, the business-activities based approach was adopted as a relatively crude but informative classification method, at least for the purposes of the present survey.

Assuming a typical response rate of 33% for this type of survey (Green, 1988), and considering costs, an original sample size of about 400 was considered sufficient to give an expected response sample size of 132. According to Green (1988), given a sample size of 132, this survey would have a 95% statistical level of confidence. However, the following assumptions must be made:

- a maximum allowable difference in characteristics between the sample and population of 5%, and
- a working assumption that 10% of the population used good quality management practices.

4.5 DATA COLLECTION

After pre-testing, the structured questionnaire was finalised (see Appendix A). The mailing list was determined and the questionnaires were mailed at the end of October 1993 to 411 computing services managers of organisations and companies throughout New Zealand. All potential respondents received a covering letter explaining the nature and purpose of the research, a copy of the survey instrument, and a pre-addressed stamped envelope for its return. Respondents were assured of confidentiality and it was stated that all published material would be of aggregated data only. Two months were allowed for the return of the questionnaire. As noted previously, respondents were asked to return the questionnaire if they were not prepared to answer it.

Of the 411 questionnaires sent out, 152 were returned, 5 were found to have been sent to an incorrect address or the company was no longer trading, and 7 respondents declined to complete the survey. One hundred and forty useable replies were received. This represents a response rate of 35%.

Owing to budget constraint, a formal analysis of non-response bias was not conducted. However, there were no apparent differences between participating and non-participating companies in terms of the research hypotheses. Telephone interviews were conducted with the 7 respondents who declined to complete the survey to identify the reasons for non-response. The most common reason for non-response was that the company was too busy or had a company policy not to respond to surveys.

The useable responses were checked, coded and entered into an Excel electronics spreadsheet. The data was analysed using Minitab or SAS software to describe and test the main variables and their interrelationships. Qualitative data such as comments,

expression of personal views by respondents and problems were recorded. One or two companies with partially filled questionnaires were contacted over the telephone and assisted to complete their responses.

5. ANALYSIS AND INTERPRETATION OF SURVEY DATA

The focus of this chapter is the 140 responses of a cross section of New Zealand companies and organisations. It involves:

- Establishing the appropriate categories for information, sorting the data into those categories, making the initial counts of responses and using summarising measurements to describe and interpret the data.
- Using inductions derived from the data concerning the relevant measurements.
- Reviewing the original hypotheses and reaching conclusions about the measurements made, their importance and their association with various categorical factors.

The tools used were tabulation, cross-tabulation, simple statistics (mean, median and standard deviation) and associative data tests (such as the Chi-Square significance tests, Fisher's Exact and Kolmogorov-Smirnov two-sample tests).

The responses were first analysed to assess whether they were representative of New Zealand industry. These are describe in Sections 5.1, 5.2, 5.3 and 5.4.

5.1 REGIONAL SPREAD

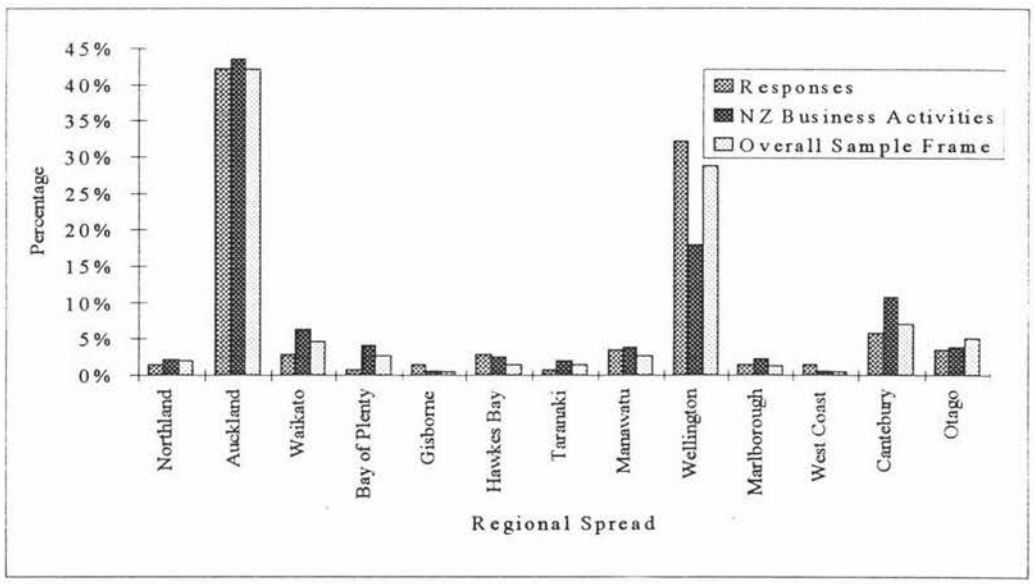
Figure 5-1 shows the regional breakdown (in percentages) of the 140 responses, the original 411 organisations and companies selected for the mailing list and the New Zealand's 1991 business activities. The regional categories used were based on the official regional council classification (New Zealand Official Yearbook, 1992). The "business activities" measure is used by the New Zealand's Department of Statistics for its tracking of the business demography database. A business activity unit represents the smallest unit operating at a single physical location and owned by a single enterprise. In practice, acitivity units correspond to shops, factories, warehouses, etc.

The respondents were representative of the business population. There were some differences, between the responses to the question and the percentage of business activities in each region, however there are explanations for these.

The Wellington region shows an unusually high response rate. This was not surprising, given that Wellington is a business center, where a number of head offices of companies and government departments are located. It was noted that the proportion of Wellington region representation in the mailing list was also high.

In contrast, Northland, Waikato, Bay of Plenty, Taranaki, Marlborough and Canterbury show significantly lower percentage of responses when compared to the business activities in these regions. They represent locations with relatively less IS/IT intensive industries, therefore, the proportion of respondents would be expected to be smaller.

Figure 5-1: Regional Responses, NZ Business Activities (1991) and Sample Frame Spread.



5.2 INDUSTRY CLASSIFICATION

Table 5-1 and Figure 5-2 show the New Zealand Standard Industrial Classification (NZSIC) breakdown of the 140 responses against the New Zealand's 1991 business activities.

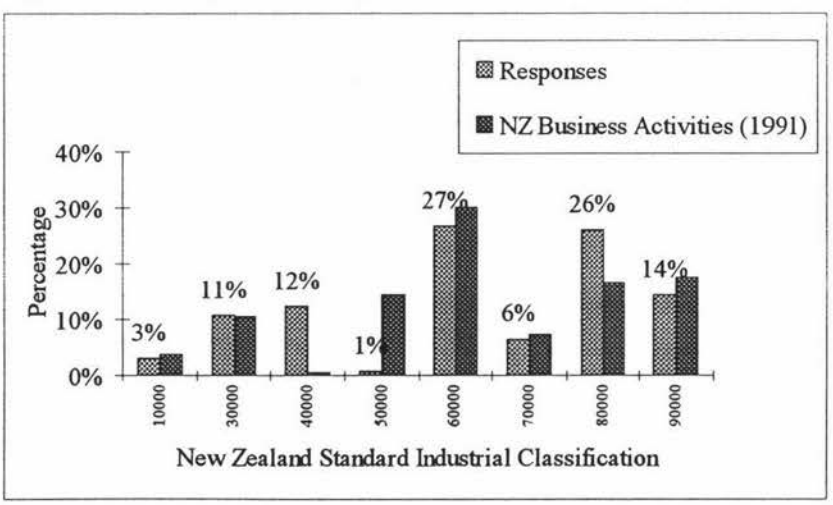
There were marked differences for industry sectors "Electric, Gas and Steam" and "Construction". However, the results were consistent with other recent surveys and business patterns (New Zealand Official Yearbook, 1992; New Zealand Official Yearbook, 1994; Macdonell, 1994).

The difference in proportion of responses from the "Electric, Gas and Steam" sector, can be accounted for by the recent establishment of electricity and gas distribution/retail authorities. Hence, the percentage measurement for the responses, which was taken in 1993, as compared to the percentage of business activities in 1991 was high. The low response rate for "Construction" was due to the drop in "Construction" business activities between 1991 and 1993 (New Zealand Official Yearbook, 1992; New Zealand Official Yearbook, 1994).

Table 5-1: Industry Sector - Responses and NZ Business Activities (1991) Spread

NZSIC Industry Sector	**Classification Number**	**Responses Percentage (Number)**	**Business Activities**
Agriculture, Forestry and Fishing	10000	3% (4)	3.54%
Manufacturing	30000	11% (15)	10.52%
Electricity, Gas and Steam	40000	12% (17)	0.36%
Construction	50000	1% (1)	14.31%
Wholesale and Retail Trade	60000	27% (38)	30.10%
Transport and Communication	70000	6% (9)	7.18%
Business and Financial Services	80000	26% (36)	16.50%
Community and Social Services	90000	14% (20)	17.50%

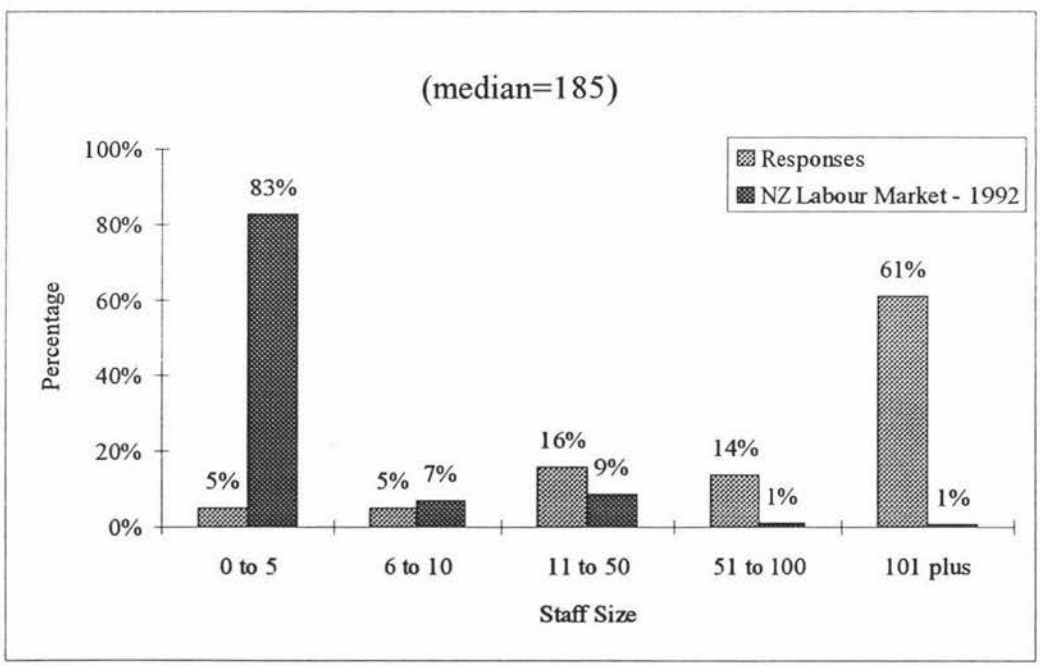
Figure 5-2: Industry Sector - Responses and NZ Business Activities (1991) Spread



5.3 STAFF SIZE

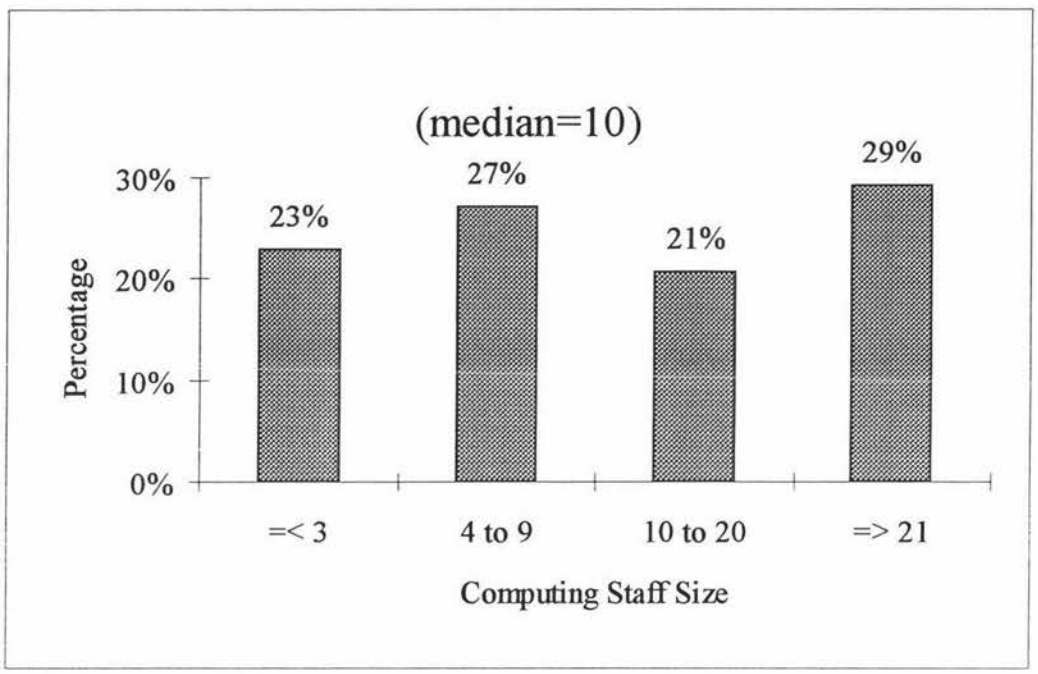
Figures 5-3 and 5-4 show the distribution of respondents' total staff size and computing staff size. In the 1992, according to the New Zealand's Department of Statistics, 90% of businesses had fewer than 10 employees (Department of Statistics, 1993). For the purpose of this survey, one of the requirements was that the computing (IS/IT) services functions would have to be sufficiently extensive to justify a quality system. Therefore, fewer small companies would qualify, and companies were usually medium or large in size. Figure 5-3 indicates the differences between the distribution of staff size found in the respondent group and that of the New Zealand labour market as a whole. Figure 5-4 indicates the distribution of staff number in computing services.

Figure 5-3: A comparison of percentage of responses and NZ Labour Market (1992) Total Staff Size Distribution (Department of Statistics, 1993)



The median for total staff size was 185 while the median computing staff size was 10. The computing staff size includes both support and development staff.

Figure 5-4: Percentage of Responses in Computing Staff Size Distribution



5.4 JOB TITLES

The first section of the survey included spaces for the respondent's name, job title and the name of the company. Of some interest here were the job titles of the respondents, their frequencies are shown in Table 5-2. Responsibilities for computing services appear to be well defined, with jobs specific to computing or information systems. This takes up the two major classes of 28% (27 + 13) responses, that is the IS and computer services manager class. Moreover, about 38% of the responses (marked * in Table 5-2) were from non-computing classes, that is, general managers, operational managers, company secretaries and directors. This indicates that a good response was received from non-computing positions. There was a high level of responses from senior management, which indicates the importance that companies appear to place on their IS/IT systems.

Table 5-2: Frequency of respondent job titles

Title	Frequency	%	
IS Manager	**27**	**19**	
Computer Services Manager	**13**	**9**	
Quality Manager, Analyst, Co-ordinator, Specialist	11	8	*
MIS and EDP Manager	10	7	
Manager (management, business, market, customer, services or facilities)	9	6	*
Director (Operations, Computer Services, IT Services)	9	6	
Managing Director	9	6	*
IT Manager	8	6	
Financial Controller, Accountant, Accounts Manager	7	5	*
General Manager	7	5	*
Consultants	6	4	
Manager, (Information Services, Data and Networks)	5	4	
Systems Manager	5	4	
Company Secretary	4	3	*
Operations/Service Manager	4	3	*
Product Development/Services Manager	2	1	*
Regional Manager	2	1	*
System Analyst/Programmer	2	1	
Total	140	100	

5.5 MEANS, MEDIANS AND STANDARD DEVIATIONS

Most of the questions in the questionnaire asked for responses on a 1 to 5 rating scale, in which 5 represented the highest level, while 1 represented the lowest. The specific meaning for the levels of response alternatives are:

Question No. Levels of Response Alternatives

A1: (1) Not interested, (2) Vaguely interested, (3) interested, (4) Quite interested, and (5) Very interested;

A2-3: (1) Never heard of them before, (2) Heard of them, but unfamiliar, (3) Familiar, but don't use them, (4) Use them occasionally, and (5) Use them regularly, please specify areas(s);

C5-9: (1)Low-(3)Medium-(5)High;

DI1-DV7: (1) Quality system feature does not exist, or is handled in an ad-hoc manner, (2) Aware of need for the quality system feature and planning commenced, (3) Quality system feature partially implemented and documentation in progress,

(4) Quality system feature fully implemented and documented. Not yet fully effective, and
(5) Quality system feature fully implemented, documented, regularly audited and highly effective.

The means, medians, and standard deviations were used to describe the central tendencies of all the simple rating scale type of responses. Refer to Table 5-3 and Figure 5-5. Figure 5-5 is a Box-and-Whisker distribution diagram. It provides a visual indication of distribution of the responses to each question (Myrvold, 1990). The plot depicts the spread of values about the mean and median of a distribution. For non-normal data the spread about the median is considered to be a more robust indicator of central location when the underlying data is skewed (Daniel, 1990).

The aggregated responses to "personal perception" (A1-3), "customers/users relationships", "management commitment", "staff acceptance" and "customers satisfaction" (C5-9) questions were relatively high. There were up to 75% of responses that were above or equal to level 3 - "medium". However, the aggregates for the quality management practice (DI1-3, DII1-4, DIII1-5, DIV1-4, and DV1-7) were clearly lower (median=2), which mean that the respondents were "Aware of need for the quality system feature and planning commenced".

There was a clear indication that respondents were "very interested" (the median) in quality management practices. However, responses for the "involvement in quality management" and "knowledge of ISO 9000" questions were lower and were less homogeneous, although still substantially high overall. The median for "involvement in quality management" was "use them occasionally" and for the "involvement in quality management" was "familiar, but don't use them". These suggest that there is an awareness of the need for quality management practice but that implementation is less than desirable. Further discussion is presented in Section 5.7.

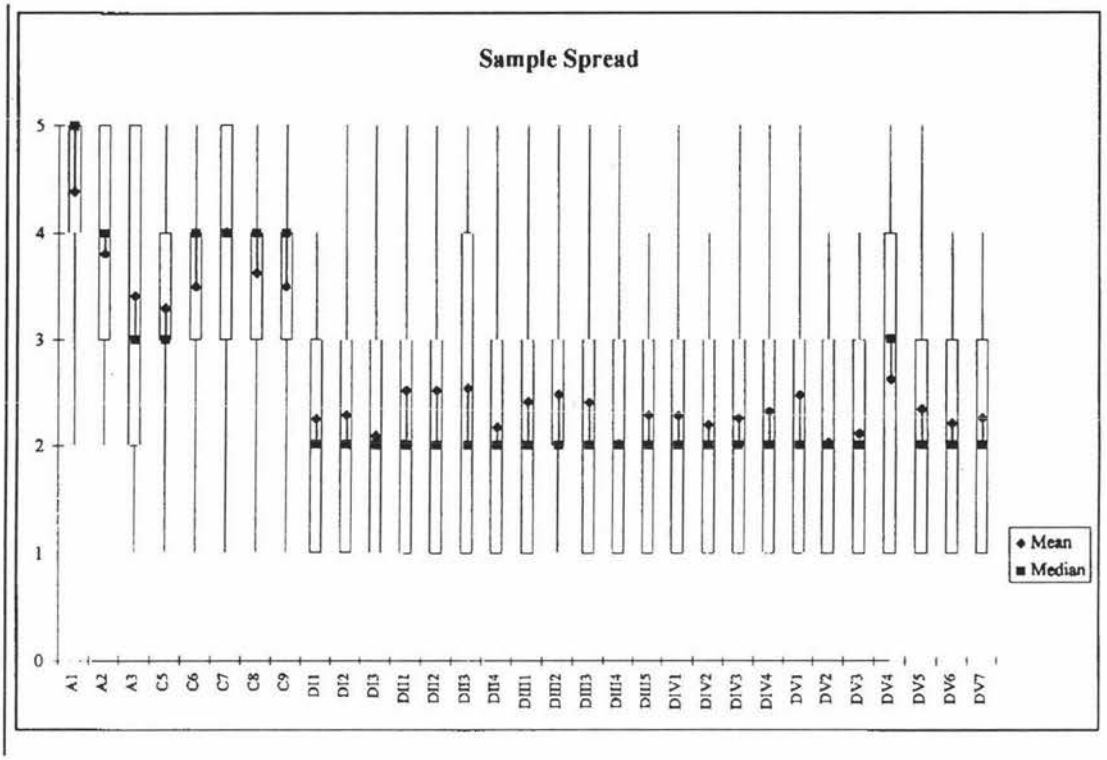
The responses from the questions about company, indicated that staff and management were committed to quality management practice in computing services. The median response was "4" for both "Senior management commitment" and "Staff acceptance". Refer to Section 5.7 and 5.12.1 for further discussions.

Table 5-3: Mean, Median and Standard Deviation for Rating Scale Responses

		mean	median	S.D.
Personal	A1. Personal interest in QM practices	4.39	5	0.86
	A2. Personal involvement in QM practices	3.80	4	1.033
	A3. Personal knowledge in ISO 9000	3.41	3	1.16
Company	C5. Customers/users level of computer literacy	3.29	3	1.01
	C6. Interaction between developer & user	3.49	4	1.04
	C7. Senior management commitment	4.01	4	1.08
	C8. Staff acceptance	3.62	4	1.01
	C9. Customer satisfaction	3.49	4	0.85
Quality	DI1. Quality policy	2.24	2	1.11
Practices	DI2. Implementing quality policy	2.28	2	1.19
	DI3. QM effectiveness review	2.09	2	1.09
	DII1. Identifying customer requirements	2.51	2	1.23
	DII2. Product/service specification	2.51	2	1.27
	DII3. Specification verification	2.54	2	1.29
	DII4. Contract review	2.16	2	1.15
	DIII1. Design development	2.41	2	1.23
	DIII2. Documentation: design & development	2.48	2	1.19
	DIII3. Change management	2.40	2	1.19
	DIII4. Sub-contracting management	2.01	2	1.08
	DIII5. Purchase management	2.28	2	1.15
	DIV1. Documentation control	2.27	2	1.16
	DIV2. Customer management	2.19	2	1.08
	DIV3. Internal audit	2.25	2	1.22
	DIV4. Staff training	2.31	2	1.16
	DV1. Customers interaction	2.47	2	1.21
	DV2. Marketing	2.02	2	1.08
	DV3. Service delivery	2.11	2	1.06
	DV4. Corrective and preventive action	2.62	3	1.29
	DV5. Customer's assessment	2.34	2	1.22
	DV6. Training needs for customers	2.20	2	1.12
	DV7. Collection and analysis of performance	2.25	2	1.21

Those questions which asked about implementation of quality management features received responses that were typically low. The medians were at level 2, that is, "Aware of need for the quality system feature and planning commenced". This is in keeping with the pattern of responses to questions A2-3 (personal involvement and knowledge of ISO 9000). Refer to further discussion in Sections 5.7 and 5.12.2. Despite the high interest in quality management practice, it does not appear to be well understood in IS/IT.

Figure 5-5: Box-and-Whisker diagram (Response Alternatives against Questionnaire Items)



An exception in responses was question DV4, that is "procedures for corrective and preventive action in response to customers", which received higher scores and a wider spread of responses (median=3, "quality system feature partially implemented and documentation in progress").

Differences in responses to questions, by different groups of respondents, are dealt with in the next few sections.

5.6 THE TEST FOR SIGNIFICANCE

A respondent might have a profile of: being very interested in quality management, use "quality management practice" regularly, have "never heard of ISO 9000 standard", in the "Manufacturing business", a company of "total staff size of about 100", have a "computer staff size of about 9", with the "computing services department working towards the registration of a quality standard", "customer focused", have "senior

management committed to quality" and a "Top 200" company of the New Zealand's Management journal. Would such a profile be more or less likely to mean that the computing services would have achieved "good quality practice" features? More specifically, which of those potential factors may be more likely to be associated with "good quality management practice" features.

The initial hypotheses, as defined in Section 4.3 (Design of the Survey), were tested using the Chi-Square (χ^2) test. The null hypotheses (H_0) were that those potential factors had no association with quality management practices. To test each hypothesis, that is, whether respondents classified under a group would exhibit different characteristics, the numbers of cases from each group which fall in the category were counted. The proportion of cases from one group was then compared with the proportion of cases from the other group(s). (Refer to Appendix C for detail discussion.) For example, we may test whether the "top 200 companies" group differs in their responses from those "non top 200 companies". Organisations and companies with 3 or fewer computer staffs may differ from those with more than 3.

The results of the significance test are summarised in Table 5-4. (Refer to Appendix D for the detail "probability value" results.) The first column defines the classification of those potential factors and the subsequent columns are the variables (organisational behaviour and "good quality management practice") being tested. Those variables which are tested statistically significant are marked in Table 5-4 with "**" representing H_0 rejected at $\alpha < 0.01$ and "*" H_0 rejected at $\alpha < 0.05$. For the rest of the unmarked cells, it was not possible to reject the null hypothesis. That is the responses from different groups within each potential factor had no significant difference.

Taking the "top 200 companies" example, we could test whether the group differ in their responses from those "non top 200 companies". It was found that only the variable DIV3 - "internal auditing of the management of computing services" was significant. Refering to Table 5-4, the H_0 was rejected at $\alpha < 0.05$ but not $\alpha < 0.01$. (Refering to Appendix D, the p value was 0.03, $df = 4$).

Table 5-4: Summary of Chi-Square (k-Independent Samples) Tests

Classifications	df	A1	A2	A3	C5	C6	C7	C8	C9	DI1	DI2	DI3	DII1	DII2	DII3	DII4	DIII1	DIII2	DIII3	DIII4	DIII5	DIV1	DIV2	DIV3	DIV4	DV1	DV2	DV3	DV4	DV5	DV6	DV7
Top 200 companies (Y/N)	4																							*								
Region (Auck, Wgtn or Others)	8				*			**																								
IT Companies (Y/N)	4	**		*	**							*															*					*
Industry Types	28	*							**									*														
Total Staff Number	16																															
Comp Staff Number	12	**	**			*									*		**	**	**	*						**	*	*	*	*		**
Exports (Y/N)	4			**						*					*											*			*			
One Sys/Sub-sys certified qs (Y/N)	4			*						**	**	**	*			**		*	**	**		*	**	**	**		**					
Work towards Certification (Y/N)	4	**	**	**			**	*		**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**
Orientation (Int, Ext or Both)	8			*	**						*	**															*					
Respondent (prov or cust)	4		**	*							**	*									*	*			*			*				
Iden. Prod/Serv Int (D, C, B or NA)	12					*																										
Iden Prod/Serv Ext (D, C, B or NA)	12			**								*		**	**			**	*		*				*	**	**	*	**			*
Spec. Req. Int (D, C, B or NA)	12			*		**				*															*					**		
Spec. Req. Ext (D, C, B or NA)	12			*						*	**	*		*				*		*						**	*	**	*	*		*
Per/Interest (H/L)	4						*	**			*	*	**	**	**	**	**	**	**	**	**	**	**		*	**	**	**	**	*	**	**
Per/Involvmt (H/L)	4						**	*		*	**	**	**	**	**	**	**	*	**	**	**	**	*		**	**	**	**	**	**	**	**
Per/KnowISO (H/L)	4						**			**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**

** H_0 rejected at $\alpha < 0.01$, * H_0 rejected at $\alpha < 0.05$

In order to have a conservative result, only those potential factors with a majority of variables that were found to be significant (to remove any randomness and noise) were picked as significant factors. Hence, the "top 200 companies", which had only one variable showing significance was not selected as a significant factor. This (and similar results) are key findings, that is, companies from the "top 200 companies" appear to be essentially the same as other companies with respect to "organisational behaviour" and progress in implementing quality management features in their computer services.

The following significant factors were selected: (Refer to Table 5-4)

- "personal interest",
- "personal involvement",
- "personal knowledge in ISO 9000", and
- "working towards certification on their computing services".

Marginally significant, were respondents with organisations and companies that:

- had different computer staff number, and
- "had at least one system registered to a quality standard".

The study shows no significant association between the level of quality management practice features implemented and whether organisations or companies:

- were in the "Top 200 companies" or not,
- were from different geographical regions - Auckland, Wellington, and others (Canterbury, Otago, Waikato, Hawkes Bay, Manawatu, Marlborough, Taranaki, Bay of Plenty, Wanganui, Coromandel and Northland),
- had different total number of staff,
- had their products or services exported,
- were in different industrial sectors - NZSIC breakdown,
- were in IT businesses (IT organisations or companies),
- were an internal, external or both oriented organisations or companies,
- were providers or customers of the computing services,
- had their developers or customers to identify the products or services - internally,

- had their developers or customers to identify the products or services - externally (outside customers),
- had their developers or customers to specify the requirements - internally, and
- had their developers or customers to specify the requirements - externally.

As observed in literature, the χ^2 tests are appropriate for data in the contingency table only if the expected frequencies are sufficiently large. When the sample size is between 20 and 40, the size requirements for all expected frequencies are 5 or more. (Siegel, 1956) Though, in this study, there were tests that contained expected frequencies of less than 5, the sample size was 140. In order to adjust for the low observed expected frequencies and also to simplify the testing procedure, cells were collapsed. Adjacent classifications were combined to increase values, and thereby reduced the number of cells. Example, the Other region group was a combination of all other smaller groupings and was measured against the Wellington and Auckland region groups.

The data were also tested using the Fisher's Exact test (Appendix E) and Kolmogorov-Smirnov two-sample test (Appendix F), and the results were consistent with those of the χ^2 test. However, the χ^2 tests were known to be more conservative (Goodman, 1954) for the types of data in of this research survey.

Table 5-5 shows a more detail analysis of responses by different groups of respondents. The first column in Table 5-5 is the listing of significant factors. The second and third columns indicate the appropriate groupings of each significant factor and their frequencies. The subsequent columns are medians found within each grouping. The last column is the averages of medians. The row below those medians consists of percentages of responses of "level 3 and above" within the grouping found significant (that is, "Yes", "High" or "=>21 computing staff").

The findings for the personal and company measures of medians are separated from those findings of quality management practice features. This is to enable a comparative

Table 5-5: Significant Factors, Medians and Percentage (for measure of responses of "level 3 and above" for the groupings found significant)

		Count	A1	A2	A3	C5	C6	C7	C8	C9	Av	DI1	DI2	DI3	DII1	DII2	DII3	DII4	DIII1	DIII2	DIII3	DIII4	DIII5	DIV1	DIV2	DIV3	DIV4	DV1	DV2	DV3	DV4	DV5	DV6	DV7	Av
"Interest"	Lo	21	-	2	2	3	4	4	3	3	3.00	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.00
	Hi	119	-	4	3	3	4	4	4	4	3.71	2	2	2	3	3	3	2	2	2	2	2	2	2	2	2	2	3	2	2	3	2	2	2	2.22
	%		-	78	46	82	83	89	92	90	80.07	42	41	36	54	50	51	38	48	48	46	35	46	40	39	39	44	54	33	39	58	45	40	45	43.95
"Involvement"	Lo	45	4	-	2	3	3	4	3	3	3.14	2	2	1	2	2	2	1	1	2	2	1	2	2	2	2	2	2	1	1	2	2	2	1	1.70
	Hi	95	5	-	4	3	4	5	4	4	4.14	2	2	2	3	3	3	2	3	3	3	2	3	2	2	2	3	3	2	2	3	3	2	3	2.52
	%		66	-	60	84	85	91	95	91	81.70	48	48	43	61	59	60	45	56	54	54	43	53	48	45	43	53	63	41	45	64	52	47	54	51.30
"Knowledge of ISO"	Lo	83	4	3	-	3	4	4	3	3	3.43	2	2	1	2	2	2	2	2	2	2	1	2	2	2	2	2	2	1	1	2	2	2	1	1.78
	Hi	57	5	5	-	3	3	5	4	4	4.14	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3.00
	%		96	98	-	84	81	96	95	86	90.98	61	63	54	74	68	68	60	63	65	63	53	58	61	51	54	60	75	56	58	81	61	58	63	62.17
Working towards cert	N	69	4	4	3	3	4	4	3	3	3.50	1	1	1	2	2	1	1	1	2	2	1	1	2	1	1	2	1	1	1	2	1	1	1	1.30
(5 already certified)	Y	66	5	4	4	3	4	5	4	4	4.13	3	3	2	3	3	3	2	3	3	3	2	3	2	2	2	3	3	2	2	3	2	3	2	2.57
	%		98	80	56	82	86	95	95	91	85.61	58	53	48	64	56	59	41	53	58	55	42	52	48	45	41	52	65	39	47	67	48	52	48	51.78
Computer Staff No.	= <3	32	4	3	3	3	4	4	3.5	4	3.56	2	2	2	2	2	2	2	2	2	2	1	2	2	2	2	2	2	1	1	2	2	2	1	1.83
	4-9	38	4.5	4	3	3	4	4	3.5	3.5	3.69	2	2	2	2	2	2	2	2	2	2	2	2.5	2	2	2	2	2	1.5	2	2	2	2	2	2.00
	10-20	29	5	4	3	4	4	4	4	3	3.88	2	2	2	3	3	2	2	2	2	2	1	2	2	2	2	2	2	2	2	3	2	2	2	2.09
	= >21	41	5	4	4	3	3	4	4	4	3.88	3	2	2	3	3	3	2	3	3	3	3	3	2	2	2	3	3	2	3	3	3	3	3	2.70
	%		100	85	56	76	90	88	98	90	85.37	59	49	41	61	59	66	46	66	71	71	51	56	44	41	44	51	76	46	56	71	63	54	63	56.73
One sys/sub-sys cert.	N	125	5	4	3	3	4	4	4	4	3.88	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2.00
	Y	15	5	4	5	3	4	4	4	4	4.13	3	3	3	4	3	4	3	3	4	4	3	3	3	3	3	4	4	3	3	3	3	3	3	3.26
	%		80	87	73	87	93	100	100	87	88.33	80	53	53	67	67	73	73	60	60	67	67	60	67	60	73	60	73	67	60	80	73	60	73	66.38

average score to be obtained from the two sets of measure. These percentages provide an estimate of measure of positive association between the significant factors and the measured variables. The variables were personal and company aspects and quality management practice features implemented within the organisations and companies. The personal aspects were defined as "interests", "involvement" and "knowledge of ISO 9000"; and company aspects were "customers/users' relationships", "management commitment", "staff acceptance" and "customer's satisfaction".

5.7 PERSONAL PERCEPTIONS

All the questions on personal factors, that is, personal "Interest", "involvement", "knowledge of ISO 9000" were identified to have significant association (most H_0 were rejected at $\alpha < 0.01$, refer to Table 5-4) with good quality management practices.

Respondents with a high level of "interest" were those responded with response alternatives of "very interested" and "quite interested". Those of high level of "involvement" or "knowledge of ISO 9000" had response alternatives of "uses them regularly" and "uses them occasionally".

Figure 5-6: Percentage of Responses in Level of Interest

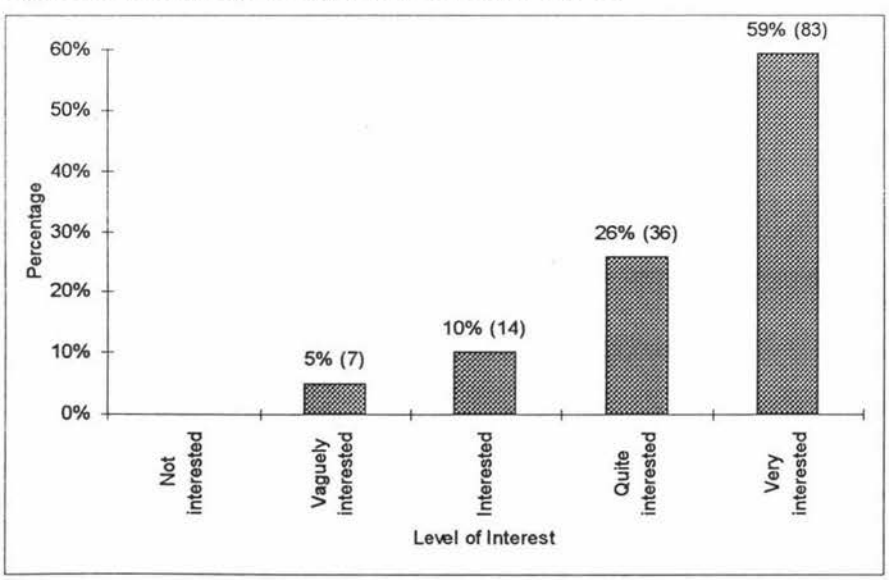


Figure 5-7: Percentage of Responses in Level of Involvement

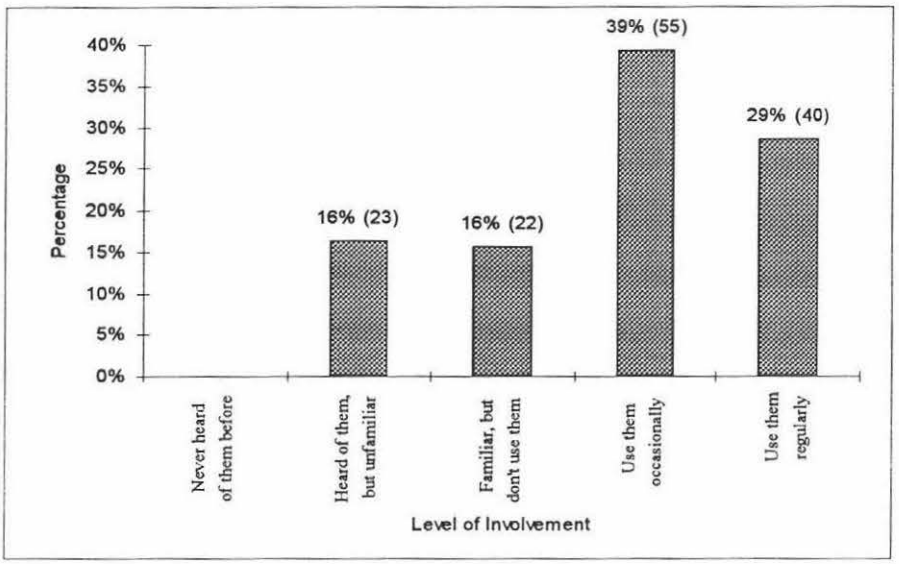


Figure 5-8: Percentage of Responses in Level of "Knowledge of ISO 9000"

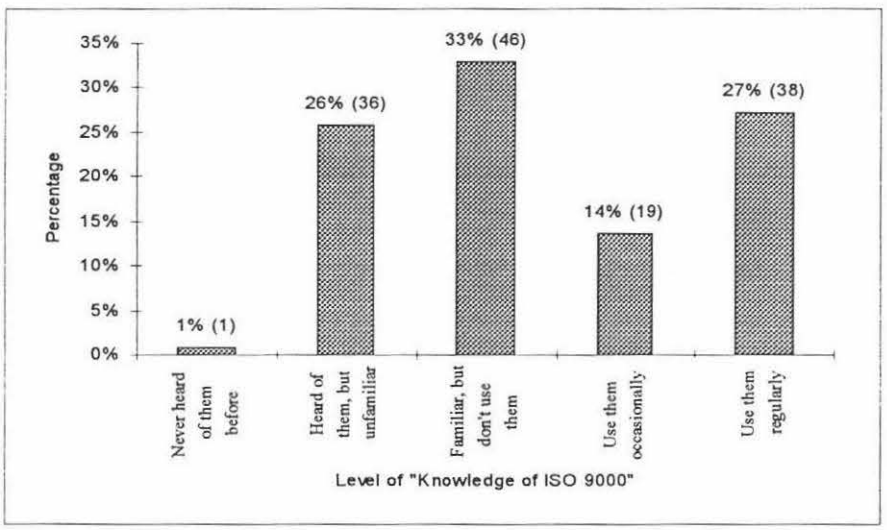


Figure 5-6, 5-7 and 5-8 show the overall breakdown of responses on "interest", "involvement in quality management practice" and "knowledge of ISO 9000". A greater level of interest was evident (the percentage interested to any degree being 95%) than was either the degree of involvement (being 68%) or the level of knowledge of ISO 9000 (41% using their knowledge).

Of real interest is how the responses to questions on "quality management practice" (DI1 to DV7) change for different levels of personal aspects, that is, the personal "interest", "involvement" and "knowledge of ISO 9000". As shown in Table 5-5 (in previous section), there is a marked difference in the medians of responses between respondents with a high and low level of "interest". However, the percentages of responses received from the high level of interest group on level 3 and above for "quality management practice" questions were only marginal (43.95% and 51.30% for "interest" and "involvement" respectively). The only exception was for the significant factor "knowledge of ISO 9000", which had an average of 62.17%. On the personal and company aspects, the "customers/users' relationships", "management commitment", "staff acceptance" and "customer's satisfaction", the percentages of responses on "level 3 and above" were higher. The percentages being 80.07%, 81.70% and 90.98% for "interest", "involvement" and "knowledge of ISO 9000" respectively.

This means that for a high level of response on "interest", "involvement" and "knowledge of ISO 9000", it is more likely to have a high level of response in the company aspects of questions. Whereas for the "quality management practice" questions, the likelihood is only marginal and the level of response is not high.

Table 5-6 and 5-7 provide a cross-tabulation of "involvement in quality management practice" in relation to "interest" and "knowledge in ISO 9000" respectively.

Of the 68% (29% + 39%) of respondents that used quality management practice, at least some of the time, 93 (32 + 36 + 21 + 4) or 98% ($\frac{93}{95} \times 100$) were at least quite interested in it. That is where "involvement in quality management practice" is high there is also a high level of personal interest.

Of those 68% of respondents using quality management practice, 56 (8 + 29 + 15 + 4) or 59% ($\frac{56}{95} \times 100$) used the ISO 9000 standards. In other words, of the 68% of respondents using quality management, but not ISO 9000, 39 (25 + 3 + 6 + 4 + 1) or 41% used TQM, CI, NZS 3563 and others.

Table 5-6: "involvement" versus "interest" in quality management practices

"involvement in quality management practice"	never heard of them before 0% (0)	heard of them, but unfamiliar 16% (23)	familiar, but don't use them 16% (22)	use them occasionally ***39% (55)***	use them regularly ***29% (40)***	100% (140)
very interested		6	9	32	36	***59% (83)***
quite interested		5	6	21	4	***26% (36)***
interested		7	6	1		10% (14)
vaguely interested		5	1	1		5% (7)
not interested						0% (0)

"personal interest in quality management practice"

Table 5-7: "involvement in quality management practices" versus "knowledge of ISO 9000"

"involvement in quality management practice"	never heard of them before 0% (0)	heard of them, but unfamiliar 16% (23)	familiar, but don't use them 16% (22)	use them occasionally ***39% (55)***	use them regularly ***29% (40)***	100% (140)
use them regularly			1	8	29	***27% (38)***
use them occasionally				15	4	***13% (19)***
familiar, but don't use them		1	17	25	3	33% (46)
heard of them, but unfamiliar		22	4	6	4	26% (36)
never heard of them before				1		1% (1)

"knowledge of ISO 9000"

Over the entire sample, 40% (27% + 13%) used ISO 9000 standard while 28% (68% - 40%) used other quality management practices and 32% used no practices. There are a large number of respondents (25) that use quality management practice occasionally and are familiar with ISO 9000, but do not use them. Hence, making the ISO 9000 standard the most common standard used in this research survey. Note also the strong responses across the diagonal of Table 5-7, which could imply a positive association between "involvement in quality management practice" and "knowledge in ISO 9000".

5.8 CERTIFICATION TO A QUALITY STANDARD

The survey indicated that 15 (4 + 6 + 5) or 11% ($\frac{15}{140} \times 100$) of organisations or companies had at least one of their systems or sub-systems certified to a standard (Refer to Table 5-8). Of that 11%, 33% ($\frac{5}{15} \times 100$) had certification for computing services systems. Hence, of the 135 organisations or companies (excluding those 5 respondents who already had their computing services registered), 47% ($\frac{64}{135} \times 100$) were working towards certification to a standard for their computing services. Of that 47% of organisations or companies, only 9.4% ($\frac{6}{64} \times 100$) had other sub-systems certified to a standard.

Table 5-8: Certification to a Standard

		"companies had at least one of their system or sub-system certified to a standard"			
		Yes (15)		No (125)	
"computing services system certified to a standard"	No (135)	4	6	58	67
	Yes (5)	5	-	-	-
		No (9)	Yes (64)		No (67)
			"working towards certification to a standard for their computing services"		

There was a large number (67 or 50%) of organisations and companies that were not "working towards certification to a quality standard for their computing services". However, the study was unable to conclude whether the organisations and companies had the intention in short-term or long-term to "work towards certification to a quality standard for their computing services".

Of those companies, who had at least one system or sub-system certified to a standard, or, those working towards certification to a standard for their computing services, the ISO 9000 series standard was the most commonly used. There were organisations and

companies working towards their own companies' internal standards, for example, Total Quality Management (TQM) or Continuous Improvement (CI) programme. A small percentage of respondents were working on such standards as: FORD 101, CAA rules, NZS 3563, ISRS and State Service standards. Some companies were working towards the New Zealand National Quality Award, or the Malcolmn Baldrige Award.

The criteria, "companies working towards certification of a quality standard for their computing services" and "companies with at least one system or sub-system certified to a quality standard", were identified to be key factors in the χ^2 tests (with most of its' H_0 rejected at $\alpha < 0.01$, $df = 4$, refer to Table 5-4). As expected, these companies were found to have achieved significantly higher level of quality management practice than other organisations and companies.

Of those "working towards certification of a quality standard", an average of 51.78% responded with level 3 and above for their "quality management practice" features implementation. That is, 51.78% of those "working towards certification" had at least their "quality system feature partially implemented and documentation in progress". (Refer to Table 5-5). An average of 85.61% responded with level 3 and above for their personal and company aspects questions.

Similarly, of those organisations and companies who had at least one system or sub-system certified to a quality standard, 66.38% responded with level 3 and above for their "quality management practice" features implementation. In the company aspects type of questions, 88.33% responded with level 3 and above. The overall medians were higher than other significant factors. The average of medians found were 3.26 for "quality management practice" and 4.13 for personal and company aspects.

5.9 RELATIONSHIP WITH CUSTOMERS

In order to put customers' relationship into its proper context, it was necessary to determine whether the respondents' computer services were internal or externally

oriented. The questions about the "total number of internal customers", "total number of external customers", and percentage of the company's product or services being exported were considered. The results show 61% of the respondents to be internally oriented, 21% - externally and 18% - both (internal and external). Table 5-9 describes the breakdown.

Table 5-9: Internal, External, or Both (Internal and External) Orientation of Computing Services

		Export			
		Yes 35% (49)		No (91)	
Internal	61% (86)	25	1	1	59
External	21% (29)	3	10	10	6
Both	18% (25)	5	5	8	7
		No (33)	Yes 25% (35)		No (72)
		IT Organisations			

With reference to Table 5-9, 25% (35) of the respondents were in the IS/IT business or were "IT Organisations". Of the 25% "IT Organisations" respondents, 94.28% ($\frac{33}{35} \times 100$) were either externally oriented or Both (externally and internally oriented).

The χ^2 tests show that, "IT organisations" and "companies' orientation" were associated with the responses on "customers' level of computer literacy" (with p values = 0.004 and 0.002, H_0 rejected at $\alpha < 0.01$, $df = 4$ and 8 respectively - Appendix D). Tables 5-10 and 5-11 show the detail breakdown of those responses, which show that IT and "external oriented" organisations and companies were positively associated with "customers' level of computer literacy".

Table 5-10: Contingency Table for "IT Organisations" and "customers' level of computer literacy"

"customers' level of computer literacy"	1	2	3	4	5	Total
"IT Organisations"	***1***	***3***	***11***	***8***	***12***	35
Non "IT Organisations"	3	20	51	22	9	105
Total	4	23	62	30	21	140

Table 5-11: Contingency Table for "companies' orientation" and "customers' level of computer literacy"

"customers' level of computer literacy"	1	2	3	4	5	Total
"Both Internal and External"	1	2	7	11	4	25
"External"	***0***	***5***	***13***	***1***	***10***	29
"Internal"	3	16	42	18	7	86
Total	4	23	62	30	21	140

It should be noted that most "IT organisations" respondents were "externally oriented" (and expected to be). In an "externally oriented" environment, it would be normal for customers to request the product or services. Hence, it was not unusual to have considered customers of an "externally oriented" environment or "IT organisations" to have a "high level of computer literacy".

The χ^2 tests and contingency table (Table 5-12) also indicate a positive association between respondents that "export their product or services" and "knowledge of ISO 9000" (p value = 0.005, H_0 rejected at $\alpha < 0.01$ and $df = 4$).

Table 5-12: Contingency table for organisations that export and "Knowledge of ISO 9000"

"Knowledge of ISO 9000"	1	2	3	4	5	Total
Export	***0***	***6***	***13***	***9***	***21***	49
Non Export	1	30	33	10	17	91
Total	1	36	46	19	38	140

When respondents had both developer and customer to "identify product or service for external customer" or "specify requirements for external customer", there appear to be an associations on responses for "Provision of computer services" (H_0 rejected at $\alpha < 0.01$ and $df = 12$).

Tables 5-13 and 5-14 show the percentages of "who initially identifies new requirements" and "who specifies technical requirements" for computing services, categorised by the type of customers being served (whether internal or external).

Table 5-13: Proportion in % (number) on "who identifies new computer product or service"

	Developers	Customers	Both	NA	
Internal Customer	6% (8)	***52% (73)***	29% (41)	13% (18)	100% (140)
External Customer	12% (17)	31% (43)	13% (18)	***44% (62)***	100% (140)

Table 5-14: Proportion in % (number) on "who specifies the technical requirements of product or service"

	Developers	Customers	Both	NA	
Internal Customer	***53% (74)***	24% (33)	14% (20)	9% (13)	100% (140)
External Customer	29% (41)	19% (27)	8% (11)	***44% (61)***	100% (140)

The percentage responding Not Applicable (NA) was the same (44%) for the externals for both questions. It means that where customers were external, whether developer or customer identifies or specifies the new or technical computing requirements, was more difficult to determine. In the case of the internal customer the greater percentage (52%) reported to identify new product or services were the customers, followed by both customers and developers (29%) in contrast to only 6% of the developers. However, in the case of specifying the technical requirements of the product or services the greatest percentage (53%) reported this to be the domain of the developers, with a smaller percentage (24%) being the domain of the customers and task was shared between them less (14%).

This suggests that for internal customers, it is the customers that identify new products, but the technical specification is written by the computer specialist. The same pattern of responses emerged for the external customers but to a lesser extent.

The data indicated that the majority of respondents provide services to internal customers. It may be considered that the quality control for internal services would be less than for organisations competing fully in the market place. Other studies have shown that there was little awareness amongst internal oriented providers of quality management (Logical Study Team, 1988).

5.10 OTHER OBSERVATIONS

While the general picture shows that "interest", "involvement" and "knowledge of ISO 9000" are key elements or factors associated with quality management practices, the analysis also identified other issues that need to be addressed.

Of the 411 selected organisations and companies in the mailing list, 224 (55%) were "Top 200" companies in 1991, 1992 or 1993. Of the 140 respondents, 45% (63) were among the top 200 companies. Hence, this is not surprising. As successful companies are known to have an interest in quality management practices. However, in the significance test, the top 200 companies did not appear to have been different from the non top 200 companies. An exception was the question DIV3 - "internal auditing of the management of computing services" (p value equals 0.03, H_0 rejected at $\alpha < 0.05$ and $df = 4$). Table 5-15 illustrates the contingency table.

Table 5-15: Contingency table for "Top 200 companies" and "internal auditing of management"

"internal auditing of management"	1	2	3	4	5	Total
Non "Top 200 Companies"	27	28	10	6	6	77
"Top 200 Companies"	***22***	***11***	***19***	***8***	***3***	63
Total	49	39	29	14	9	140

There was a consistent significant response on "senior management committment" and "staff acceptance" to quality management from all those significant factors, namely, personal "interest", "involvment", "knowledge of ISO 9000" and companies "working towards certification of a quality standard".

Refering to Table 5-4 (section 5.6) and 5-16, respondents from "Other" regions had significantly lower (p value equals 0.007, H_0 rejected at $\alpha < 0.01$ and $df = 8$) "staff acceptance for quality systems" than both Auckland and Wellington regions.

Table 5-15: Contingency table for regional breakdown and "staff acceptance to quality management"

"internal auditing of management"	1	2	3	4	5	Total
Auckland	0	7	20	17	15	59
Others	***4***	***5***	***10***	***10***	***7***	36
Wellington	0	0	17	20	8	45
Total	4	12	47	47	30	140

Both factors, respondents that were "certified to a quality standard" and "computer staff sizes" and were marginally associated with quality management practices. Their observations were:

There were 11% (15) of respondents that "had at least one of their system or sub-system certified to a quality standard". Those organisations and companies were perceived to have responded higher level of quality management practice features in DI (Management), DIII (Design and Development) and DIV (Maintenance) of computing services. An example of their contingency tables is illustrated in Table 5-16 (Management - formal management system for implementing quality policy).

Table 5-16: Contingency table for "System or Sub-system certified to a quality standard" and "Management - formal management system for implementing quality policy (DI2)"

"formal system for quality policy"	1	2	3	4	5	Total
No System or Sub-system certified	43	38	26	14	4	125
System or Sub-system certified	***2***	***5***	***1***	***4***	***3***	15
Total	45	43	27	18	7	140

These organisations and companies who "had at least one of their system or sub-system certified to a quality standard", 66.38% of them responded with level 3 and above for their quality management system features. Refer to Section 5.12.3 for further discussion.

Further analysis on the factor "computer staff sizes", show that organisations and companies who had "21 or more computer staff" responded with significantly higher level of quality management practice features. Table 5-17 is an example of those detail analysis works.

Table 5-17: Contingency table for "Computer Staff Sizes" and "Design and Development - methods for developing documentation (DIII2)"

"methods for developing documentation"	1	2	3	4	5	Total
Computer Staff size of =< 3	13	10	7	1	1	32
4-9	13	11	6	4	4	38
10-20	5	14	4	6	0	29
=> 21	*3*	*9*	*14*	*12*	*3*	41
Total	34	44	31	23	8	140

There were 29% (41) of organisations and companies who had "21 or more computer staff". Their responses to questions DIII (Design and Development) and DV (Provision) were significant. Refering to Table 5-5, 56.73% of these organisations and companies responded with level 3 and above for their quality management system features. Refer to Section 5.12.4 for further discussion.

5.11 GENERAL COMMENTS

A selection of the comments that emerged when respondents were given the opportunity to make general comments about the issues under investigation, is presented next. These comments provide qualitative data which gives a 'feel' for respondents' situation and their reactions to them.

Some typical comments from the respondents showed a positive trend in quality management practice. Two companies who had been practising "quality" for many years said:

> "Our company took up the TQM philosophy around 3 years ago. We are hoping for ISO 9000 accreditation early next year."

> "Computer services has practiced quality management for many years, the corporation is now planning for ISO 9000 accreditation with the computer services as facilitators."

Here are some of the comments from respondents who had just begun instituting quality systems:

> "I have a strong personal interest in this area, but I have only recently managed to make my management share that interest. They have now done so, and we have started on the process towards ISO 9000 accreditation."

> "We are in the process of implementing a systems development methodology of Information Technology. The draft has been approved by the senior executive and an implementation plan is being finalised at present. This document covers most aspects of quality management ..."

> "The provision of computer services (including analysis, design, development and maintenance) is by traditional DP standards. Our company has embarked on the process to acquire ISO 9000 accreditation."

> "We are in a state of change and will be reviewing quality management practices very closely as part of the implementation project."

".... has recently appointed a consultant to work with management and staff in analysing and documenting systems, staff training etc. in our overall push to improvement to customer service."

"No formal quality system in place, though very conscious of need for quality and of user needs."

"Have implemented corrective action and change request procedures, still developing IS policy."

"We are in the process of getting our procedures in place for certification - we anticipate this to be completed in the next 12-18 months."

"..... I have only been in this role for 6 months, I am currently implementing quality for our services and performance criteria."

"We are in the process of implementing IS policies ....."

"We are at the first stages of planning quality measurement systems for client services ...."

Quality often been described as a journey, and certification under ISO9000 was only one milestone on a route to development of a complete quality management system. Several companies took the opportunity of this questionnaire to air their views and problems:

"... accreditation is no guarantee of product quality. In other words a well documented poor product. Is it a huge exercise in empire building? Rightly or not most people think computers and hardware in particular are commodity items and they buy on price. ISO will increase costs."

"TQM and related ideas and performance monitoring systems are extremely important, however, implementation of such systems requires

considerable time and requires highly dynamic complex business systems to be fully tested and documented before becoming operational. This causes a dilemma in that our industry changes occur extremely quickly and thus there is a difficulty in being flexible enough to react in timely manner to changes in requirements."

".... quality management and formal procedures are completely unknown in this organisation. Is there any evidence that the effort of putting them in place is worth it in a team of 3.5 people?"

"I am very aware of the need to develop and implement quality standards, but at this stage the company is very small, and I am having to focus on other work to keep the company going."

"With a small staff and very limited resources, a quality system is seen as infeasible."

From the types of comments, it may be summarised that all organisations and companies recognised the importance of quality management practices. Some organisations and companies were motivated by improving their performance and quality of customer services. However, there were reservations about the usefulness and benefits of quality management practices and their ability to cope with the rapidly changing IS/IT environment. There were concerns on whether the effort and expenditure on quality management practices would be worthwhile or even feasible for small organisations and companies.

5.12 DISCUSSION OF RESULTS AND CONCLUSIONS

Some of the main issues and conclusions emerging from the research survey can be summarised as follow:

- There was substantial interest, staff acceptance, management support and management commitment for quality management in computing services.

- There was a general lack of people with sufficient involvement in and knowledge of quality, quality management and quality standards.

- The implementation levels of quality management system for most organisations and companies were low.

- The most common quality standards adopted by companies to build their quality systems were the NZS 9000 series standards.

- Less than 50% of the organisations and companies were working towards certification of a quality system for their computing services.

- Good quality management practices appear to be associated with organisations and companies that have staff interested and involved in quality management. Organisations and companies "working towards certification of a quality standard" were also considered to have a strong association with quality management practices.

- Organisations and companies with "one system or sub-system certified to a standard" and "computer staff size of more than 20" were perceived to have done marginally better in the area of quality management practices.

- There were perceived limitations and reservations about introducing quality management practices.

5.12.1 Personal Perceptions

The research survey indicated that a large majority of organisations and companies were very interested in quality management practices. There was staff acceptance of,

management support and management commitment for quality management in computing services. However, the "involvement" and "knowledge" of quality, quality management and quality system standards was limited and the responses were varied. The average response to the "involvement" and "knowledge" questions were "use them occasionally" and "familiar, but don't use them".

Y.K. Shetty, a professor of management at Utah State University's College of Business (I/S Analyzer, 1994), advises that even though most corporate executives believe that quality and productivity of computing services are the most critical issues, many organisations have difficulty in achieving them. She suggests that executives have difficulty in relating quality and quality systems to computing services. To succeed in applying quality to computing services, other than simply through management support and management commitment, Professor Shetty recommends personnel involvement, institutionalised improvement, education and the use of methodologies to achieve quality.

The research survey in this thesis also found that personal and general organisational factors have a positive association with "customer/supplier relationship" and "quality management practice". Respondents with high levels of "interest", "involvement", "knowledge of ISO 9000" or "working towards certification of quality standard" achieved significantly higher levels of quality management practices.

A study done in the United Kingdom indicated that the availability of people with the vision and skills required to develop a high quality business systems is a key factor. There is a "need for education and training programmes, to establish an environment that supports high quality work". (CSC Index, 1991)

New Zealand is relatively new in the development and management of quality for information systems and information technology. The subject area of quality is growing rapidly in popularity. Government, industry groups and the NZOQ (New Zealand Organisation for Quality) have had a significant impact in their leadership roles, in the

promotion of quality programmes, and in their advisory function in regard to quality issues, (Baguley, 1994).

5.12.2 Quality Management Practice Implementations

Based on the research survey, organisations and companies were not responding well with respect to the quality management practice features. The means and medians for most quality management practice features were consistently low (with both mean and median about 2) - "Aware of need for the quality system feature and planning commenced". The only exception was "procedures for corrective and preventive action in response to customers" (DV4), which received a higher level and a wider spread of answers (mean=2.62 and median=3). This centres the distribution around "quality system feature partially implemented and documentation in progress".

There may be several reasons for this situation. Probably the greatest contributor is that organisations and companies were at the initial stage of implementing their quality systems. This is a typical phenomenon, where organisations and companies are responding to customers needs and have just begun their journey towards quality, "customer focus", and the new way of doing business. At this stage organisations and companies had just started to apply the quality "feedback loop".

It is important for organisations and companies to progress onwards with their quality system implementations. It is not enough to have the interest and a partially built quality system. There must be continuous improvement and a quality system to keep track of the direction and achievements made. The importance of a quality management system is that it provides a flexible framework within which skills, methods, controls and standards can be applied in a quality conscious way.

5.12.3 Quality System Standards and "working towards certification"

The DTI's (Department of Trade and Industry - United Kingdom) series of research surveys indicated the importance and benefits of quality systems, assessment and

certification, process standards and product standards. That research also recommended the need to promote the awareness of quality management systems and quality standards to company directors and senior managers, particularly of smaller companies.

The DTI's research surveys highlighted the lack of confidence in 3rd-party assessment and certification for computing services. There was a need to review the whole area of assessment and certification in order to improve market confidence in 3rd-party certification of quality management for computing services. The DTI's consultants explained the reasons for the lack of confidence in 3rd-party assessment and certification could be due to the short period that it was operative. Other reasons were the lack of accredited third party certification bodies in the computing services field and the shortage of trained, experienced and registered Lead Assessors/Assessors.

Even though our present research survey indicated that very few companies had their computing services systems certified to a quality standard, there was a promising level of respondents who were working towards it (47%). The NZS 9000 series standards were the most popular. However, a small percentage of the respondents were working towards the NZS 3563: Software Quality Management System standard, TQM, CI or company internal standards.

On a wider scale, in 1993, New Zealand had approximately 750 companies certified to the NZS 9000 Standards (Walker, AJ, 1993). Since then, many more companies have obtained certification for their quality systems. A telephone survey revealed that local NZS 9000 Standards certifying bodies estimated that, in mid 1994, the number of companies certified for NZS 9000 in New Zealand was about 955. (Pang, 1994) Consequently, this research survey, which was conducted at the end of 1993, reflected the situation over the 1993/1994 period. This indicates that companies are beginning to recognise the importance of quality management systems and that the number of companies gaining certification for the NZS 9000 quality system standards is growing rapidly.

Perhaps, an indication of the growth in recognition of quality management is the recent increased in quality standards certification bodies. Now, New Zealand's certification bodies include - Telarc, Standards New Zealand (SANZ), Bureau Veritar, SGS New Zealand, KPMG Peat Marwick, Quality Society of Australasia (QSA), Lloyds, Det Norske Veritas (DNV), and International Certifications Ltd (ICL).

5.12.4 Other Factors Influencing Quality Management Practice

There were several other factors found to have significant association with the implementation of quality management practice features, (Refer to section 5.10 Other Observations). However, there is one which is worth discussing, namely the companies with more than 21 computer staff. In the survey, 41 (29%) respondents were with "computer staff size of 21 or more". This group of respondents performed marginally in achieving quality management practice features for "Design and Development of Computer Services" (DIII) and "Provision of Computer Services" (DV).

Previous research suggests that there is a relationship between IS staff size, computing services and organisational success (Raymond, 1990). According to Thong (1993), small companies lag behind those larger organisations in the use of IS/IT due to the characteristic problem of resource poverty. Resource poverty results from smaller companies operating in a highly competitive environment, suffering financial constraints and lack of resources.

5.12.5 Summary

Prior to the study many organisations and companies were perceived to have difficulties in the application of quality management practice in computing services. The objective of this study then was to assess the state of quality management practices of computing services in New Zealand industry as a whole.

A postal survey was designed and sent to 411 organisations and companies, and 140 responses were received. These responses were tested to see if they were representative

of the New Zealand industry. If it is reasonable to conclude that 140 responses constitute an adequate sample then the results just presented provide a relevant and useful insight into quality management practices in computing services in this country.

The research findings indicate willingness of staff and a commitment of management to strive for improvement. A number of organisations and companies indicated the growing acceptance of quality management, that they were in the process of implementing some quality system features. Many organisations and companies also expressed some of the common problems faced in implementing quality systems.

The results of the study present a snap-shot of the status of quality management in New Zealand industries. The findings are consistent with findings of other research studies and written works in quality management literatures.

6. CONCLUSION AND FUTURE RESEARCH

This study was motivated by the researcher's concern about the status of quality management practices in New Zealand's organisations and companies. More specifically, there were concerns about the use of quality, quality management and quality standards. The following paragraphs review the research findings and answers to the research questions defined in Chapter 2.

1. What is the current status of quality management practice of computing services in industry?
2. What is the level of acceptance of quality management standards?

Despite there being substantial interest in and acceptance of quality management[1] in computing services, there has been a general lack of knowledge[2] on the part of organisations and companies to implement practices. The degree of quality management system implementations has been low for most organisations[3] but just under half of those surveyed were working towards certification[4] of their computing services.

3. What are some of the common quality standards adopted in industry?
4. What are some of the factors that may influence quality management practice?

Not surprisingly good quality management practices were more likely where staff were interested and involved in quality management. Organisations and companies "working towards certification of a quality standard" were also considered to have a strong association[5] with quality management practices. Where at least one system or sub-system was certified to a standard and the computer staff numbers were greater than

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[1] As reported in sections 5.5, 5.7 and 5.12.1

[2] As reported in section 5.5, 5.7 and 5.12.1

[3] In sections 5.5 and 5.12.2

[4] In sections 5.8 and 5.12.3

[5] In sections 5.6, 5.8, 5.10 and 5.12.3

twenty, organisations were perceived[6] as having done better in the area of quality management practices. The quality standards adopted by organisations and companies to build their quality systems were the NZS 9000 series[7] standards. There was also a small percentage of organisations and companies using companies' internal standards, TQM, CI, NZS 3563 and the New Zealand National Quality Award.

As was raised in the background[8] studies, there are several problems related to computing services, software development, quality standards and quality management practices. Some of the same concerns were similarly expressed in the general comments[9] by organisations and companies. The results of the research study have confirmed the widespread interest[10] and recognition of quality, and the awareness[11] of the potential benefits in quality management. There are several international efforts[12] in improving quality standards and guidance documents. There are significant investments, within organisations and companies, in education, training and other areas[13] of quality and quality management. Provided that such a trend persists, the barriers and reservations about quality management in New Zealand will soon be overcome.

The research results indicate high levels of interest, staff acceptance, management support and commitment for quality management in computing services. Given the current situation, the researcher believes that the use of quality management practice will continue to grow rapidly in New Zealand. Probably, the NZS 9000 quality standard will still be maintained as the dominant quality system standard. There will be a growing need for and recognition of 3rd party assessment and certification in quality system standards.

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[6] In sections 5.10 and 5.12.4

[7] In section 5.8 and 5.12.3

[8] In sections 3.10 and 4.1

[9] In section 5.11

[10] In section 5.5, 5.7 and 5.12.1

[11] In section 3.6, 3.7, 3.8, 3.9 and 5.11

[12] In section 4.1 and 5.12.3

[13] In section 5.12.1 and 5.12.3

6.1 LIMITATION OF SURVEY APPROACH AND RESULTS

Several limitations of this research are apparent and improvement must be considered in future studies. Implications on the results and proposal for improvements are discussed.

As mentioned in the Design of the Survey section, the choice of a simple rating method for the survey was based on its practicality, ease of use and cost. Several limitations arise from the standpoint of its application in the survey. There are problems associated with treating the data in the analysis phase. Certain assumptions[14] had to be made about the scale properties.

It was also apparent that the measurements of attitudes and behaviours (as used in Part A and C of the questionnaire) are too complex to be measured along a single ordered set of categories. However, relatively few data collection methods are available in this area. For future research survey, there is a need to explore the use of anchored scales, multi-dimensional scaling and other data collection methods for behaviours and attitudes.

The ISO 9000 standard was used as a measure to indicate the extent of good quality management practices of organisations and companies. The ISO 9000 standard was selected on the basis that it is a more recognised standard and it is general enough for use in the computing services field. Perhaps a better approach would have been to pick elements from specialised standards and guidelines designed for specific purposes, such as quality, management, software development, configuration management and project management.

A key aspect of the survey was to obtain a relatively large number of responses quickly from a cooperating group of respondents. This is merely to provide an indicative response and a cross-sectional view throughout New Zealand's organisations and companies. It only includes organisations and companies that have something to do with

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[14] In section 4.3.1

IS/IT and computing services. Therefore, many potential sources of selection bias are present.

By the nature of the research design, a limitation is that the data used to test the hypotheses were cross-sectional. The subject areas were too broad in coverage and too general. A preferred approach would be to take the research survey in two steps. First, a much simpler "pre-survey" should be conducted to gather data for an overall general nature. Second, a more in-depth study from a selected segmented group of organisations and companies to provide a more complete insight into the use of quality management practice.

Cross-tabulation and chi-square tests were used for analysing associations between variables. Extended work on the data analysis could have included multi-variate procedures to test relationships among more than two variables.

6.2 FUTURE RESEARCH

The results of the survey suggest that the potential for further research is substantial. Of the 140 respondents, 37 (26%) organisations and companies were interested in the extended research study. However, owing to budget constraints, it was impossible to extend the detail of the analysis. In the process of designing this research study, other areas of future research were identified, as follows:

It would be interesting, within the scope of this research, to further study the direct influence of several potentially important factors in relation to good quality management practices. They include organisational size (staff size, capital, revenue and various types of turnover), nature of business and type of organisations and companies. In this study, data related to many of these factors were collected and viewed from a general perspective. In addition, many of the factors identified in the analysis were not investigated due to the small sample size after further classifications had occurred. Further research is needed to extend the understanding of some of those significant

factors found in this study, and to identify the relative importance of their influences on good quality management practices.

Other extended research studies could relate quality management practice variables to specific operational factors. Operational factors such as: budget, customer interface, customer satisfaction, the hours put in for customers and services, and systems certification to a specific standard. In this way, important variables influencing different outcomes could be identified and their association investigated.

This study made no attempt to measure "quality management" as a measure of "computing services effectiveness" or "computing services success". Further research is needed to develop additional and substantive measures of computing services success to address the quality management practice and effectiveness aspect of computing services.

Other areas of future research could include considering the following questions:

- What is the contribution of IS/IT to organisational and business performance?
- Is there a relationship between organisational practice and good quality management practice?
- What are the problems involved in software quality management practices?
- What are the Capability Maturity Model (CMM) level of achievements within New Zealand computing industries?
- Specifically, what are some of the problems faced by the IS/IT industries concerning quality and quality management system?

6.3 FINAL CONCLUSIONS

The above future research suggestions illustrate the need for more research studies in the field of computing services. The results of this study only provide a general overview of the current situation of quality management practices of computing services in New Zealand organisations and companies. The study has identified aspects of some of the factors that may affect quality management in computing services. It confirms some of the findings in the other studies, as was discussed in section 5.12. The study also relates concerns about problems faced by the New Zealand's industry, as reported in chapter 3 and section 4.1.

As this research is an exploratory study, the results could be used as a basis for more extensive research studies. Implications of the results were drawn for computing services managers, quality practitioners and educational institutions. Organisations and companies that participated in this exercise can gauge themselves, in view of their standing on quality management practices and make strategic decisions to improve.

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8. APPENDIX A: SURVEY INSTRUMENT

8.1 LETTER TO COMPANIES AND MANAGERS FROM RESEARCHER

October 1, 1993 <Massey University Letter Head>

The Computer Services Manager
<Company Name>
<Address>

Dear Manager,

We are currently investigating the extent and application of Quality Management in computing services in New Zealand. The purpose of the investigation is to compare the current state in New Zealand with progress in other countries, and to prepare guidance for computer services users and providers in New Zealand.

As part of the investigation we have prepared a survey questionnaire of current understanding and practise of Quality Management of computing services in New Zealand. Would you please assist us by completing the enclosed copy and returning it in the free post envelope provided.

Should you have difficulty with any part of the questionnaire, please feel free to contact me, at the address below, or to contact Professor Don Barnes or Mr Gordon Smith at the address above.

To aid us in gaining a complete picture, would you please return the questionnaire, even if you are unable to complete it fully. A note on page 9 indicating why you were unable to complete it, would be helpful.

Thank you for your attention.

Alfred Pang
c/- Faculty of Business, Manawatu Polytechnic, Palmerston North.
Telephone 64-6-356 7104 , Facsimile 64-6-356 6110

8.2 QUESTIONNAIRE

A SURVEY ON QUALITY MANAGEMENT IN COMPUTING SERVICES

A STUDY TO DETERMINE THE CURRENT STATE OF QUALITY MANAGEMENT PRACTICES OF COMPUTING SERVICES IN NEW ZEALAND'S INDUSTRIES

October 1993

Brief

The questionnaire has been designed to capture general information about the current state of quality practice in computing services within New Zealand's industry. It is largely based on the elements of quality management systems as defined in the ISO 9000 series of standards.

The particular computer services we would like to address are:

- ❑ management of information systems,
- ❑ software/hardware development or support for internal computer users, and
- ❑ software/hardware development or support for external customers.

All responses to the questionnaire will be kept completely confidential. Only summary, aggregate information will be reported.

Instructions

First impressions are often accurate - don't dwell too long on your answer. You will be asked to respond in one of three ways: tick the appropriate box, circle a number on a scale, or write your answer or comments on the line provided.

Definitions

In the context of this survey, **Customer** is defined as both internal and external users of the computing product(s) or services. The ISO standards define,

- ❑ **Quality** as: "The totality of features and characteristics of a product or service that bear on its ability to satisfy stated or implied needs.";

- ❑ **Quality policy** as: "The overall quality intentions and direction of an organisation as regards quality, as formally expressed by top management."

- ❑ **Quality System** as: "The organisational structure, responsibilities, procedures, processes and resources for implementing quality policy."

Company: _____

Name _____ **Job Title** _____

A. Quality Management Perception

We are interested in your personal perception of quality management in the area of computing services. Please tick the appropriate box.

1. To what extent are you personally interested in quality management practices?
   ❑ Not interested ❑ Vaguely interested ❑ Interested ❑ Quite interested ❑ Very interested

2. To what extent are you personally involved in quality management practices?
   ❑ Never heard of them before ❑ Heard of them, but unfamiliar ❑ Familiar, but don't use them
   ❑ Use them occasionally ❑ Use them regularly, please specify area(s)

_____

_____

_____

3. How much do you know of the ISO 9000 standards?
   ❑ Never heard of them before ❑ Heard of them, but unfamiliar ❑ Familiar, but don't use them
   ❑ Use them occasionally ❑ Use them regularly, please specify area(s)

_____

_____

B. Company Profile

In this section we ask that you provide information about your company in order to determine the use of quality management in relationship to the size of your computer services department or the whole organisation.

1. The nature of business or product(s) of your organisation:
   ❑ Government ❑ Education ❑ Information Technology
   ❑ Manufacturing ❑ Retail & Distribution ❑ Finance

   ❑ Others, please specify _____

   _____

2. Total number of staff in your organisation (equivalent full time): # _____

3. Total number of staff working in computing services (equivalent full time): # _____

4. Total number of staff working in each of the following areas:
   a. Management Information System (MIS): # _____
   b. Software/hardware development or support for internal computer users: # _____
   c. Software/hardware development or support for external customers: # _____

5. Total number of internal customers/users supported by your computing services section: # _____

6. Total number of external customers to whom you provide computer products/services: # _____

7. Approximate percentage of your company's product(s)/ services exported? % _____

8. Is your company's overall management system certified for conformance to any quality standards. If [Yes], please specify which standard(s). ❑ Yes ❑ No

_____.

_____.

9. Is your company's computing services department certified for conformance to any quality standards. (Please specify) ❑ Yes ❑ No

_____.

10. If (9) is [No], is your company's computing services department working towards any quality standards/awards. (Please specify) ❑ Yes ❑ No

_____

_____

_____.

C. General

We would like your opinion on the relationship between the customers/users community and the people who develop and support the computing services.

1. Who initially identifies a new computer product or service for internal use?
   ❑ Developers ❑ Customers/Users ❑ Not Applicable

2. Who initially identifies a new computer product or service for external customers to whom you provide computer products/services?
   ❑ Developers ❑ Customers/Users ❑ Not Applicable

3. Who initially specifies the technical requirements of the product or service for internal use?
   ❑ Developers ❑ Customers/Users ❑ Not Applicable

4. Who initially specifies the technical requirements of the product or service for external customers to whom you provide computer products/services?
   ❑ Developers ❑ Customers/Users ❑ Not Applicable

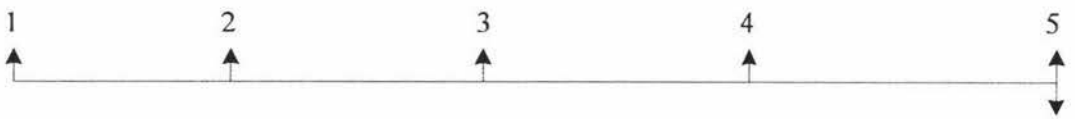
		Low Medium High
5.	What is the level of computer literacy in your customers/users community?	1___2___3___4___5
6.	In your opinion, what is the degree of interaction between developer and user?	1___2___3___4___5
7.	To what extent is your senior management committed to Quality?	1___2___3___4___5
8.	To what extent does the staff accept the need for quality systems?	1___2___3___4___5
9.	In your opinion, what is the level of customer satisfaction with your computing services?	1___2___3___4___5

D. Quality Practices (If you have difficulty answering this section, would you please note the reasons on page 9 and return the survey.)

Listed below are questions which ask to what extent some key features that make up a quality system, for the management of computing services have been implemented in your organisation. Please circle the appropriate level of achievement for each feature.

Please use these guidelines to gauge the level of achievement for each feature.

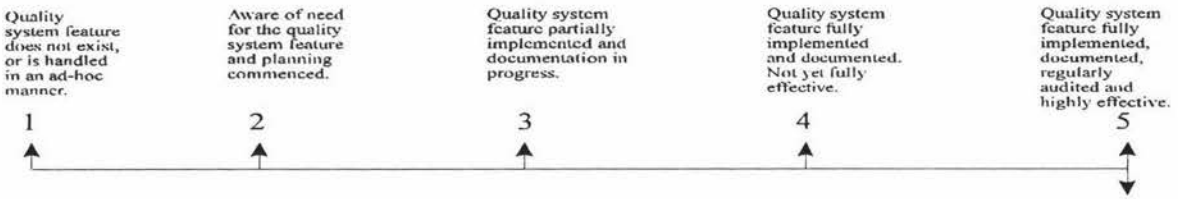
1	2	3	4	5
Quality system feature does not exist, or is handled in an ad-hoc manner.	Aware of need for the quality system feature and planning commenced.	Quality system feature partially implemented and documentation in progress.	Quality system feature fully implemented and documented. Not yet fully effective.	Quality system feature fully implemented, documented, regularly audited and highly effective.



Part I. Management of Computer Services	**Level of Achievement**
1. Do you have a defined and documented quality policy for the provision of computer services?	1 2 3 4 5
2. Do you have a formal management system for implementing your quality policy?	1 2 3 4 5
3. Do you have a formal procedure for reviewing quality management effectiveness?	1 2 3 4 5

Part II. Customer Requirements of Computer Services

1. To what extent does your quality system include procedures for identifying customer requirements?	1 2 3 4 5
2. To what extent does your quality system include procedures for converting identified customer needs to product/service specification?	1 2 3 4 5
3. To what extent does your quality system include procedures for verifying product/service specifications with customers?	1 2 3 4 5
4. To what extent does your quality system include procedures for contract review?	1 2 3 4 5



Level of Achievement

Part III. Design and Development of Computer Services

1. To what extent does your quality system include procedures for developing a design to meet the customer's requirements? 1__2__3__4__5

2. To what extent does your quality system include standard methods for developing documentation during design and development? 1__2__3__4__5

3. To what extent does your quality system include procedures for managing change during design and development? 1__2__3__4__5

4. To what extent does your quality system include procedures for managing sub-contracting of computing services? 1__2__3__4__5

5. To what extent does your quality system include procedures for managing the purchase of software and hardware needed for computing services? 1__2__3__4__5

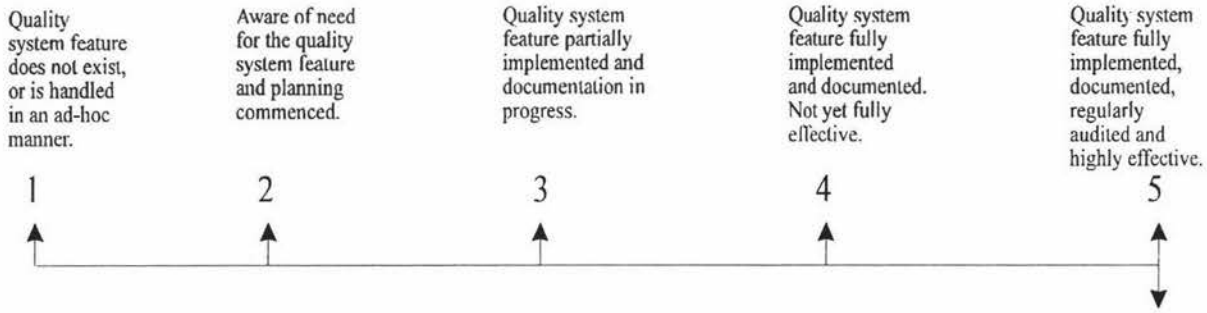
Part IV. Maintenance of Computer Services

1. To what extent does your quality system include procedures for controlling the availability and organisation of computer documents? 1__2__3__4__5

2. To what extent does your quality system include procedures for keeping customers informed of the current state of equipment and services? 1__2__3__4__5

3. To what extent do you carry out internal auditing of the management of computing services? 1__2__3__4__5

4. To what extent does your quality system include procedures for identifying and providing the training needs for all personnel in the computer services group? 1__2__3__4__5



Level of Achievement

Part V. Provision of Computer Services

1. To what extent does your quality system include procedures for interacting with customers? 1__2__3__4__5

2. To what extent does your quality system include procedures for marketing your product/service to current and potential customers? 1__2__3__4__5

3. To what extent does your quality system include procedures for design of service delivery? 1__2__3__4__5

4. To what extent does your quality system include procedures for corrective and preventive action in response to customers' problems? 1__2__3__4__5

5. To what extent does your quality system include procedures to obtain customer's assessment of your services? 1__2__3__4__5

6. To what extent does your quality system include procedures for identifying and providing the training needs for customers in the use of your services? 1__2__3__4__5

7. To what extent does your quality system include procedures for quantitative data collection and analysis of your service performance? 1__2__3__4__5

Would you be willing to take part in a more detailed survey of quality management in computing services? ❑ Yes ❑ No

Do you wish to add anything else:

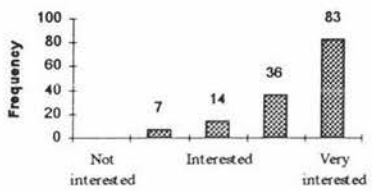
The End. Thank you.
Please mail using the Return Paid envelope.

9. APPENDIX B: OVERALL DIAGRAMATIC DESCRIPTION

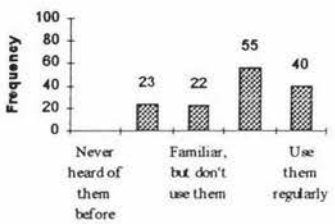
(of the responses to questions A1-3, C5-9, DI1-3, DII1-4, DIII1-5, DIV1-4 and DV1-7)

A1. To what extent are you personally interested in quality management practices?
A2. To what extent are you personally involved in quality management practices?
A3. How much do you know of the ISO 9000 standards?

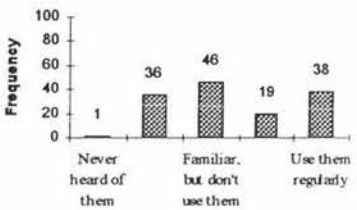
A1



A2

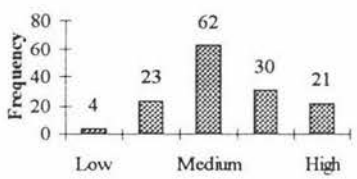


A3

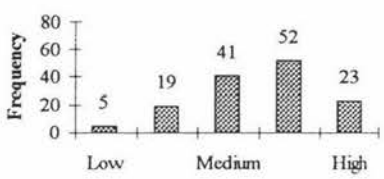


C5. What is the level of computer literacy in your customers/users community?
C6. In your opinion, what is the degree of interaction between developer and user?
C7. To what extent is your senior management committed to Quality?

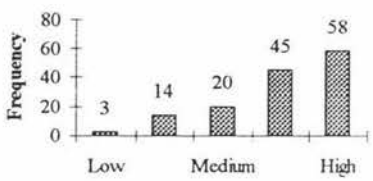
C5



C6

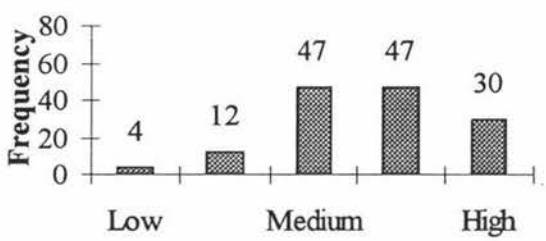


C7

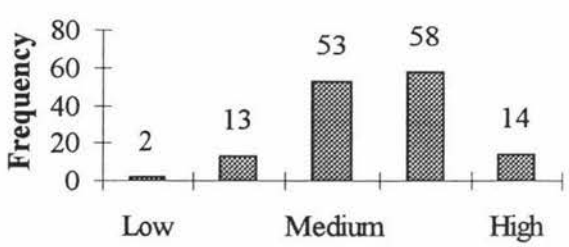


C8. To what extent does the staff accept the need for quality systems?
C9. In your opinion, what is the level of customer satisfaction with your computing services?

C8



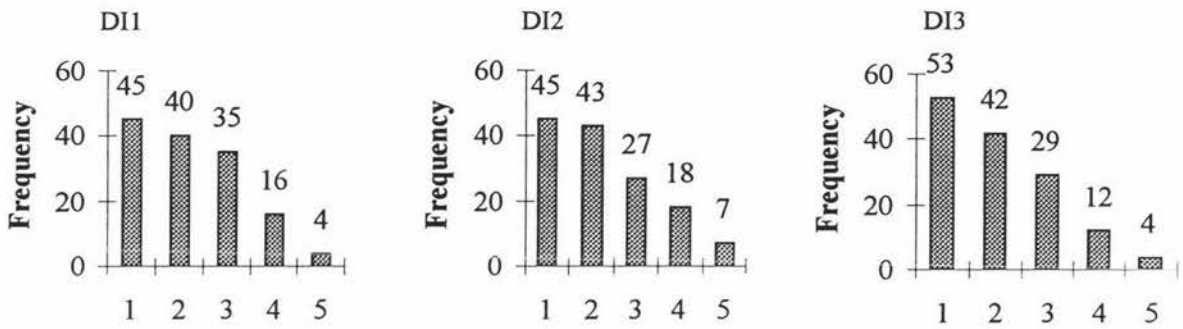
C9



DI1. Do you have a defined and documented quality policy for the provision of computer services?

DI2. Do you have a formal management system for implementing your quality policy?

DI3. Do you have a formal procedure for reviewing quality management effectiveness?

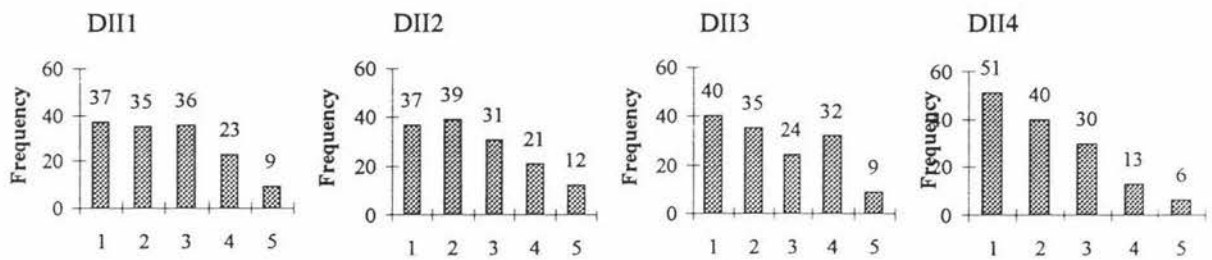


DII1. To what extent does your quality system include procedures for identifying customer requirements?

DII2. To what extent does your quality system include procedures for converting identified customer needs to product/service specification?

DII3. To what extent does your quality system include procedures for verifying product/service specifications with customers?

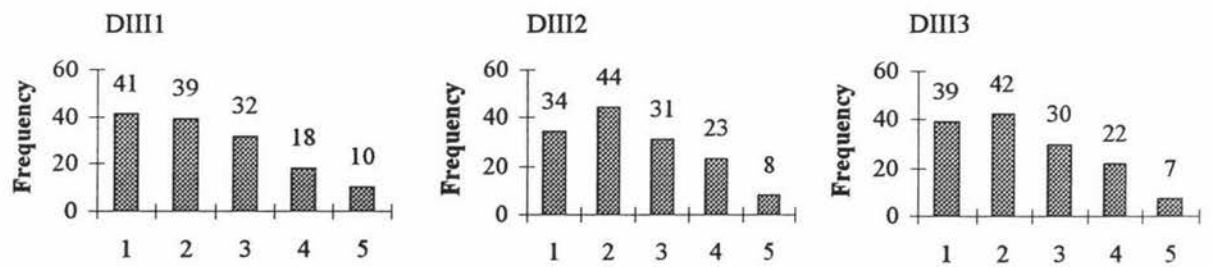
DII4. To what extent does your quality system include procedures for contract review?



DIII1. To what extent does your quality system include procedures for developing a design to meet the customer's requirements?

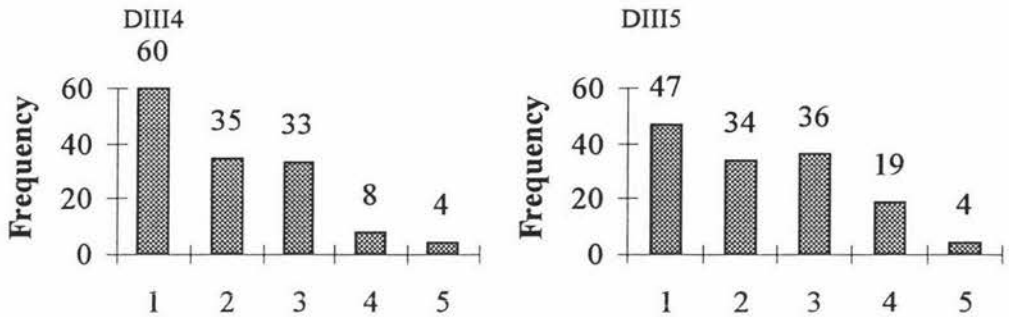
DIII2. To what extent does your quality system include standard methods for developing documentation during design and development?

DIII3. To what extent does your quality system include procedures for managing change during design and development?



DIII4. To what extent does your quality system include procedures for managing sub-contracting of computing services?

DIII5. To what extent does your quality system include procedures for managing the purchase of software and hardware needed for computing services?

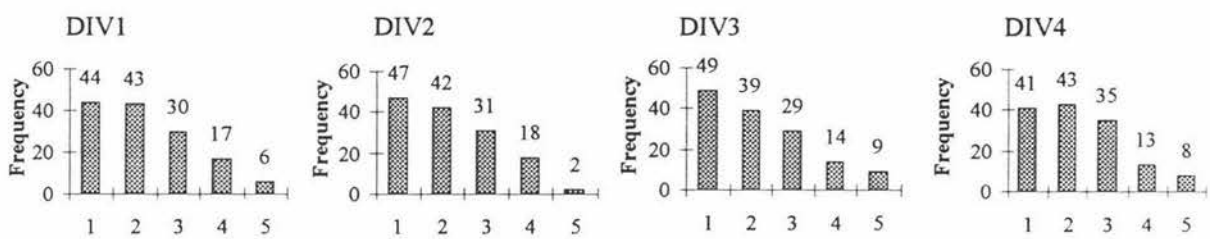


DIV1. To what extent does your quality system include procedures for controlling the availability and organisation of computer documents?

DIV2. To what extent does your quality system include procedures for keeping customers informed of the current state of equipment and services?

DIV3. To what extent do you carry out internal auditing of the management of computing services?

DIV4. To what extent does your quality system include procedures for identifying and providing the training needs for all personnel in the computer services group?

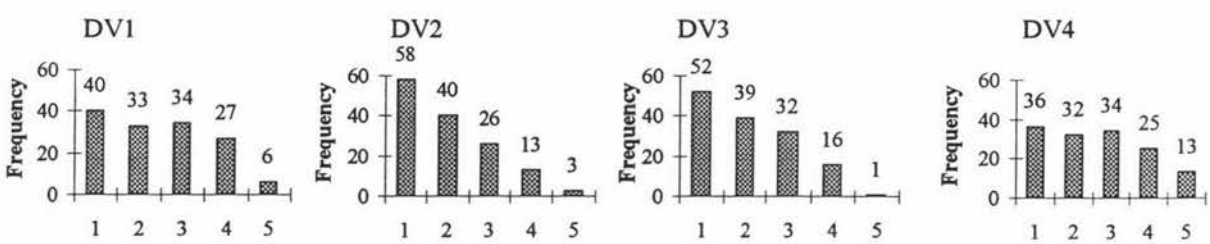


DV1. To what extent does your quality system include procedures for interacting with customers?

DV2. To what extent does your quality system include procedures for marketing your product/service to current and potential customers?

DV3. To what extent does your quality system include procedures for design of service delivery?

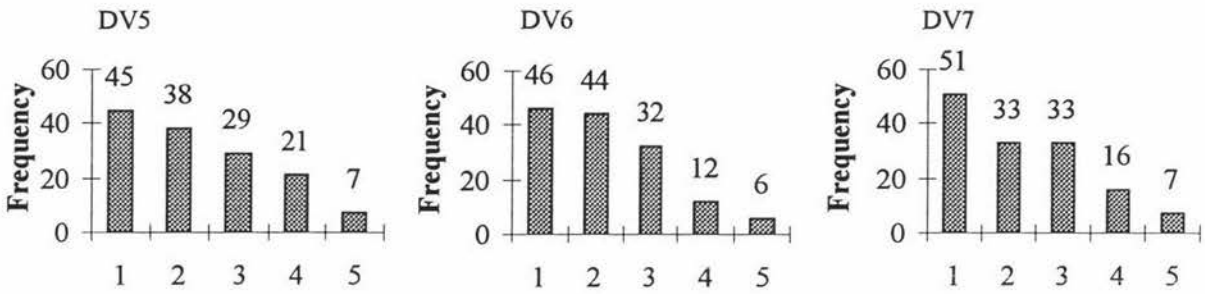
DV4. To what extent does your quality system include procedures for corrective and preventive action in response to customers' problems?



DV5. To what extent does your quality system include procedures to obtain customer's assessment of your services?

DV6. To what extent does your quality system include procedures for identifying and providing the training needs for customers in the use of your services?

DV7. To what extent does your quality system include procedures for quantitative data collection and analysis of your service performance?



10. APPENDIX C: χ^2 TEST FOR INDEPENDENT SAMPLES - METHOD

A null hypothesis (H_0) may be tested by using the equation: (Siegel, 1956)

$$\chi^2 = \sum_{i=1}^{r}\sum_{j=1}^{k}\frac{(O_{ij} - E_{ij})^2}{E_{ij}} \qquad \text{(Eqn. C-1)}$$

where O_{ij} = observed number of cases categorised in ith row of jth column

E_{ij} = number of cases expected under H_0 categorised in ith row of jth column

$\sum_{i=1}^{r}\sum_{j=1}^{k}$ directs one to sum over all (r) rows and (k) columns cells.

To find the expected frequency for each cell (E_{ij}), multiply the two marginal totals common to a particular cell, and then divide this product by the total number of cases, N.

We may illustrate the method of finding expected values by the "Top 200 companies" example. Considering the measure on quality practice - "formal procedure for reviewing quality management effectiveness" (DI3). Table C-1 shows the frequencies with which 77 companies are "Top 200 companies" and 63 non "Top 200 companies" are categorised into their achievement levels of "review of quality management effectiveness" (DI3).

Table C-1. "Top 200 companies/Non Top 200 companies" - "review of quality management effectiveness" (DI3)

	Low <- level -> high					
	1	2	3	4	5	Total
Top 200 companies	30	24	14	6	3	77
Non Top 200 companies	23	18	15	6	1	63
Total	53	42	29	12	4	140

Now the null hypothesis would be that the achievement levels of "review of quality management effectiveness" (DI3) are independent of whether a company is a "Top 200 company" or not, that is, that the proportion of "Top 200 companies" that do not have the "quality system feature, or handled it in an ad-hoc manner" (level 1) is the same as the proportion of non "Top 200 companies", etc. With such a hypothesis, we may

determine the expected frequency for each cell by the method indicated. In each case we multiply the two marginal totals common to a particular cell, and then divide this product by N to obtain the expected frequency.

Table C-2. "Top 200 companies/Non Top 200 companies" - "review of quality management effectiveness" (DI3): Observed and Expected Frequencies.

	Low <- level -> high					
	1	2	3	4	5	Total
Top 200 companies	*29.1* 30	*23.1* 24	*15.9* 14	*6.6* 6	*2.2* 3	77
Non Top 200 companies	*23.8* 23	*18.9* 18	*13.0* 15	*5.4* 6	*1.8* 1	63
Total	53	42	29	12	4	140

Thus, for example, the expected frequency for the lower right-hand cell in Table C-2 is $E_{32} = \frac{(4)(63)}{140} = 1.8$. Table C-2 shows the expected frequencies for each of the ten cells for the data in Table C-1. In each case the expected frequencies are shown in italics in Table C-2, which also shows the various observed frequencies.

Now if the observed frequencies are in close agreement with the expected frequencies, the difference (*Oij* - *Eij*) will of course be small, and consequently the value of χ^2 will be small. With a small value of χ^2 we may not reject the null hypothesis that the two sets of characteristics are independent of each other. However, if some or many of the differences are large, then the value of χ^2 will also be large. The larger χ^2 is, the more likely it is that the two groups differ with respect to the classifications.

The sampling distribution of χ^2 as defined by the equation at the beginning of this section (Eqn. C-1) can be shown to be approximated by a chi-square distribution with "degree of freedom", *df*,

$$df = (r - 1)(k - 1)$$

where r = the number of rows and k = the number of columns in the contingency table.

We may compute χ^2 for the values in Table C-2 by the application of formula Eqn. C-1:

$$\chi^2 = \sum_{i=1}^{r}\sum_{j=1}^{k}\frac{(O_{ij} - E_{ij})^2}{E_{ij}}$$

$$= \frac{(30-29.1)^2}{29.1} + \frac{(24-23.1)^2}{23.1} + \frac{(14-15.9)^2}{15.9} + \frac{(6-6.6)^2}{6.6} + \frac{(3-2.2)^2}{2.2}$$

$$+ \frac{(23-23.8)^2}{23.8} + \frac{(18-18.9)^2}{18.9} + \frac{(15-13.0)^2}{13.0} + \frac{(6-5.4)^2}{5.4} + \frac{(1-1.8)^2}{1.8}$$

$$= 1.4351$$

We observe that for the data in Table C-2, $\chi^2 = 1.4351$ with

$$df = (r - 1)(k - 1) = (2 - 1)(5 - 1) = 4$$

The probabilities associated with the various values of chi-square are given in standard statistics' text. If an observed value of χ^2, is equal to or greater than a particular level of significance, at a particular *df*, then H_0 may be rejected at that level of significance. In the above example, reference to a Chi Square table reveals that the χ^2 value is between the levels of significance of 0.80 and 0.90. However we would normally reject the H_0 only if the observed χ^2 value was greater than the tabulated χ^2 value at 0.05 (5%) or 0.01 (1%) level of significance. Hence, there is insufficient evident to reject the null hypothesis H_0. SAS, a computer aided statistical tool, performs a similar analysis, giving the "Prob > CHISQ value" (*p* value), which can be compared directly with the levels of significance. In the above example, the SAS statistical tool produces a *p* value of 0.839, which indicates a similar result. Again we would normally reject H_0 if *p* value was less than 0.05 or 0.01.

11. APPENDIX D: RESULTS OF CHI-SQUARE (K-INDEPENDENT SAMPLES) TESTS *

Classifications	df	A1	A2	A3	C5	C6	C7	C8	C9	DI1	DI2	DI3	DII1	DII2	DII3	DII4	DIII1	DIII2	DIII3	DIII4	DIII5	DIV1	DIV2	DIV3	DIV4	DV1	DV2	DV3	DV4	DV5	DV6	DV7
Top 200 companies (Y/N)	4	0.434	0.126	0.577	0.120	0.802	0.839	0.450	0.276	0.443	0.334	0.839	0.938	0.205	0.109	0.405	0.303	0.790	0.164	0.708	0.278	0.724	0.582	0.030	0.443	0.877	0.844	0.467	0.692	0.624	0.406	0.399
Region (Auck, Wgtn or Others)	8	0.759	0.212	0.791	0.044	0.869	0.648	0.007	0.989	0.408	0.789	0.303	0.855	0.798	0.909	0.540	0.661	0.477	0.593	0.281	0.851	0.545	0.859	0.700	0.864	0.904	0.788	0.779	0.864	0.302	0.350	0.652
IT Companies (Y/N)	4	0.005	0.214	0.027	0.004	0.438	0.091	0.252	0.184	0.493	0.217	0.013	0.052	0.071	0.271	0.054	0.083	0.614	0.744	0.309	0.680	0.720	0.368	0.203	0.456	0.127	0.015	0.127	0.089	0.662	0.806	0.012
Industry Types	28	0.031	0.187	0.242	0.077	0.852	0.111	0.228	0.006	0.138	0.764	0.300	0.674	0.496	0.411	0.294	0.079	0.023	0.245	0.337	0.541	0.317	0.287	0.168	0.949	0.707	0.459	0.219	0.369	0.333	0.584	0.370
Total Staff Number	16	0.554	0.842	0.604	0.158	0.136	0.844	0.505	0.312	0.461	0.949	0.623	0.495	0.858	0.233	0.580	0.602	0.541	0.082	0.323	0.812	0.831	0.461	0.694	0.913	0.160	0.638	0.658	0.511	0.542	0.335	0.790
Comp Staff Number	12	0.008	0.009	0.198	0.615	0.037	0.816	0.192	0.217	0.322	0.464	0.929	0.275	0.156	0.036	0.449	0.003	0.002	0.001	0.040	0.074	0.678	0.761	0.544	0.364	0.001	0.035	0.033	0.037	0.017	0.158	0.008
Exports (Y/N)	4	0.344	0.066	0.005	0.582	0.472	0.168	0.331	0.257	0.047	0.224	0.391	0.213	0.262	0.031	0.500	0.746	0.654	0.478	0.764	0.670	0.850	0.331	0.089	0.387	0.035	0.586	0.397	0.019	0.064	0.164	0.664
One Sys/Sub-sys certified qs (Y/N)	4	0.360	0.287	0.045	0.443	0.311	0.647	0.481	0.763	0.001	0.010	0.000	0.041	0.085	0.083	0.000	0.241	0.040	0.001	0.000	0.274	0.019	0.002	0.009	0.001	0.053	0.008	0.130	0.061	0.074	0.274	0.069
Work towards Certification (Y/N)	4	0.000	0.000	0.000	0.117	0.451	0.001	0.036	0.669	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Orientation (Internal, External or Both	8	0.384	0.265	0.015	0.002	0.384	0.636	0.802	0.379	0.181	0.033	0.004	0.168	0.470	0.505	0.220	0.277	0.205	0.264	0.581	0.099	0.351	0.154	0.302	0.323	0.179	0.048	0.284	0.114	0.063	0.304	0.086
Respondent (prov or cust)	4	0.812	0.002	0.019	0.691	0.138	0.491	0.551	0.353	0.207	0.010	0.050	0.914	0.722	0.994	0.135	0.996	0.929	0.645	0.389	0.016	0.011	0.288	0.441	0.025	0.174	0.159	0.041	0.425	0.558	0.530	0.825
Iden. Prod/Serv Int (D, C, B or NA)	12	0.523	0.190	0.194	0.178	0.038	0.820	0.759	0.325	0.257	0.417	0.798	0.642	0.442	0.430	0.610	0.646	0.193	0.626	0.383	0.919	0.378	0.614	0.900	0.348	0.704	0.212	0.687	0.624	0.677	0.748	0.803
Iden Prod/Serv Ext (D, C, B or NA)	12	0.455	0.404	0.004	0.750	0.190	0.623	0.716	0.862	0.203	0.059	0.037	0.139	0.003	0.003	0.473	0.214	0.000	0.020	0.138	0.032	0.199	0.494	0.289	0.032	0.004	0.005	0.044	0.004	0.198	0.101	0.023
Spec. Req. Int (D, C, B or NA)	12	0.506	0.551	0.050	0.223	0.005	0.722	0.365	0.553	0.045	0.166	0.321	0.243	0.066	0.446	0.056	0.471	0.091	0.285	0.492	0.137	0.310	0.262	0.247	0.015	0.401	0.088	0.161	0.268	0.010	0.374	0.283
Spec. Req. Ext (D, C, B or NA)	12	0.281	0.770	0.021	0.217	0.369	0.413	0.407	0.124	0.043	0.002	0.035	0.192	0.046	0.321	0.258	0.350	0.040	0.344	0.027	0.255	0.628	0.529	0.831	0.090	0.008	0.031	0.004	0.026	0.033	0.055	0.023
Per/Interest (H/L)	4	1.000	1.000	1.000	0.143	0.566	0.023	0.002	0.749	0.107	0.018	0.040	0.002	0.002	0.000	0.001	0.000	0.005	0.001	0.004	0.007	0.005	0.010	0.246	0.011	0.000	0.007	0.003	0.000	0.020	0.002	0.002
Per/Involvmt (H/L)	4	1.000	1.000	1.000	0.474	0.610	0.001	0.011	0.173	0.018	0.001	0.001	0.000	0.000	0.000	0.001	0.000	0.012	0.000	0.001	0.009	0.003	0.011	0.136	0.000	0.000	0.000	0.000	0.000	0.005	0.001	0.000
Per/KnowISO (H/L)	4	1.000	1.000	1.000	0.714	0.454	0.008	0.201	0.705	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.000	0.000	0.004	0.000	0.006	0.007	0.001	0.000	0.000	0.000	0.000	0.001	0.000	0.000

* With probability (p value) of obtaining the observed χ^2 chi square value, if the responses are independent of the grouping of the factors (H_0), for a given degree of freedom (df).

12. APPENDIX E: SUMMARY OF RESULTS FOR KOLMOGOROV-SMIRNOV TWO-SAMPLE TEST*

Classifications		A1	A2	A3	C5	C6	C7	C8	C9	DI1	DI2	DI3	DII1	DII2	DII3	DII4	DIII1	DIII2	DIII3	DIII4	DIII5	DIV1	DIV2	DIV3	DIV4	DV1	DV2	DV3	DV4	DV5	DV6	DV7
Top 200 companies	Y/N																															
Region	Auck																															
	Well																															
	Others				**																											
IT/Others	Y/N	**			*																						*					
Indust Type	10000																															
	30000							*	*	**																						
	40000								*																							
	50000																															
	60000								*																							
	70000		*																										*			
	80000																															
	90000						*		*																							
Total Staff	=< 5																															
	6 to 10																															
	11 to 50																															
	51 to 100																															
	=> 101								*																							
Comp Staff	=< 3	*	*												*		**	*	*		*					*			*			
	4 to 9																															
	10 to 20																															
	=> 21	*	*							*					*		**	**	**	*	*					**	**	**	*	**	*	**
Exp/Non	Y/N			**						*					*											*			*			
Certified	Y/N			*						**		*	*		*	**		**	**	*		*	*	*	**		*			*		*
Work Towards/Cert	Y/N	**	**	**			**			**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**
Orientation	Int										*	*															*					
	Ext								*																							
	Both			*	*					*	*	*				*					*						*		*	*		
Pers/Ans/Quest	Prov/Cust			*																												
Identifies Prod/Serv Int	Dev																															
Identifies Prod/Serv Int	Cust																															
Identifies Prod/Serv Int	Both																															
Identifies Prod/Serv Ext	Dev																															
Identifies Prod/Serv Ext	Cust																										*					
Identifies Prod/Serv Ext	Both										*							*								**	*	*			
Spec. Req. Int	Dev					*																										
Spec. Req. Int	Cust													*		*											*					
Spec. Req. Int	Both					*																										
Spec. Req. Ext	Dev									*	*															*						
Spec. Req. Ext	Cust																										*	*				
Spec. Req. Ext	Both									**	**	*					*	*		*						**	*	*	**	*	*	
Per/Interest	H/L									*	*	**	**	**	**	**	**	**	**	**	**	**	**		**	**	**	**	**	*	**	**
Per/Involvmt	H/L						**			**	**	**	**	**	**	**	**	**	**	**	**	**	**		**	**	**	**	**	**	**	**	**
Per/Know/ISO	H/L						**			**	**	**	**	**	**	**	**	**	**	**	**	**	*	**	**	**	**	**	**	**	**	**	**

*Based on the testing of a particular group against all the other groupings within the same factor (** H_0 rejected at $\alpha < 0.01$, * H_0 reject at $\alpha < 0.05$)

13. APPENDIX F: SUMMARY OF RESULTS FOR FISHER'S EXACT TEST ON 2x5 TABLE

Classifications		A1	A2	A3	C5	C6	C7	C8	C9	DI1	DI2	DI3	DII1	DII2	DII3	DII4	DIII1	DIII2	DIII3	DIII4	DIII5	DIV1	DIV2	DIV3	DIV4	DV1	DV2	DV3	DV4	DV5	DV6	DV7
Top 200 companies	Y/N																							*								
Region	Auck																															
	Well							*																								
	Others				*			*																								
IT/Others	Y/N	**		*	**							*	*														*					*
Indust Type	10000.00																															
	30000.00								**	**		*				*	*	**		*				*								
	40000.00								*																							
	50000.00																															
	60000.00								**																							
	70000.00	**	*																													
	80000.00	*					**																									
	90000.00	*					**	*																								
Total Staff	=< 5					*													*	*						**				*		
	6 to 10																															
	11 to 50																														*	
	51 to 100																															
	=> 101																						*									
Comp Staff	=< 3	**	**			*			*				*		**		*	*	*							*						
	4 to 9																*															
	10 to 20																															
	=> 21	**	*							*					**		**	**	**	**	*					**	**	**	**	**	**	**
Exp/Non	Y/N			**						*					*											*			*			
Certified	Y/N									**	*	**				**		*	**	**		*	**	**	**		**			*		*
Work Towards/Cert	Y/N	**	**	**			**	*		**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**
Orientation	Int/O			*							*	*																				
	Ext/O				**																											
	Both/O			**	*					*	*	**				*		*			*						**		*	*		
Pers/Ans/Quest	P/C		**	*							*	*									*	*			*			*				
Identifies Prod/Serv Int	Dev				*																											
Identifies Prod/Serv Int	Cust																															
Identifies Prod/Serv Int	Both								*									*														
Identifies Prod/Serv Ext	Dev																								*				*			
Identifies Prod/Serv Ext	Cust			*							**			**	**											*	**		*			*
Identifies Prod/Serv Ext	Both										*	*		**	**			**							*		**		*	*		**
Spec. Req. Int	Dev					*																										
Spec. Req. Int	Cust													**		**		*							*		*			**		
Spec. Req. Int	Both					*																										
Spec. Req. Ext	Dev									*	**	*		*				*								**		*	*	*		
Spec. Req. Ext	Cust			*					*																		*	*				
Spec. Req. Ext	Both			*						**	**	*		*			*	**		*						**	*	*	**	**	**	*
Per/Interest	H/O						*	**			*		**	**	**	**	**	*	**	**	**	**	*		*	**	**	**	**	*	**	**
Per/Involvmt	H/O						**	*		*	**	**	**	**	**	**	**	*	**	**	**	**	**		**	**	**	**	**	**	**	**
Per/Know/ISO	H/O						**			**	**	**	**	**	**	**	**	*	**	**	**	**	**	**	**	**	**	**	**	**	**	**

*Based on the testing of a particular group against all the other groupings within the same factor (** H_0 rejected at $\alpha < 0.01$, * H_0 reject at $\alpha < 0.05$)