The Use of Standards for Information Systems within New Zealand Healthcare

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Abstract

Standards are starting to gain prominence in a world that to some may seem to be being devoured by the advancements of technology. Healthcare is by no means void of the impact of technology, in fact some believe that technology could serve no better purpose than to advance healthcare.

To be able to link these new (and what some may consider incredulous) technologies, from hospital to hospital, doctor to doctor, patient to doctor, or any of the permutations of these, appropriate information systems standards are required.

Whilst people have begun to acknowledge that standards are important, few are willing to put forward what is exactly required from a standard, or indeed why one standard is considered to be more appropriate than another standard. Consequently this research aims to create and then investigate the framework to ascertain what the critical success factors are when selecting and utilising a standard. An associated goal of this study is to gain an understanding of which standards for information systems are being utilised within the New Zealand healthcare environment.

A survey of New Zealand healthcare found that the 'Completeness' of the standard is considered to be the most important element for adopting health information systems standards. Organisations wish to adopt standards that meet the required need, and that provide the required functionality. A number of different standards are utilised within New Zealand healthcare, some of which differ between organisations. Information systems management standards were the least utilised standards by all organisations.

It was found that organisation type and structure and the purpose of the standards both influenced the relative importance of different factors in the selection of standards.

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Table of Contents

List of Figures

List of Tables

Chapter 1 Introduction

In the computer industry new standards can be the source of enormous wealth or the death of corporate empires. With so much at stake, standards arouse violent passions.
(Cargill, 1998)

A standard can be defined as a published document that sets out (at least) the minimum requirements necessary for a number of interconnected elements to do the job that it or they are required for. These elements can include material, structure, product, method, system or multiple systems. Standards have many benefits associated with them, these include the acceleration of information transfer and retrieval, the ability to introduce new and improved commerce services, the facilitation of trade and manufacture, as well as providing a platform for business process re-engineering.

Standards within healthcare hold these benefits and many more. Whether healthcare agencies are being threatened by government reform, the onset of managed care, or decreasing reimbursements, providers are experiencing increased pressure to reduce costs. At the same time they are being asked to better document all aspects of patient care, accurately measure utilisation, track treatment effectiveness via outcomes, and refine practice guidelines based on cost/outcome information, often across multiple modalities. Suggested ways for providers to meet such varied challenges are through utilising wide area communication, improving documentation and reporting, and increasing documentation - not via a traditional paper, medical chart. The only way this can be carried out is through the use of information systems that conform to standards to control and ensure compliance between all of the individual components.

Whilst many acknowledge that standards are important, few are willing to put forward what is exactly required from a standard, or indeed why one standard is considered to be more appropriate over another standard. Accordingly, this research project aims to develop a framework to explain what the critical success factors are when selecting and utilising a standard.

In the first instance a literature review was undertaken. Within this many significant points became apparent. The first of these was to complete an analysis of the different

aspects of standards (as a whole). This involved understanding what a standard encompasses and therefore developing a definition. An understanding of the reasons why people use standards was also developed, so as to understand how important standards are, not only with business or technology but also with healthcare. It was appropriate to complete a discussion with regard to the problems that exist with standards, as there are indeed many faults with standards including their definition, usage, understanding and acceptance. The final focus of this section involved identifying the different pieces of literature that contained questions that need to be asked when adopting or selecting a standard.

The next section discussed the use of standards within healthcare. This involved acknowledging many crucial factors including ethical considerations, confidentiality and security. This section also notes many of the significant healthcare standards developers, so to gain an understanding of where standards are being developed.

The literature review then becomes more focussed with specific regard to the use of standards within the New Zealand healthcare arena. This includes an understanding of what New Zealand's role is with the development of healthcare standards, an understanding of what healthcare standards are being utilised within the New Zealand healthcare system, and finally, an understanding of the healthcare system within New Zealand.

From this basic understanding of definitions and application came the research component. A literature review was also completed with regard to survey research, acknowledging appropriate research design, sampling procedures and data collection so to be able to complete the research to an appropriate level.

A survey was developed which focuses on three main respondent classifications: public hospitals, private hospitals and Independent Practitioner Associations (IPAs). The survey asks questions with regard to the demographics of the organisation. The organisational characteristics, the selection process undertaken by the organisation when adopting standards, the characteristics which influence the adoption of standards, the actual standards which the organisation uses and finally a series of open ended questions to conclude the survey.

The results of the developed framework were very interesting. It was found that the 'Completeness' of the standard was the most important Critical Success Factor for both IPAs and public hospitals. Private hospitals were found to be somewhat behind with their use of computers and standards, and were therefore not utilised within any statistical testing. Results used from private hospitals were however used within qualitative discussion.

A number of different standards application areas were identified, from which many different standards were used. A point of considerable interest was the lack of Information Systems Management standards from any of the three organisations.

1.1 Research Questions

Research questions enable focus and allow for a direct goal (or goals) to be achieved. The aim within this research project was to have research questions that relate to two different yet very intertwined fields of technology and healthcare. The proposed research questions plus, an individual commentary follow:

- Identify why people adopt standards.

This provides the background of the project through the use of a literature summary of why healthcare agencies use standards. This was deemed to be an essential starting point, so to be able to understand the rationale behind people's uptake and application of standards. This section will also include many other background points.

- Identify the critical success factors that are proposed within literature, which encourage the adoption of a specific standard.

This question delves into the creation and understanding of individual standards. It is asking why one standard would be selected over another and what the reasoning would be. The resulting factors have been named critical success factors (CSFs). It is expected that the CSFs will be found within literature. The resulting model has been named the Standards' Adoption Framework (SAF.)

- Identify which information systems standards are being adopted within New Zealand healthcare.

This question brings in a New Zealand focus, as well as the actual research component.

- Ascertain if the SAF is generalisable across different application areas, and different organisations.

This research question will utilise the SAF and will provide the ability to research a number of points. Firstly, it will be possible to find out if the SAF is generalisable (in its entirety) across many different standard organisations (shown by the long arrows if it is generalisable or short arrows if it is not in Part A, Figure 1). Secondly, it will be possible to ascertain if the organisations rank the CSFs differently across application areas (Part B, Figure1).

If it is found that different standards applications have different CSF rankings (the SAF is not generalisable) it will therefore be possible to compare and contrast the individual CSFs. This will make it possible to ascertain if IPAs place the same emphasis on the same CSFs as public and private hospitals and vice versa (Figure 1 Part C).

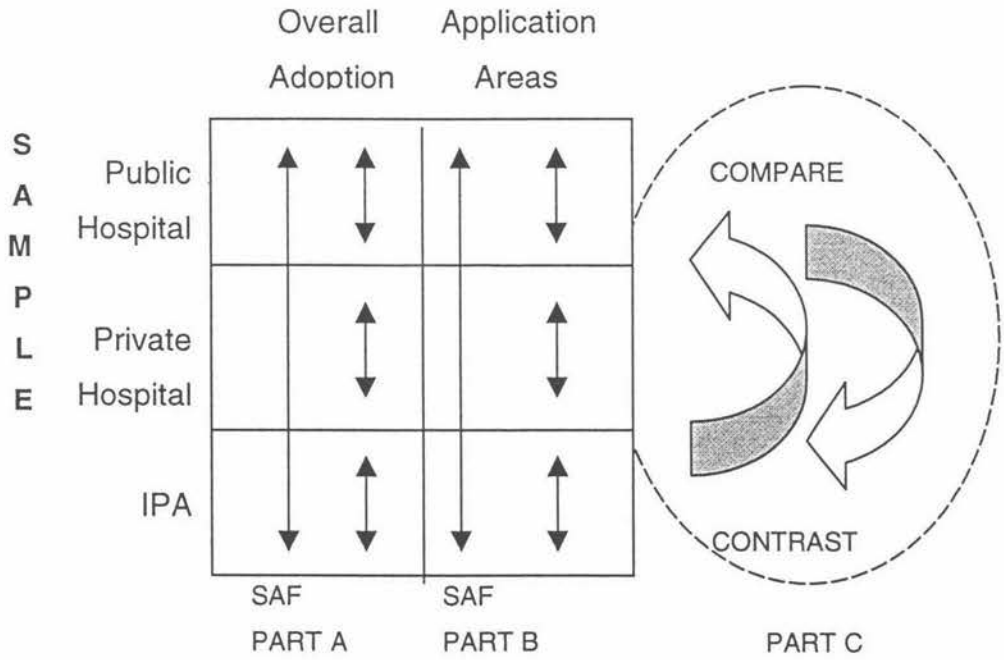

Figure 1 – Research Testing Model

1.2 Thesis Structure

Whilst fulfilling the requirements of this research report an appropriate format was required. The one utilised within in this research process uses the guidelines suggested by Willes (1991) with the addition of an extra chapter.

Chapter One - Introduction

This chapter provides an oversight to the research project, giving some background to the project, as well as the research process that was undertaken and the results that were obtained.

Chapter Two – Literature Review

This chapter delves into a literature study that was undertaken to gain an understanding of standards. This included gathering information about why standards are needed within healthcare and the use of standards within New Zealand healthcare.

Chapter Three – Development of Research Model

This chapter introduces the research process that was undertaken. This includes elements such as theory development, and some of the considerations essential within information systems research.

Chapter Four – Research Design

This chapter discusses the process of developing the survey that was utilised within this research project. The associated components of research design including survey management and data collection techniques are also discussed.

Chapter Five – Healthcare Survey Data Analysis

This chapter presents the results and the subsequent analysis of the healthcare survey.

Chapter Six – Discussion

This chapter discusses some of the concepts, results and processes that became evident throughout the research project. This chapter also contains future research possibilities that could be used to extend this research.

Chapter Seven – Conclusions and Recommendations

This chapter formally answers the initial research questions that were posed at the beginning of this research project, as well as giving an overall conclusion of the results of the research project. The recommendations and future research possibilities are also provided within this chapter.

1.3 Limitations

Whilst completing this research project it was essential that certain constraints were set in place from the outset. It was important to acknowledge that the project was to be tied to a timeframe of approximately twelve months, meaning that the study was required to gather information from an appropriate sample in a timeframe of two to three months. This was important as it held great relevance to the sample selection and their location. The obvious constraint of available resources and financial costs held significance with the choice of the appropriate research method. The scope of standards surveyed and healthcare organisations also had to be constrained because of the wide use of standards amongst many different applications. This was done by selecting limited and very specific standard sets, and a limited application of these standards. Hence the use of researching only standards used for information systems (to be discussed in greater depth later).

Some of the acknowledged limitations of this research include:

- A limited study of the relevant literature with regard to criteria for standards adoption
- A limited sample size
- A focus on the information systems manager rather than the end user
- The possibility of the survey being completed by those who were not qualified to complete the survey therefore biasing the results
- Restricted pilot testing on different user groups
- A focus solely on New Zealand healthcare
- A single study rather than one completed over different periods of time

However despite these constraints the research project will be still of value to New Zealand healthcare. It will force people to acknowledge that standards are becoming a vital part of modern healthcare. It will provide a tool that will help people adopt standards and understand why the particular standards have been adopted. It will also provide a list of the standards that are currently being used within New Zealand healthcare.

Chapter 2 Literature Review

Computers are sprouting on hospital wards and some fear they will soon displace the patients in the beds, the staff having long since become redundant.

(Reid and Boore, 1987)

Polgar and Thomas (1995) write that, to justify any research proposal it is necessary to write a literature review. The literature review is a summary and critical evaluation of previous research and theory relevant to the problem that is to be investigated. In this way the literature review both provides a conceptual background for the proposal and justifies the need for further empirical evidence by identifying 'gaps' in our knowledge.

Accordingly, this chapter covers a range of material with regard to the research objectives. Many different areas are touched on because of the extensive area healthcare, standards and privacy and security are a part of. A brief discussion is also included involving ethical considerations involved within the medical arena.

2.1 Methodology

Different methods of gathering previously written literature were utilised, including:

- Extensive searching on the Internet, and various Library catalogues using key word searches on: electronic medical records (EMR)/health standards/standards development /privacy and security/informatics/patient records/health ethics and many derivatives there-of.
- Searching through relevant Internet web sites, involving the applications of standards, health informatics and EMR.
- Personal communications with people relevant to the field.
- Comprehensive searching of Journals.
- Comprehensive searching through the library for literature.

2.2 Order of the Literature Review

As the thesis topic evolved so did the main focus of the research. Accordingly the order of the literature review, is one of general definition and basic understanding through to the comprehensive learning and understanding of healthcare standards, and indeed understanding what constitutes a standard. A discussion is held on the following topics:

- Defining and understanding what a standard is, as well as identifying the advantages and disadvantages of utilising standards
- Identifying what properties the literature states a good standard must have
- Identify why standards are used within healthcare
- Identify standards' developers within the healthcare arena
- Identifying the use, application and development of standards within New Zealand healthcare
- Identify what standards are being utilised within New Zealand healthcare as well as understanding the structure of the New Zealand health system
- Identifying the important elements of survey research, and information systems research

2.3 Overview of Standards

This section introduces the basic concepts of standards. What are standards? Why do people use and adopt standards? What are some of the problems inherent within standards? And finally, what criteria make a 'good' standard?

2.3.1 Definition of a Standard

Standards are by no means an easy topic to either define or discuss. Many of the problems that are inherent within standards flow on to affect the elements with which the standards are trying to help. This can often explain why many people's perceptions of standards could be generalised as being less than positive. However, it is first essential to try and define a standard.

One possible method of definition is to say what a standard is not. Snow (1994) notes that "standards are not a cure-all, cannot be made overnight, cannot be a prerequisite for market entry, and in areas of rapid technological change may not be required." Snow (*ibid.*) continues that standards are however for public good, developed in a process for developing markets and commoditisation.

Hogan and Radack (1997) state, somewhat more clearly, that standards for information technology, are the technical rules and the foundation for systems that are interconnected and that work across applications, organisations and geographic locations. Hogan and Radack (*ibid.*) suggest two different forms of standards exist:

- *De facto* - often proprietary and generally privately developed and occur when a product becomes widely used within the market place.
- *Consensus* - inherently open and publicly available and are developed openly by consensus standards development activities.

Crocker (1993) suggests a third form of standard:

- *De jure* - a standard which is made legitimate by force of law.

These forms of standards are common and are mentioned within: Aiken and Cavallini (1994), Baldo, Crocker (1993) and Nelson (1998).

The Standards Association of New Zealand (SANZ, 1983) defines standards to be "Specifications or codes of practice which are written by interested parties to define materials, methods, processes and practices." SANZ (*ibid.*) acknowledge that standards provide a basis for determining quality, performance, safety, reliability and economy but leave freedom for design and material innovation. When standards are cited in legislation, [a de jure standard] regulations, or by-laws, a means of enforcing minimum safety requirements are provided. SANZ (*ibid.*) continue that standards are a vital part of the national economy.

Unfortunately it is not just a simple process of selecting an appropriate definition and moving on. Standards can indeed be involved within different applications. Batik (1989) suggests that the word 'standard' is actually akin to a surname. For example, it is possible to have a test method, a specification, a definition even a practice – standard. That is, the word standard can be attributed and appended at the end to many different elements, somewhat similar to incorporating a surname to a first name.

Therefore, [their discussion continues] a *standard test method* is a standard way to conduct a test, whether it be physical, electrical or chemical. A *standard specification* defines the properties of a thing. A *standard definition* is an absolute in the standard process – if one cannot define what is to be standardised, then one cannot prepare a standard. *Standard practices* apply to procedures, to design criteria, and to guides.

Crocker (1993) also acknowledges the idea of different standards. Crocker *(ibid.)* states different uses by noting that, [particularly] in data communications, a standard can specify a set of procedures, or it may specify characteristics of information that is exchanged among humans, or it may even specify what to do when operating the system.

A somewhat different path is taken from above by the Medical Records Institute (MRI, 1998a), by suggesting that a standard definition must encompass standards that are being developed by accredited standards organisations. As well as all other categories of organisations who are affecting or working on, technical, procedural and systems standards, guidelines, professional protocol, minimum requirements, as well as actual industry practices.

This is very pertinent, as it is the first definition which acknowledges that a standard needs to be created and that it must be done in a manner which is certified and accepted by the people who will in turn be adopting it.

In essence, to define a standard, at the many different levels, stages and locations, requires a thesis of its own. Aden and Harris (1993) acknowledge this, by not even trying to define, but by noting that the definition of a standard, unfortunately, tends to be contextually dependent upon the situation and the author. In this sense it may seem

appropriate to be deliberately vague, or to say that standards don't need to be defined, yet realistically it is important to have a firm understanding of what is to be researched.

Accordingly, it is proposed within this research process to define a standard as being (Standards New Zealand, 1998) "a published document that sets out (at least) the minimum requirements necessary for a material, structure, product, method, system or even systems which are interconnected to do the job that it (or they) are intended for."

This definition has been chosen for use within this thesis as it has a number of important points. The first of these is that it states that it must be a published document; this implies that it will have some degree of formality and understanding. Secondly, it does not try to limit or constrain what the requirements are for the use of a standard. This is very relevant because of the different uses, sizes and applications of standards. It is also important because it recognises the desire of interconnection, which is indeed one of the most important and significant goals of healthcare at this present stage. It is also a relevant definition as it acknowledges that a standard is only a tool that it is to be utilised in conjunction with another component.

2.3.2 Reasons for Adopting Standards

Standardisation is one of the hallmarks of an industrial society. As a society becomes increasingly complex and its industrial base begins to emerge, it becomes necessary for the products, processes, and procedures of the society to fit together and inter-operate (Cargill, 1998). This is a particularly relevant (and somewhat sociological) point as to why people adopt standards. Whereas Cargill (*ibid.*) concentrates on the idea of society, Hogan and Radack (1997) concentrate on the idea of interoperation within an information systems society.

Hogan and Radack (*ibid.*) states that standards are essential because they allow for different products, developed by different vendors to inter-operate; so that software, data and application programs can be moved from one hardware platform to another; and so that information that is transmitted and stored in information systems can be protected.

This too is relevant, not only does 'society' have a need for standards, but the elements within, especially (and as this is relevant to this research project) information systems.

A number of the benefits of using standards are presented by Aden and Harris (1993), these include:

- Interchangeability among hardware platforms so that users can migrate from vendor to vendor if and when the need arises
- Easier comparisons between products, since one of the roles of a standard is to serve as a comparison metric
- Standard software should allow portability of applications from one platform to the next. More importantly, from an organisational point of view, portability should be possible for the users. This is especially important where users move from location to location
- Similar user interfaces should allow for minimising retraining costs
- Ability to share complex data
- Interoperability of components
- Configuration flexibility; by permitting mix and match of components and software to meet specific mission requirements

Some, however, have discussed less direct reasons for the need for standards. For example Scott-Hill (1996a) writes, "that amazingly, some seem to not accept the use of standards, and seem to prefer the alternative – chaos." Snow (1994) simply states (and does not go on to define) three reasons for standardisation--interoperability, portability and data exchange. Crocker (1993) adds to this discussion the idea that "most standards seek to solve a problem in the most general manner, and for the longest term possible." Where as Radda, Carson, Haynes and Moore (1994) note that standards are intended to facilitate connections among components, whether machine, parts or people.

Scott-Hill (1996a) lists some benefits of standards that are somewhat similar to that of Aden and Harris (1993), within this list however Scott-Hill includes a new set of reasons. It is indeed the new set of standard benefits that are entwined with the use of technology. Scott-Hill (*ibid.*) suggests that standards:

- Accelerate information transfer and retrieval
- Provide an ability to introduce new and improved commerce services
- Facilitate trade and manufacture
- Provide a platform for business process re-engineering

Batik (1989) is also relevant within this discussion because he discusses the idea of different levels of standardisation. Batik (*ibid.*) notes that the object of international standardisation and related activities is to facilitate international exchange of goods and services, and to promote co-operation in the sphere of intellectual, scientific, technological and economical activities.

Going into greater depth Batik (1989) states that standards can be used as a tool to improve the economic status of a country. "Via the generous transfer of technical knowledge (through standards) to developing countries an increase in prosperity to those developing nations and in the world; it is possible to increase product quality worldwide, lower production costs, and stimulate world trade to the advantage of all."

Oksala, Rutkowski, Spring and O'Donnell (1996) add to the discussion via the assumptions that they make about standards. Firstly, standards are critical. Secondly, standards shape the marketplace, and thirdly that the ideal standard stabilises the market and allows for a variety of interoperable products that reduce costs through competition.

A somewhat softer point of view is taken by Bousquet (1997) who maintains that the point of standardisation is that people get used to a kind of model [or method] and get familiar with similar concepts [and constructs]. New concepts can also be assimilated through standards modified in a clear way. Making a comparison with something known, gives us the feeling of being more confident in ourselves and we are therefore more likely to understand.

Ford (1994) takes an interesting stance as to why people adopt standards by relating the need for standards directly to the need for security. "As with many other information technology areas, security is not an internal matter of individual products. Security can only be achieved through the interoperation of many different systems and systems

components. Given the unpreparedness of customers to lock in particular vendors, standardisation of security architectures, mechanisms and protocols is essential."

Ferris (1994) takes the exact same stance, and notes that standardising measurable assurances (security methods) is essential for a security program. These standards serve to define how IS systems should be designed, implemented, administered and used. Derivations from these norms are either violations of security or if staffed and accounted for by those responsible for risk decision, (that is if a conscious decision is made to go against the standard), a way to measure exceptions to the rule. If these exceptions are frequent enough, the deviations can provide a measure for the need to reconsider the particular standard.

The importance and applications of standards are many, however Batik, (1989) notes that one general statement can be applied to all standards. Standards consolidate scientific and technical knowledge, making possible a mechanism that brings the benefits of scientific research into widespread application. Standards are mankind's best communication medium for broadcasting technical progress.

With the many positive reasons as to why people should adopt standards, it is hard to understand why there is, so much deliberation with regard to standards. Therefore, it is appropriate to hold a discussion with regard to the many problems and faults associated with standards.

2.3.3 Problems with Standards

The ease at which it is possible to find faults with standards was quite astounding. Standards seem to have many issues that have remained unresolved, even through the test of time. One of these issues, is one of definition (of sorts).

One of the problems of defining a standard may be because of the actual difficulties that exist in the identification of standards. To highlight this example, Batik (1989), explains in a single corporate document that two standards were referred to in five different ways: ANSI/ASME B16.11, ANSI B16.11, ASME 16.11, ASTM A181 and ASTMA 181.

In continuation, it is also hard to tell if a standard is a draft standard, a proposed standard, a tentative standard, an interim standard, an inactive standard, a standard that is re-approved without changes, a revised standard, an addendum standard, or a supplement to a standard (Batik 1989).

However, on a different level another problem exists, that is the "Technology and Standards Continuum" as discussed by Aiken and Cavallini (1994). The technology and standards continuum will affect anyone who attempts to identify, design, adopt, or affect a technology standard. This continuum is composed of many technologies and standards at different maturity and evolutionary stages. The life cycle of a technology will be at any discrete point in time be intersected and possibly paralleled by the life cycle of a relevant standard associated with that technology. It might also intersect the predecessor and successor of the technology and even itself.

Time seems to be one of the major fault of standards; they either take too long to create (Aiken and Cavallini 1994, Gritzalis 1997 and Scott-Hill 1996b) or they don't remain useful and applicable within the desired arena for a long enough time frame. This means, that people are spending considerable time and cost creating standards, and they are in turn, being rendered useless.

Cargill (1998) allows for a change in focus by discussing the participants involved within standards creation. Cargill (*ibid.*) states that the participants in standardisation activities must realise that they are not there to protect the standardisation process; they are there to get standards out. These standards must be deployable by, and useful to, businesses that are producing products. "Perfect standards two years late are worthless; tremendously imperfect standards are also worthless."

Cargill (*ibid.*) is reaffirming the issue of time and standards development. At the same time however, is making a subtle point suggesting that people involved within standardisation development are protecting the standards development process.

Morrell and Stewart (1996) take a somewhat different stance and present a list of problems that can occur when utilising or up-taking standards. Some of these include:

- The standards-making world is subject to strong forces over which it has little or no control, including de facto standards, new technologies, national positions on trade policy and the market positions of existing vendors.
- Most company representatives to standards committees approach their task from a technical rather than business perspective.
- Representatives to standard groups are often 'volunteers' rather than in dedicated paid positions.
- The work of different standards groups is often related, but those relationships are not always recognised. To complicate matters, the fusion of various technologies may generate connections between previously unrelated standards.
- There are very few major organisational contexts for standards making. Most formal national and international standards are developed by committees sanctioned under powerful organisations, such as ANSI and ISO (discussed in a following section). Many standards are developed by different industry consortia, implying that many different formats and styles of standards are created.

Oksala et al (1996) raise an issue, which few other articles have. They note that standards are developed within a cultural milieu. Standards are developed by a community that has a set of values and a particular perspective on information technology. The people, developing and using the standard have a long involvement in their particular field and the paradigm of the field may work as a kind of selection paradigm.

This is very important as it is acknowledging that although standards are for use (ideally) everywhere, standards may often be created, with a specific environment (indeed, their own environment) in mind. It may, in some situations, be far too hard to try and understand what another company, competitor, or even country will be using, or doing with the same tools. Indeed this is one of the problems of standards development.

Hovenga, Kidd and Cesnik (1996) briefly discusses this point by noting that the adoption of standards may be mandatory or voluntary, and various types of standards exist. The type of standard is determined by who has developed or adopted the standards or by the purpose for which the standards was developed.

Another problem that is mentioned, is that of cost. Whereas a number of people acknowledge that standards are needed, few are willing to accept the costs (time and resources) that are needed when creating a standard.

Indeed, Cargill (1998) depicts standardisation as running on urban myths; elaborating on the idea that there is no coherent, widely held and widely accessible body of literature on the nature, rationale, or practice of standards. There are no standards for standardisation. Cargill *(ibid.)* continues that standards are the fundamental agents of change, and yet the knowledge of how they work—inside the discipline and the market is only vaguely understood. Until this vague understanding is made into a coherent knowledge base, standards will continue to exist in the twilight realm.

Aiken and Cavallini (1994) continue this point and were one of the few authors willing to admit, that they themselves are sure of the need for standards, yet find that they have no agreement about a number of basic issues, like the following:

- How to identify which standards exist and which need to be developed and enforced?
- How should standards be chosen? To what extent should the choice be influenced by industry, or the purchasing power of the federal government, or the actions of formal standards bodies and consortia?
- Who are the people actually developing and mandating the standards? Do they have real-life operational experience in the area they so greatly influence?
- What are the professional and ethical responsibilities of those persons who set standards? Are short-term cost benefits and conformity more important than diversity and competition?
- Should multiple standards be allowed to coexist? For example, at the network layer, are IP and OSI allowed to coexist?
- What is the real practical life cycle of a technology and/or standard and how is it phased out or replaced when appropriate?

It is indeed this list of questions that rest on the mind of many people when using standards. Part of the goal of this research project is to answer pieces of the first two questions, with regard to New Zealand healthcare.

To ascertain which standards are selected over and above another standard, it is essential to set up a form of criteria. The literature presented many different sets of criteria, with many having common elements. The following section, lists the different criteria found, and presents the criteria that shall be used within the research.

2.3.4 Identifying the Criteria for a Good Standard

Six relevant articles were identified with regard to evaluation criteria for standards. One of these articles, National Institute of Standards and Technology (NIST, 1998) presented a criterion that was used to evaluate a range of existing standards. The five other articles were giving a hypothetical list of questions that should be answered when selecting standards. It is the combining of these different forms of criteria that are used to formulate the underlying model of this research. Firstly, the individual sets of questions will be shown.

Baldo et al (1997) present an article predominantly about software reuse standards. Within this they named several characteristics that should be evaluated when selecting an appropriate standard.

- Relevance - Does the document address the important issues that are within the appropriate scope?
- Impact – Does the document enjoy broad support and/or demonstrated effectiveness?
- Normative nature – Does the document provide normative recommendations (prescription) rather than simple information (description)? That is, is the document explained in definition rather than being vague and/or broad?
- Currency – Is the document relevant to the current and near-term environment?
- Quality – Is the document clear, accurate, and otherwise useable?

Baldo et al (1997) explains that the *Relevance* criterion evaluates the appropriateness of the document with respect to the criteria of IEEE. The *Impact* criterion is important as it evaluates the extent to which the document had already achieved acceptance in the reuse and software engineering community. The *Normative* criterion evaluates the extent to which the document provides normative direction rather than information. The *Currency* criterion evaluates the important idea of time and the extent to which the document is suitable for application today and in the foreseeable future. And finally the *Quality* criterion evaluates other characteristics of the document's suitability.

Although a very relevant list, Baldo et al (1997) felt it important to mention that the evaluation criteria which is described is useful, yet does not address the technical soundness of the document. This point shows a downfall in the criteria that they have provided.

Aden and Harris (1993) take a more direct approach to selecting a standard. It is suggested that before selecting any standards or initiatives, it would be useful to identify functional areas that are important for promoting application portability. These areas include operating systems, programming languages, user interface, data interchange, networking protocols, security and others. Some of the key criteria for standards selection are:

- Availability of implementation from a cross section of vendors.
- Is the standard compatible with other standards?
- Is the standard based on well-understood technology, and has it matured enough to ensure that no major changes will occur?
- Is the standard consensus based?
- How portable is the standard?
- Does the standard meet the functional requirements?
- Can the standard easily add new technologies when they become available?
- Is the standard relevant to the problem?
- Is there interoperability among application environments?
- Can the standard be tested to prove compliance?
- Is there freedom from legal issues?

It is interesting to note that Aden and Harris (1993) explain that there is a big possibility that the purchaser will be unable to find standards that fit all of the requirements. Aden and Harris (*ibid.*) continue that this is not unusual—standards are meant to be general strategic management tools, not tactical solutions. When there are not really enough standards to go 'around' the challenge that exists is to create an open system.

Morrell and Stewart (1996) suggest that a standard should have two types of metric associated with them. Firstly, metrics to assess how well the standard development process is unfolding and secondly actual measures of the quality of the standards that are produced. Only the latter shall be discussed here.

Morrell and Stewart (1996) suggested a variety of criteria for a successful standard:

- Are vendors building products?
- Do the products meet users needs?
- How large is the installed base?
- Are products priced in terms of commodity costing?
- What impact has the standard had on the viability of the vendors industry?
- Are diverse products interoperable?
- Were standards-conformant products on the market before standard was finalised?
- Does the standard allow applications that are *portable* to different platforms?
- *scalable* in size?
- and *interoperable* with other applications?

Morrell and Stewart (1996) also holds a relevant discussion about the criteria noting that, if these criteria are to be of value, they must be embedded in a system that includes two features. Firstly, it must trace the success of a standard to various aspects of the standards process, thus providing information on how the process might be improved. Secondly it must relate information to new standards efforts so that past mistakes are not repeated.

Oksala et al (1996) present a discussion on the standardisation process, and questions what the most important outcome of a standard is:

- Is the standard *timely?*
- Is the standard *functional?*
- Does the standard provide a common ground for acceptance?
- Does the standard have *longevity?*
- Does the standard have *durability?*
- Is the standard needed in terms of some context or plan?

These questions were not asked directly, but were asked in accordance of what they believe is needed within a standard. For example, they suggest that it is essential to get a standard that does something now. If a standard works today, and is needed today, it is best. Oksala et al (1996) suggests that there is too much effort involved in getting standards durable or correct, all that counts is that it works now, and for a period of time. This is again bringing in the issue of time. It is often found that a standard that is timely, will not stand the test of time, that is, it may not be durable.

Likewise it is suggested that it is essential to get a standard that everyone accepts. After all, the most critical aspect of a standard is that it provides a common ground for exchange.

Oksala et al (1996) contradicts themselves with their next point. It is suggested that a standard must stand the test of time, [albeit in complete opposition to their first point]. The saving grace may be that it is suggested that areas in which technology is changing shouldn't waste effort on standardisation. "Standardisation is only for things that are going to be around for a long time." The problem with this argument is it would therefore mean that most forms of technology would be without standardisation, and indeed, interoperability (one of the main goals of standards) would not exist because it is in its infancy.

Finally, it is suggested that getting the right standard is very important. The right standard is the standard that is needed in terms of some context or plan. It will enable other kinds of developments and not preclude experiments.

The next criteria was that of Batik (1989). Batik presented three very broad yet relevant questions, Batik questioned:

- Does the standard meet the required need?
- Is the standard the best that can be achieved at this time?
- Does the standard meet the criteria?

The final criterion reviewed, was presented by the National Institute of Standards and Technology (NIST, 1998). The report in which the criteria were located was to be used as a catalogue from which selections of standards can be made (only in response to clearly defined user requirements).

The criteria used was different in that it was not termed in a series of questions, more as a statement of intent and the possible evaluation. The criteria were defined as follows:

- *Level of consensus*: A low evaluation is given to specifications that are proprietary or are used by a very limited or specialised group of users, such as vendor consortia; a high evaluation is given for a specification that has already become a national or international standard; average evaluations are assigned for public domain specifications that are not standard, or that may be in the process of becoming a standard (i.e., standards committee work-in-progress), or that are widely available across various hardware/software platforms.

- *Product Availability*: A low evaluation is given to specifications for which only a very few proprietary products are available; high evaluations are given to specifications for which there is a wide variety of products available from various vendors across different application platforms; average evaluations are assigned to specifications that may be proprietary but have many products available from a variety of vendors, or that are public domain specifications with products readily available.

- *Completeness*: A specification is evaluated on the degree to which it defines and covers key features necessary in supporting a specific functional area or service. For example a network security specification that includes all of the components described would be evaluated higher than others that do not include all of the features.

- *Maturity*: According to the underlying technology of a specification, a high evaluation indicates that it is well-understood (e.g., a reference model is well-defined, appropriate concepts of the technology are in widespread use, the technology may have been in use for many years, a formal mathematical model is defined, etc.). A low evaluation indicates that it may be based on technology that has not been well defined and may be relatively new.

- *Stability:* A high evaluation means that the specification is very stable, that no changes are expected within the next 2 years. A low evaluation indicates that significant or many changes are expected within a relatively short time (1 to 2 years), or that some incompatibilities exist between current and expected releases of the specification. An average evaluation is given to those specifications that may have known changes forthcoming to replace features in the existing specifications.

- *Problems/Limitations:* Lower evaluations are assigned to specifications with severe restrictions on use or capabilities (e.g., licensing restrictions) or known problems tend to be too difficult and too numerous to overcome (e.g., new releases of the specification are not compatible with previous releases, or not enough is covered in the standard to be useful). An average evaluation is given to those specifications that require some minor additional facility in order to be fully effective in their intended environment. This additional facility may be provided by a related standard, or other specification.

NIST (*ibid.*) also require extra information items, not part of the criteria per se, but for information gathering and storage purposes. These include:

- Specification title: The full identifying title of the specification for purposes of ordering or reference.
- Specification available from: Organisation from which the specification can be ordered.
- Publication date: Date on which the publication was released for general use (usually designated on the specification's title page).
- Sponsoring Organisation: The organisation responsible for developing or maintaining the specification.
- Rationale: In a very few cases, a rationale section has been included to describe the reasoning behind a specific recommendation. The intent of this section is to show that a requirements validation process was undertaken before a recommendation was made.
- Applicability: Description of the service area that covers the recommended specification.
- Conformance testing: Provides information about current and future plans for conformance testing of products based on the recommended specification.
- Bindings: Application program interfaces (API) that are applicable to the recommended specification, such as Graphical Kernel System's (GKS) bindings to Ada, C, and Fortran. These are the subroutine and function calls necessary to use the services of a standard implementation in a particular programming language. Bindings are not applicable to all specifications recommended, such as data interchange formats.
- Future plans: Published or otherwise-announced directions and long-term plans (i.e., 3 years or more) for individual specifications.
- Alternative specifications: In some instances, other specifications exist besides the recommended specification. Users may want to review these alternatives before selecting a specification on which to standardise.

It was felt that the previous set of criteria were the most relevant to standards adoption, even though it was not posed in question form as the other sets were. It was beneficial because the critical success factors that were presented were replicated in many of the other articles. These criteria were considered better in the fact that some answers were suggested, rather than being hypothetical questions.

Consequently it was decided that the most appropriate way of deciding upon the criteria to be used within this research project, was to utilise the above categories, but put them in question form. This was a matter of re-ordering the wording of the category, or simply using a relevant question from another article.

A conscious choice was made when compiling all the criteria to ascertain whether it would be more useful to have a SAF constructed of one group of questions, or to break the questions up into specific categories. It was decided to use the latter to provide the opportunity to show if different criteria influence different standards applications. This will be discussed in greater detail in Chapter Three.

Once the criteria for standards adoption had been found it was important to understand the benefits of standards within healthcare.

2.4 The Use of Standards within Healthcare

This section is used to refine the use of standards, and place them in the required context of healthcare. This section identifies why standards are essential to the healthcare arena, and who is creating these standards.

2.4.1 Identify Why Standards are Crucial Within Healthcare

Standards are utilised in many contexts and applications. Standards (can) govern and control and therefore create results. Some standards can also be considered as being more relevant than others are. One example of this is the Military Specification C10022C, a 15 page long document, with 17 pages of amendments. The standards use? This particular standard is for chewing gum (Batik, 1989).

On a less cynical note, standards are essential within healthcare for a plethora of reasons. One of these reasons is due to an ethical issue that has been around since the dawn of time. A trip to the doctor and/or hospital often means baring it all (Hall, 1998). A doctor has been compared to a priest with the amount of information they are told,

and expected to keep confidential. Manning (1998b) explains, that the physician's duty to keep information private and confidential derives from ancient physician oaths, basically unchanged at their core, and from more recent legal recognition that an individual has a right to keep those things private which he/she desires to be kept private.

Whilst the need for privacy, and confidentiality is remaining constant (if not increasing), the environment that encompasses it is going through great change. Information is being shifted from paper forms and files to electronic media. Goldman and Mulligan (1998) discuss this issue and note that "although it is naive and incorrect to suggest that paper records of health information are adequately secured against unauthorised access and misuse, the world of electronic information exchange raises many more unique and trying security challenges."

The example that Goldman and Mulligan (*ibid.*) use, could almost be considered extreme, but is still relevant. "Consider a networked environment, in which it is possible for a record to be accessed by multiple individuals from around the world simultaneously, each of whom with varying degrees of abilities to view, alter, delete, or copy the information."

Goldman and Mulligan (*ibid.*) notes, that it is a lack of comprehensive rules to protect patient privacy that has put patient privacy at risk in the paper-based records medical system; however the potential breaches of privacy and the damage possible if we proceed into the era of electronic record keeping may be devastating by comparison.

Jachinowski, Levy and Norris (1997) discuss this change of methods. Whether hospitals are being threatened by healthcare reform, the onset of managed care, or decreasing reimbursements, providers are experiencing increased pressure to reduce costs. At the same time they are being asked to better document all aspects of patient care, accurately measure utilisation, track treatment effectiveness via outcomes, and refine practice guidelines based on cost/outcome information, often across multiple modalities.

One question presented asks, "how can healthcare providers meet such varied challenges?" Jachinowski et al (*ibid.*) provide an answer; "only through wide-area communication, improved documentation and reporting, and increased documentation—not via a traditional paper, medical chart."

Jachinowski et al (*ibid.*) continues, that if a goal is to be paperless, a centre should have the capability of sending information electronically – provided that the recipient can receive it. Likewise, a centre should be able to receive information electronically if it sent in a format that the system can understand. However (and very importantly) because not all systems speak the same language, an interface is used to translate the information into a language that both systems can understand. One such 'language' is Health Level 7 (HL7) [which will be discussed in a following section].

Ball, Douglas, O'Desky and Albright (1991) acknowledge the same basic point. Standard protocols for communication and data exchange are crucial if such gateways are to be capable of handling data that enter from either side of that gateway and of passing those back and forth in a way that allows machines on one side to read data being sent from the other.

Jachinowski et al (1997) concludes that an electronic medical record that is inconsistent with established standards will only encumber a centre's ability to participate in the future healthcare environment.

This is the first true instance of someone applying the use of a standard to the doctors, hospitals and end users. It is very relevant as it notes that a standard must be 'used' correctly to be of any benefit.

The comment made by Jachinowski et al (*ibid.*) would have dramatic effects for the ill prepared and technology phobic healthcare provider. If one did not wish to combine health and technology, Jachinowski et al is bluntly saying, that their existence within future healthcare is very limited.

Zelmer (1998) writes an equivalent article. Zelmer begins by noting that there are numerous drivers fuelling the continuing pace in health information management.

Amongst which, are the search for ways to improve continuity and integrity of care services to the community; the goal of achieving equity of access to care for all, regardless of domicile; the drive towards empowering patients and involving them more directly in their own healthcare decisions; and the imperative to improve the cost-effectiveness of healthcare delivery.

Zelmer (*ibid.*) carries a useful discussion by suggesting a possible tool to make the aforementioned points plausible. Zelmer contends that communication is the key to the success of these endeavours: the need is for rapid, flexible, effective, and practicable methods for the exchange of information between people and between computers, with complete confidentiality to protect the privacy of individuals.

Manning (1998b) explains, that within the United States of America, (with regard to legislative issues) that at present current, federal, state statutes and case law represents an erratic, non uniform morass of regulation of privacy and confidentiality protections. Private and legislative efforts have been proposed to standardise and increase patients', employees' and insured' privacy protections in their health records. The physician-patient relationship and physicians' ethical obligations proscribe uses of data that are unrelated to the diagnosis or treatment of individual patients.

Although it may seem easy to ridicule and worry about the use of technology specifically within the very topical issue of medical record keeping, it is important to remember that, "technology, if harnessed to a policy agenda of preserving and enhancing privacy, offers some unique opportunities. If developed and implemented with privacy as a cornerstone, technology can abate some of the security risks proposed by paper-based records and address many of the unique security risks inherent in electronic systems (Manning, 1998b)."

Indeed, our own Honourable Jenny Shipley has acknowledged the advances in technology. From the Ministry of Health web site, (MoH, 1998) "Dramatic technological changes have occurred over the last two decades and will continue to produce major improvements in the way services are delivered to consumers over the medium term...together, technological advancements are greatly improving our ability to prevent, treat and manage acute chronic disease. In the health area, developments in

imaging technology, fibre optics, and new pharmaceutical's are contributing to a wide range of elements. Telemedicine has the potential to free health services from the constraints imposed by the physical location of facilities and providers – and so improve the speed at which people can access the services they need."

Hovenga et al (1996) acknowledge the same point. "Standards are the key to facilitate the sharing and exchange of information between departments, health agencies and health workers."

Within health informatics the widespread adoption of standards is expected to improve the health of the nation's population at a lower cost by improving the ability of health professionals, public and health service administrators to share and make better use of the information generated (Hovenga et al, 1996).

From what Hovenga et al (*ibid.*) write, standards seem to be the answer to many problems. It sounds somewhat idealistic to expect so much, when standards in their basic form are tools used with other components (as per the definition). In essence Hovenga et al are trying to quantify the benefits of communication.

Of significance is the Ministry of Health web page (1998) which notes "that the potential benefits of technology are clearly immense." With appropriate warning it continues, "However, new technology should be introduced only where it leads to benefits commensurate with the costs involved, or to overall improvements in cost effectiveness. Careful consideration of ethical implications is also needed before introducing new technology."

This is taking a step away from the use of standards, and queries the use of technology in its entirety. Technology although used to try and improve our environment, can still hold great risk and potential problems for those inexperienced or uncertain of its abilities, or those who use technology to the detriment of others.

The technological aspect of standards is also relevant. Standards exist at three different (and very relevant) architectural levels (MRI, 1998a). At the bottom is the bitways layer, often called the networking or computing layer. This layer of standards ensures

that computers and networks are operating properly and can work together in most conditions, whatever the application. This layer ensures that the various parts of the computer contribute to a coherent computer system, and that the system works. This layer also standardises the basic networking technologies.

The second layer is the middleware or services layer. The interface from computer basics to (general) uses is established through the standards developed at the middle ware layer.

The third layer represents applications. Eighty to ninety percent of all standards healthcare developers would also be building on the foundation of middleware and base layers.

Sometimes in order to look forward people need to look both backwards, and sideways. Ball et al (1991) writes, that by the mid 1970s healthcare institutions began to realise that the future use of computer technology should focus on producing system environments which could address the growing overlap between functions required by different sets of users. It was not until recent times that developers of health information systems discovered that they were designing applications that had already been developed by colleagues in different disciplines.

Ball et al (*ibid.*) succinctly and positively elaborates on the use of a standardised medical record. Ball et al notes that here is a major movement within many medical organisations to collaborate to produce a standardised medical record which can be utilised by all parts of the healthcare delivery system in an interactive manner rather than the previous archival, chronological storage of the past.

This lifelong record should be capable of being easily transmitted to other facilities and abstracted for essential and critical information. It should indicate potential health problem areas, accumulate individual healthcare costs per problem entity, graph anthropomorphic and laboratory data, and fulfil a host of other needs and desires.

There are many different views on the uptake of standards. Accordingly it seems that whilst standards are being acknowledged (if not thoroughly accepted) by those within

the information systems field, they are not being utilised by the doctors (or end users) themselves. Greenfield (1980) concentrates his effort on the doctors directly. Greenfield (*ibid.*) notes that overall the advantages to the doctor are: savings in administrative and clerical effort and costs, and more efficient and effective management of the practice. The advantages to the patient are: early warnings of risks, recall notices, better prescription control and better care resulting from the information.

Blair (1998) has similar concepts in the use of standards by explaining that "standards can simplify information processes, facilitate interoperability among systems, improve the clinical specificity required to support outcomes measurement, define policies and procedures to protect confidentiality, help evaluate the performance of health plans and establish minimum requirements for data security and integrity."

However with the benefits becoming actual, standardisation for some organisation still remains out of reach. Greenfield (1980) warns that while there can be little argument about the benefits of computers to general practice, they are still a threat or a risk that some may well try to avoid. Greenfield (*ibid.*) advises that it is essential to "make haste slowly." For it is clear that a concerted and standardised approach is essential and until many possibilities have been tested, that standard approach cannot be specified.

2.4.2 Standards' Developers within the Healthcare Arena

This next section examines who is making healthcare standards from countries and organisations external to New Zealand.

The nature of the standards industry means that a definitive answer of all the people making healthcare related standards is very difficult to ascertain. The MRI (1998a) mentions the major standards organisations particularly relevant within America as (including):

American College of Radiology and National Electronic Manufacturers (ACR/NEMA), American Nurses Association (ANA), Accredited Standards Committee (ASC X12), American Society for Testing of Materials (ASTM, plus Group E31), Institute for Electrical and Electronic Engineers (IEEE), Health Level 7 (HL7), Health Industry

Business Communications Council (HIBCC), National Council for Prescription Drug Programs (NCPDP). These eight organisations are comprised of about 2000 volunteers who are working on approximately 150 work items. An American National Standards Institute (ANSI) Standards Board will co-ordinate them. In addition, the Standards Developer Organisations have formed a joint committee to co-ordinate their work. They have developed methods for co-operation on both the staff level and the membership level. The organisations with the highest potential overlap, such as HL7 and X12, have also started talks for co-operation in order to streamline the process.

The MRI (1998a) also categorises professional societies involved in standards creation:

Organisations such as American Medical Association (AMA), American Nurses Association (ANA), the Association of Information and Image Management (AIIM), the American Health Information Management Association (AHIMA), and the American Medical Informatics Association (AMIA). Besides these active organisations there are many other medical speciality organisations and colleges.

The MRI (1998a) also notes Industry Consortia:

Groups such as the Healthcare Open System Trials (HOST) and the National Information Infrastructure (NII) also influence the standards process.

Another organisation that is very important in the development of standards is the International Organisation for Standardisation, more commonly known as ISO. ISO is a non-governmental organisation that was established in 1947. The mission of ISO is to promote the development of standardisation and related activities in a world with a view of facilitating the international exchange of goods and services, and to developing co-operation in the spheres of intellectual, scientific, technological and economic activity.

The International Organisation for Standardisation (ISO) is a worldwide federation of national standards bodies from 130 countries, one from each company. ISO's work results in international agreements that are published as International Standards (ISO, 1998).

CEN (European Committee for Standardization) is another important organisation for developing standards. CEN's mission is to promote voluntary technical harmonisation in Europe in conjunction with worldwide bodies and its partners in Europe. Harmonisation diminishes trade barriers, promotes safety, allows interoperability of products, systems and services, and promotes common technical understanding.

CEN works in conjunction with other private or public organisations, representing European and worldwide interests. In particular, it has an agreement for technical co-operation with ISO (CEN, 1998).

2.5 The Use of Standards within New Zealand Healthcare

After discussing the use and development of standards from a worldwide perspective it is important to come back to the goal of the research project and focus on New Zealand healthcare.

Accordingly, this section provides a brief background to the New Zealand healthcare system, as well as discussing the role that New Zealand plays within standards development. The final section ascertains what healthcare standards are being utilised within New Zealand.

2.5.1 Structure of the New Zealand Heath System

The New Zealand Government is committed to providing a wide range of publicly funded, comprehensive and quality health and disability support services to the community (NZHISa, 1998).

The New Zealand health system is going through great change. In 1993 the Health and Disability Services Act set up a new way of organising healthcare. At the time of writing the Health Funding Authority (HFA) was working on joining four regional services (previously known as the Regional Health Authorities) into one, more centralised funding agency (NZ Health, 1998).

Each year the Government decides how much public money will be spent on healthcare. The National Advisory committee on Health and Disability advises the Government on which health services should be publicly funded and with what priority. The Government through the Minister of Health allocated money to the HFA to purchase health services for the people of New Zealand.

With this the Government also provides broad guidelines on what services must be provided. These services can be bought from a range of providers including public hospitals, non-profit health agencies, iwi groups or private organisations (NZ Health, 1998).

Within New Zealand there are 23 public hospitals companies[1] (previously called Crown Health Enterprises). Each company has a board of directors appointed by the Ministry of Health. These companies run public hospitals and other services, such as National Cervical Screening Program, health promotion activities and public health nursing services.

Private healthcare providers include private hospitals, laboratories and radiology centres and general practitioners. General practitioners (GPs) have generally found it useful to organise themselves into groups (called Independent Practitioner Associations or IPAs) to negotiate funding.

It is also appropriate for community based and non-profit providers such as the Family Planning Association or Plunket to apply to be funded.

2.5.2 New Zealand's Role within Standards Development

New Zealand, although little in stature and remote in location (Hicks, 1996), does have a 'say' with regards to the standards process. The MRI (1998a) writes that, "healthcare application standards today come from the main centre's of development in Europe and the United States. Australia/New Zealand, Canada and Japan are also participating in

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[1] It is acknowledged that public hospitals, are undergoing many name changes. At the time of writing 'public hospitals' was still the most common way of referring to these organisations.

the standards development process. Currently, however, there is a lack of co-ordination between national development organisations, which adds to the confusion. On the positive side, communication between the two largest centres of development, the United States and Europe is improving rapidly.

Standards (1993) also include New Zealand as an important contributor to the standards process. Standards (*ibid.*) write that the Standards bodies of New Zealand and Australia have committed themselves to international alignment for all future joint standards. Globally New Zealand is active in the International Organisation for Standardisation (ISO) and the International Electrotechnical Commission (IEC), which create uniform standards for the international market.

Standards (1993) notes that both joint Australian/New Zealand Standards and ISO/IEC Standards rely on input from New Zealand interests and from other member countries to produce acceptable final standards.

In New Zealand most standards are published by Standards New Zealand, which is an independent non-profit organisation operating as the trading arm of the Standards Council. New Zealand standards are developed through an open process of consultation and consensus in which all the interested parties are invited to participate. They are then approved by the Standards Council (and in some cases by a Government Minister) in accordance with the requirements of the Standards Act 1988 (taken from Standards New Zealand, 1998).

Within New Zealand a Health Standards Committee also exists, there are numerous working groups included within this committee. One particular working group is the Health Informatics Sub-Committee. This group works in the provision and promotion of all required national health informatics standards and guidelines the area of the development of communication standards used for the communication of all health information. This group supports and provides input into any healthcare informatics standards initiatives that may develop, and also ensure appropriate New Zealand representation on relevant Joint Australian/New Zealand Subcommittees and Working Groups.

Any draft standards that are approved by the Health Standards Committees are then processed by Standards New Zealand, so to become an official New Zealand standard. They may then be submitted to Australia as a join standard.

An example of a New Zealand initiative is 'The New Zealand Electronic Medical Record Standard' (Electronic Medical Records Standards Subcommittee, 1998).

There a number of goals associated with this standard. The developers wish for the standard to be a useable tool, exploited by different users such as:

- *Decision Makers* – As a planning tool, to allow the implementation of organisational networks of medical information between different centres, and in order to manage the quality of delivery care, establish forecasts and budgets, manage contracts etc.
- *Healthcare Professionals* – as a verification instrument to rely on the quality of the information about patients, as an instrument to improve the quality of care, and be able to support other medical activities.
- *Information Systems Professionals* – as an instrument to develop consistent applications, capable of interchanging consistent data, complying with common criteria in terms of semantic and syntactic aspects.

It is assumed that with the appropriate time and resources this standard will become readily acknowledged and used within New Zealand, and ideally places afar.

2.5.3 Healthcare Standards within New Zealand

Standards usage within New Zealand is becoming more prominent. This is partly because of the initiative of the New Zealand Health Information Service (NZHIS) and its many different tiers of communication.

The NZHIS has established one such project management group to co-ordinate and manage the national implementation of ICD10-CMA. ICD10-CMA is the International Statistical Classification of Diseases and Related Health Problems - Tenth Revision. This classification superseded ICD9-CMA for morbidity coding in healthcare facilities.

ICD10-CMA has been prepared by the National Centre for Classification in Health (NCCH), specifically for clinicians and users of coded data.

This group is chaired by NZHIS and includes representatives from Healthcare providers, divisions of the Health Funding Authority (HFA), the Accident Compensation Corporation (ACC) and the Crown Company Monitoring Advisory Unit (CCMAU).

In addition, three working groups have been established to identify and manage issues relating to the areas of Coding Training, Information Technology, and Mapping/Contracting.

The benefits of moving to ICD10-CMA include New Zealand 'needing' to move to the Australian version of ICD10-CMA in order to continue to use the Australian grouping for contracting and reporting purposes. With additional benefits of moving to ICD10-CMA including:

- Greater specificity of data, particularly in the accompanying procedure classification
- Compatibility of data with Australia, particularly for benchmarking purposes
- Increased ability to describe and monitor health outcomes
- Improved clinical coherence of future casemix groups

HL7 is another well-utilised health standard within New Zealand. Jachinowski et al (1997) briefly summarise Health Level 7. HL7 is a computer application protocol for electronic data exchange in healthcare environments. Level Seven refers to the highest level of the International Standards Organisation's communication model for exchanging data. HL7 has emerged as today's standard healthcare data format because the protocols are completely independent of any manufacturer. As long as an electronic medical record is equipped with an HL7 interface, a centre will be capable of communicating electronically with any outside system that is also HL7 compliant to exchange orders and results, Admission Discharge and Transfer (ADT) information and billing data and more.

Medical Centre Information Systems (MCIS, 1998) proposes that HL7 can act as a superstructure in this environment to facilitate a common specification and specifications methodology. It is indeed both practical and economical to develop and commit to standard interfaces for computer applications in healthcare institutions.

The primary goal is to provide standards for the exchange of data among healthcare computer applications that eliminate or substantially reduce the custom interface programming and program maintenance that may otherwise be required

Similarly Jachinowski et al (1997) continues Digital Imaging and Communications in Medicine (DICOM) protocols have emerged as today's standard healthcare image message format, again because these protocols are completely independent of any one manufacturer. As long as an EMR is DICOM-compliant, a centre will be capable of receiving DICOM formatted images (Cat Scans, Magnetic Reasoning Images and electronic portal images) from multiple sources and departments.

Jachinowski et al (1997) concludes that, while the HL7 and DICOM standards govern how information is communicated electronically, other standards such as ICD9-CMA, and SEER (Surveillance, Epidemiology and End Results, a continuing project that collects cancer data on a routine basis from designated population-based cancer registries in various areas of the country of the National Cancer Institute), govern how critical information is communicated directly to the healthcare professional.

The NZHIS (1998a) has placed on the Internet, a list of standards which are currently known health informatics standards that are being utilised within New Zealand, the list is as follows:

Standard	Status	Standards NZ Status
Security and authentication communications standards with NZHIS and NHI and MWS systems	Under development Pilot standards endorsed	
National Provider Index	Under development Pilot Standards endorsed	

Table 1 – Health Internet Standards

Standard	Status	Standards NZ Status
NZHIS standard for NHI and MWS	In Use	Draft
Referral, Status and Discharge	In Use	Draft
Laboratory and Radiology Orders	In Use	Draft
Laboratory and Radiology Results	In Use	Draft
HBL GMS Claims and Payments	In Use	Draft
Transfer of Video and Images	Gap	
Pharmacy Claiming	Gap	

Table 2 – HL7 Communication Standards

Standard	Status	Standards NZ Status
ACC Billing and Payments	Pilot	Unknown

Table 3 – EDIFACT Standards

Standard	Status	Standards NZ Status
ICD9-CMA	In Use	MoH approved
ICD10-CMA	Pre-implementation	MoH approved
Read Codes	In Use	MoH approved
LOINC Laboratory and Radiology codes	Under review	In Process
Read Code Drugs Chapter	Under development	
Read Code Administration Chapter	Gap	

Table 4 – Clinical Coding Standards

Standard	Status	Standards NZ Status
Electronic Medical Record	Under development	
National Term Dictionary	Under development	
A data dictionary for PMS systems	Gap	
Nursing Care Planning	Gap	

Table 5 – NZHIF Standards

2.6 Summary of Chapter 3 - Literature Review

The literature review was undertaken to get a theoretical background about the use and applicability of standards. The literature review started in a broad manner covering aspects of standards in general and then moved specifically to gather information about standards within healthcare, and finally within healthcare New Zealand.

To begin with a definition of a standard was sought that encapsulated the different elements which standards can include, and the different areas to which they can be applied.

From then many uses of standards were found including the ability to share data and the ability for components to work together.

Standards were found to be essential within healthcare for many reasons, they include, the security and privacy of the data, the possibility of decreasing costs and as means of improving healthcare in general.

A number of different standards development organisations were noted including organisations such as ISO, CEN and ANSI.

Finally the New Zealand healthcare system was discussed, as was the role that New Zealand plays towards developing healthcare standards. The final section presented a list of New Zealand based standards.

The literature review is relevant as it provides a thorough background into the utilisation of standards both internal and external to New Zealand. It provides an insight as to why standards are adopted, and some of the relevant questions that are asked when adopting standards. The next chapter builds on this information and leads to the formal creation of the Standards' Adoption Framework, and the components within.

Chapter 3 Development of Research Model

There are no standards for standardisation.
(Cargill, 1998)

This chapter introduces the background understanding, theories and models that were utilised when completing this research project. It discusses the problems inherent within information systems research and examines two essential considerations that were important. The background into the development of the models and theories is also explored.

3.1 Information Systems Research

Lewins (1993) contends that research involves: gathering evidence, sifting, analysing, and building up connections, which are then followed by the thesis as the statement of discoveries and theoretical insights. Newman, Benz, Weis and McNeil (1997) elaborate that, if a 'student' can base a study on a theory, the whole study will be easier, be cleaner, and will more likely contribute to the knowledge base.

Information systems research has many faults including time and inadequate measuring methodologies (Mumford in Nissen, Klein and Hirscheim (Eds),1991, Boland and Hirscheim 1987). Mumford (1991) provides a checklist for improving information systems research (ISR):

- A need to improve relevance, this involves selecting an appropriate target audience
- Identify an appropriate concern within the target audience that you are addressing - that essentially determines relevance
- Place the study in its wider intellectual context
- Explain (predominantly to yourself) why you chose the methodology you are using
- Understand what contribution you are making to: the target audience, the cumulative tradition of ISR, to the wider research environment

This list of seemingly simple research goals are often overlooked; within this research project they were considered to great depth and utilised at all times.

3.2 Ethical Considerations

Rountree and Laing (1996) write that the instant that we select a topic for research, we position ourselves in a web of relationships which have the potential to raise ethical issues. Rountree and Laing (*ibid.*) continue, that many individual issues exist, some of which may include: access to information, safeguards for research participants, benefits for society from the research, and processes for disseminating the results of the research. More issues, that are relevant especially for the research project include: ownership of data, confidentiality, anonymity, privacy, risk of harm to subjects, gender and cultural sensitivity and finally informed consent.

Newman et al (1997) also discusses informed consent and states that when using participants within any form of research it is essential to obtain their consent. The form or information sheet must convey that the participants are not required to participate, and that they can stop any time. The consent form discusses the consequence of declining to be in the study, or of withdrawing from it.

For the above reasons, and as good research practice consent from both the Massey University Ethics Committee as well as the Manawatu - Wanganui Ethics Committee was sought and subsequently gained before undertaking any form of research with the potential participants. This process was helped by the physical creation of an Information Sheet (Appendix Four).

The Information Sheet began with the personal contact details of the people running the survey. The next section was a brief and basic introduction to the use of standards within healthcare and why the survey is relevance to New Zealand healthcare. It was essential to establish the different groupings of people who were to be receiving the survey so that the all of the participants were aware of who else would be receiving the survey, this was the next section. This section also assured the potential participants that the returned surveys will be kept in a locked filing cabinet, and all data stored with many personal computer security mechanisms including log-in computers. The final two sections assured confidentiality (by using numeric code rather than names) and stated the rights of the participant (such as the ability to decline or withdraw at any time).

Because of the methodology used (mail out survey) prior individual consent was not needed, yet was presumed when a completed survey was returned. It was also stipulated that individual data not would be identified by organisation name, but that it would be combined to a pool of data to be used in an aggregate form whenever possible. This was another method that was utilised to ensure the confidentiality of the respondent. This is discussed in greater depth in Chapter Four.

3.3 Economic Considerations

As suggested by the limitations mentioned in Chapter Two, economic costs hold large weighting with regard to the research project endeavour. It is important that the best be made of the appropriate resources so to get the most out of the research.

Cost and time considerations were a significant factor of this research process and will be shown by the scoping issues noted in Chapter Four.

American Statistical Association (ASA, 1998), note that a checklist of budget factors, such as the one following may be useful in estimating total survey costs (whether in time or money):

- Time for planning the study and steering it through the various stages
- Sample selection costs
- Labour and material costs for pre-testing the questionnaire and field procedures
- Labour and material costs for getting information from the questionnaire onto a computer file
- Potentially important costs are incidental telephone charges, postage, reproductions, and printing costs for all stages of the survey

3.4 Relevance to Research Area

Throughout the research project many different elements have been touched upon. This is including (but not limited to) a literature review covering the broad details of a standard right through to the specific notion of standards for IS within NZ healthcare. Via this study the obvious confusion and lack of concrete definitions and concepts as to 'how' and 'why' people adopt (or do not adopt) particular standards became apparent.

Initial attempts at trying to find information on IS standards was also found to be difficult, provoking more questions on how the IS manager would learn and ascertain what standards 'should' be adopted.

Accordingly the need and importance of this research project became apparent. The feedback that has been gained from the intended audience has been widespread and very positive. Many of the concepts discussed within the literature review have become apparent after communications with some participants additional to the completion of the survey.

The information that this research provides will be useful to many organisations and individuals, it can be used as a catalyst to those who have not yet realised the use of standards, or as a communication medium for those do realise the benefit of standards, and are unsure of which standards to adopt and why.

The questions that will be asked specifically with regard to the research project include:

- Identifying why people adopt standards
  Completed within the literature review, to gain a detailed understand and a theoretical background.

- Identify the critical success factors that are proposed within literature which encourage the adoption of a specific standard.
  This question is asking why one standard would be selected over another and what the reasoning would be.

- Identify which information systems standards are being adopted within New Zealand healthcare.

  This question makes it possible to ascertain the level of standard usage within New Zealand.

- Ascertain if the SAF is generalisable across different application areas, and different organisations.

The research question involves the use of literature and the creation of theoretical models. It was essential when creating the model that a number of different categories were utilised, and that it was based on previous literature pieces. The next section introduces the different theoretical models that were utilised.

3.5 Theoretical Model Development

When developing this research project it was essential to create a theoretical model as to why standards are adopted. Polgar and Thomas (1995) write, "We develop model and theoretical frameworks, which systematically explain how variables are interrelated."

Newsted, Huff and Munro (1998) also note that a carefully constructed theory is a precursor to the actual use of an instrument. They note that theories propose constructs and their expected relations. They guide the investigation of these relations as they attempt to help one understand behaviour and identify regularities in it. However, this is also a two-way street: instrument development can often refine theories as well. As Straub (1989, cited in Newsted et al, 1998) indicates, "Attention to instrument issues ... brings greater clarity to the formulation and interpretation of research questions. In the process of validating an instrument, the researcher is engaged, in a very real sense, in a reality check. He or she finds out in relatively short order how well conceptualisation of problems and solutions matches with actual experience of practitioners."

Accordingly two theoretical models were developed for use within this research project, the first of these is the Standards' Adoption Framework, and the second is the Standards Categorisation Scheme. A framework was also utilised within this project that takes into account the different stages of organisations, this is discussed in a later section.

3.5.1 Standards' Adoption Framework

The Standards' Adoption Framework aims to specify what individual elements are essential in the decision making process when selecting a specific standard. Six literature articles acknowledged this concept, and presented some form of criteria, these were: Batik (1989), Morrell and Stewart (1996) Oksala et al (1996), Baldo et al (1997), Aden and Harris (1993), and National Institute of Standards and Technology (1998).

Each article had varying degrees of depth and definition. Batik (1989) presented a pool of three questions, that whilst were useful, were presented in a manner that was considered to be very broad and non-specific. Morrell and Stewart (1996) suggested ten different points (questions) associated with what makes a good standard, the main grouping of questions that this related to was the concept of 'Interoperability'. Oksala et al (1996) suggested six criteria, with a range of applications. Baldo et al (1997) also suggested six criteria. Aden and Harris (1993) suggested twelve criteria that were predominantly concerned with the concept of 'Completeness'.

It was decided that the combining of these would create the most useful model to work within. It is important to note that National Institute of Standards and Technology (1998) presents the most thorough criteria as this model has already been successfully used and accepted as a standard criterion.

Therefore the proposed two step model combines the individual questions, into the broader, and tested categories.

Figure 2 shows the first model that was built with random lines combing the different sets of criteria. As the model was developed further it was decided that it would be appropriate to pool the different questions (delete any identical questions), then group them into similar terms, and discover how they then relate to the NIST model.

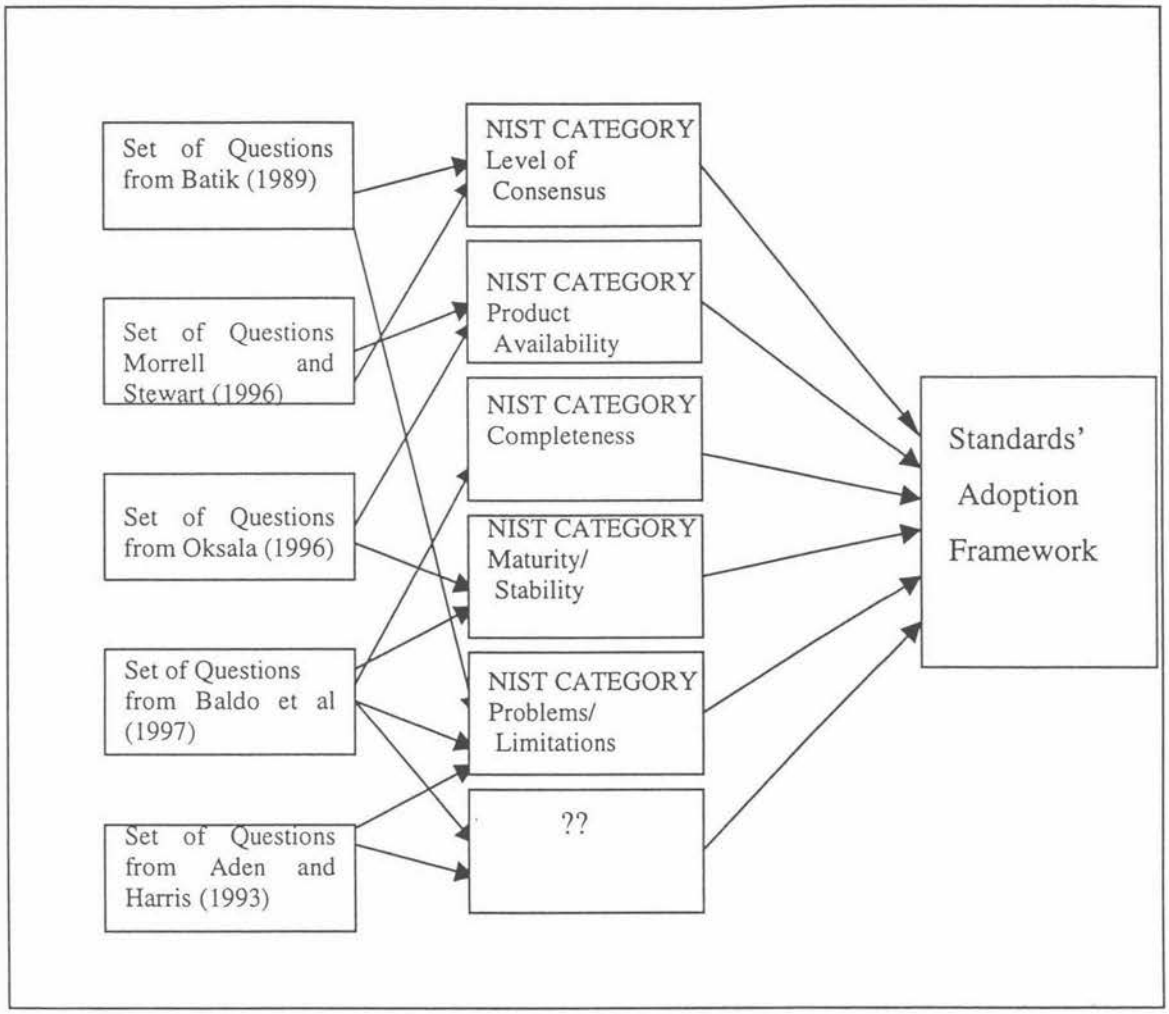

Figure 2 – Initial Standards' Adoption Framework

When comparing the different sets of questions, one question in particular was asked repeatedly, "Does the standard meet the required need and functionality?" This has been shown once within the 'Completeness' category. The final model is shown within Figure 3.

This model is useful because it shows the individual questions in relation to the already tested and acknowledged NIST categories. It is important to note that once the groupings were made it became obvious that another category had to be appended to the NIST model. 'Interoperability' was important to the different literature pieces, but was not accounted for with the NIST model, consequently it was added as a specific category.

Another change was also created with the NIST model. In the original model 'Maturity' and 'Stability' were two separate categories, it was decided that it would be appropriate to combine the categories into one, as they were both concerned with the issue of time.

As standards exist at so many different levels of development, it was felt that it was appropriate to include a question that deals with the stage of development the standard is at. It was felt that this would fit most easily into the 'Level of Consensus' category. Therefore the question:

- Is the standard consensus based?

was also included within the framework.

The individual CSFs were explained to the sample as follows:

- Level Of Consensus
  The degree of awareness which exists about the standard.
- Product Availability
  The range of applications and accessibility of the standard.
- Completeness
  The ability of the standard to cover the required features.
- Maturity/Stability
  The length of time the standard has been known.
- Problems/Limitations
  The number of faults within the standard.
- Interoperability
  The ability of the standard to co-operate with other applications.

In summary the SAF develops a general theoretical model which identifies and integrates the factors which are required for an IS standard to be successful, and therefore adopted.

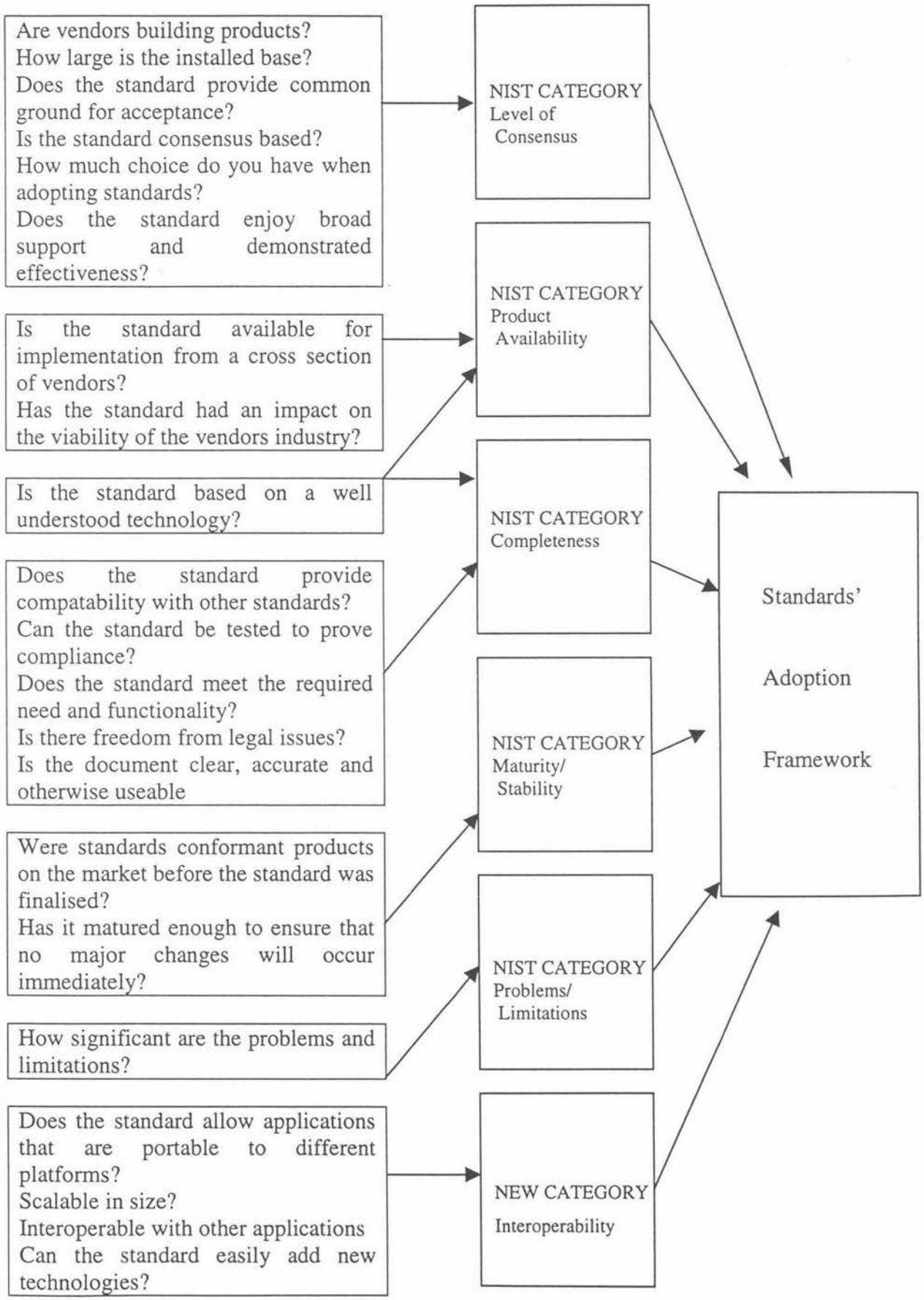

Figure 3 – Final Standards' Adoption Framework

3.5.2 Standards Categorisation Scheme

Many different healthcare standards exist. It was important when designing this research model to create some sort of scope of which standards will be measured. This was essential because it would be well out of our depth to gather information about each and every utilised standard.

An inherent aim of this research project was to ascertain if the SAF can be applied in a holistic manner, or if different CSFs within the model became important within different standards applications (or categories).

Accordingly, two main categories of standards have been acknowledged. The first of these were the different standards that are utilised within the different phases of the lifecycle. Three main divisions were acknowledged; Analysis, Implementation and Operation.

The second significant category was used to understand where the different focus points of healthcare lie. Four main categories of standard application were acknowledged, these include: Clinical Coding, Information Exchange Protocols, Information Systems Management and Technology Infrastructure use,. Some examples of different standards applications have been provided within Table 6.

Clinical	Info. Exchange	I.S Management	Infrastructure
Read codes	Communication	Security	Database
Data format codes	EDIFACT	Privacy	Network
Data dictionary	Format HL7	Disaster Recovery	Operating system

Table 6 – Standards Applications

As part of the process of deciphering what standards to study, a matrix was created, to graphically display what standards will be selected. As of the previous discussion the matrix will take the form shown in Figure 4.

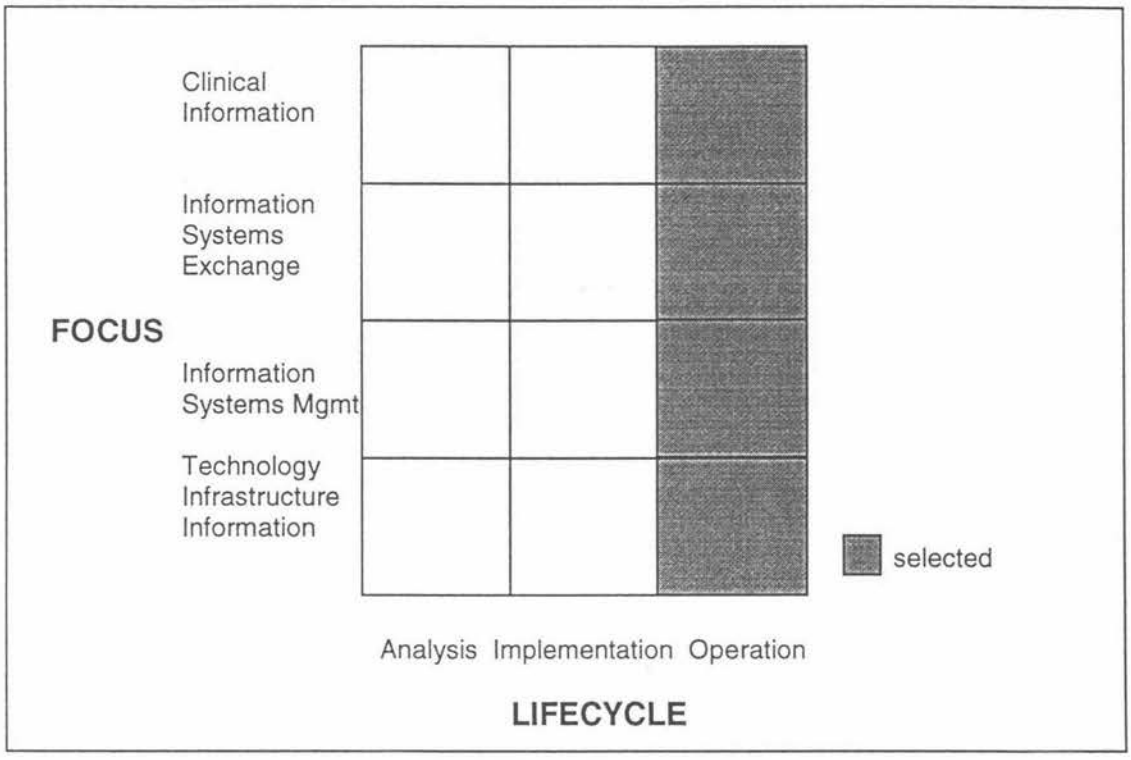

Figure 4 – Standards Selection

The matrix shows twelve different categories. It was decided to select the 'Operational' stage of the lifecycle for a number of important reasons. Firstly, this encompassed each different category of IS standards. Secondly, it focussed on the particular standards that would actually be used within an organisation, that is they were physically operational and would therefore hold significant purpose. Thirdly, noting the current status of standards it would seem that there are very few standards used within the analysis and implementation aspects of IS within hospitals.

Once the models were created it was important to have an understanding of what would be tested, accordingly the next section discusses the hypotheses development.

3.5.3 Stages of Growth

Frenzel (1992) acknowledges that organisations that utilise computers go through 'relatively predictable' stages of growth. Frenzel (*ibid.*) identifies a model developed in 1974 by Nolan and Gibson that, even though considerable time has passed, has gone through accretion changes rather than conceptual changes.

These stages are particularly relevant within this research project as they assist in the explanation of the assimilation of new technologies for different organisations, as well as enable justification as to why initial demographic questions are asked within this research project's survey.

Frenzel (*ibid.*) suggests that the different stages are important because of the notion that computers are used within different sized firms, to different degrees of functionality. This point is particularly relevant within New Zealand healthcare. As already stated three organisations have been identified. Public hospitals which are generally large organisations, with a large amount of patient throughput, and a large amount of data. IPAs which are much smaller than public hospitals, and a lot more physically disperse, and finally private hospitals which are generally small and local healthcare agencies.

Consequently it is very likely that these organisations will have different levels of functionality for possibly, even the same task. The Stages of Growth theory is useful as it makes it possible to find out what stage the organisation is at with their use of technology, and their use of standards. Similarly Frenzel (*ibid.*) concludes his discussion by noting; "The stage hypothesis is an important concept because it provides insight into the technology adoption process."

Technology adoption will often need some form of standard adoption as well, thereby making the two intertwined. The stages and their associated definitions are shown in Table 7.

Stage Number	Title	Definition
1	Initiation	The technology is initially introduced into the organisation, as some users begin to find applications. The use grows slowly as people become familiar with the technology and its applications.
2	Contagion	As more individuals and departments become acquainted with it, demand increases and use of the technology proliferates. Enthusiasm for the new technology builds rapidly at this stage.
3	Control	During the control stage the issue of cost versus benefits intensifies and management becomes increasingly concerned about the economics of technology.
4	Integration	As systems proliferate within the organisation and databases continue to grow, the notion of systems integration becomes dominant. Management becomes interested in leveraging integrated systems and their databases.
5	Data Administration	During this stage management is concerned with the valuable data resources. Functions are created to manage and control the databases and to ensure that they are utilised effectively.
6	Maturity	In this stage, if it ever occurs, the technology and the management process are integrated into an efficiently functioning entity.

Table 7 – Nolan's Stages of Growth

3.5.4 Hypotheses Development

The actual hypotheses development was left to relatively late. The SAF was created initially (so to ensure a model would be used that would allow for appropriate testing) as was the matrix to show which standards would be studied. This was important as it allowed for scope to be decided upon at a relatively early stage.

The hypotheses' building was done as a three-step process. Firstly, it was appropriate to think as an IS manager for a hospital and decide (taking into consideration, size, cost, staff and technology) which CSF would be most important for each standard application.

Secondly it was appropriate to think as an IS manager within an IPA (taking into consideration size, physical dispersion, budget, staff size, cost and technology usage) and decide which CSFs are most relevant for them.

Thirdly it was appropriate to compare and contrast each to formulate the hypotheses. A graphical representation is shown in Figure 5.

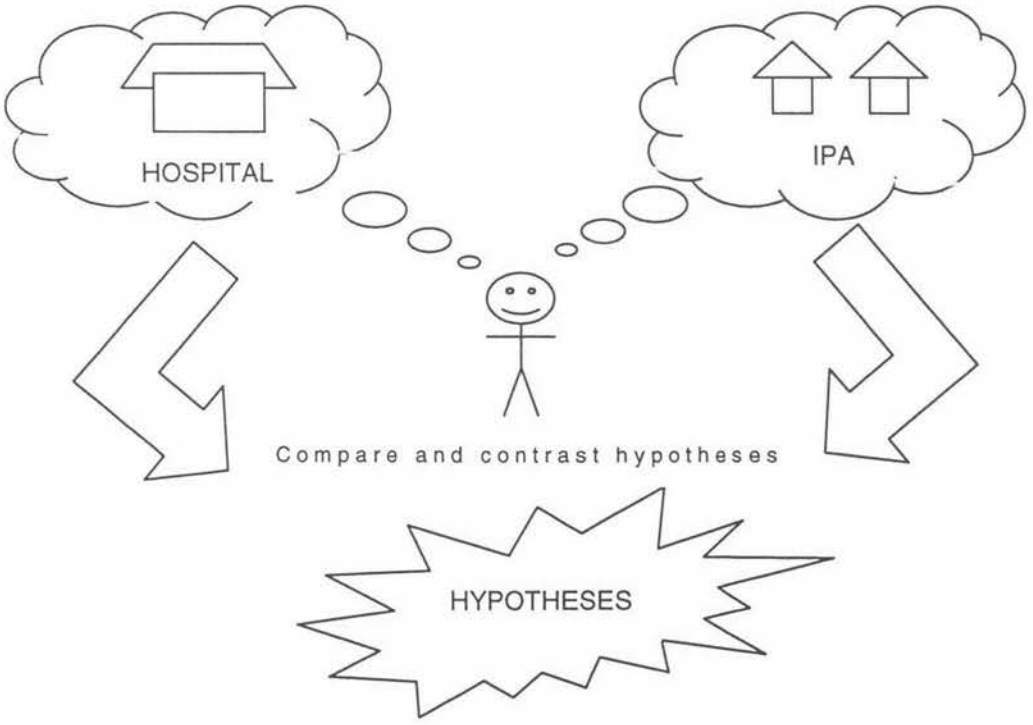

Figure 5 – Hypothesis Building

When creating the hypotheses the importance of the IS manager became relevant. Consequently a brief discussion on the IS manager, their influences, and who indeed influences them is included within the next section.

3.5.5 The Information Systems Manager

The nature of health information systems is such that there are a wide number of players. The healthcare system has influence and relevance to almost everyone; accordingly the people and the associated roles that they may take (or even have to acknowledge), are wide ranging.

This is an essential point with regard to this research project. Even though the scope was narrowed by allowing only standards for information systems to be discussed, and by suggesting directly who would be appropriate to complete the survey (the information systems manager), there still remain a number of people who can be considered as being relevant. This group of people include (using the information systems manager as a starting point), the equipment suppliers, the end users, the service providers as well as the information consumers (Ministry of Health, Health Funding Authority) to name but a few.

Each of these categories of people are important yet due to time, cost and even ethical considerations it was decided to not survey each and every member with regard to their adoption or uptake of standards. The part that they take with regard to standards adoption is briefly discussed.

Equipment suppliers and service providers have great influence with regard to the IS manager because they are in essence the people that provide the manager with any tools or services that are needed. In some cases providers' will therefore urge for a particular standard to be adopted as a requirement, or even as a suggestion. Consequently the role which the suppliers take in the standards adoption process can be considered as being important.

Blair (1998) also formalises the importance of the vendor by noting that "...vendors and healthcare institutions are driving the development of new standards. Without any government mandates, private sector market forces are pressuring health plans, managed care organisations and integrated delivery systems to compete in terms of cost and value."

The end users are also important because of the pressure that they may place on the IS manager, they may have heard or read about a standard and consequently want that particular standard applied. It would not be feasible to survey every end user, indeed it is hard enough to define them within New Zealand healthcare. Accordingly the role that they play with regard to the IS manager is acknowledged and is also considered important.

The Health Funding Authority (HFA) also has relevance with regard to the IS manager because of the control that they hold. As already noted funding is gained through this group, which would imply that if the HFA request for a standard to be utilised, organisations underneath would work hard to comply to this rule. Accordingly monetary issues would also be significant in the mind of an IS manager.

Another controlling factor for an IS manager would be the Ministry of Health. Any standards which they legislate will also have great influence on an IS manager.

Other issues which influence the IS manager include, the size of the organisation, the number of staff, the difficulty of the standard to implement, the level of computer usage, and the installed computers. Another important element considered is the aforementioned theory of the 'Stage of Growth' of the organisation. Indeed many other issues are relevant, the ones noted here are considered to be at the highest level of importance.

Once the different influences on the IS manager have been acknowledged it was important to find a methodology which recognises that different views can exist. Soft Systems Methodology (SSM) allows for the concept that people have different views of the same situations because people see events occurring in genuinely different ways (Open University, Block IV). It is this essential concept which is relevant to this

research topic. Whereas the main focus point is indeed the IS manager, it has been acknowledged that those around the manager also hold relevance and influence, and accordingly see standards in a different way. This can be shown graphically in a tool utilised by SSM. The rich picture is shown in Figure 6.

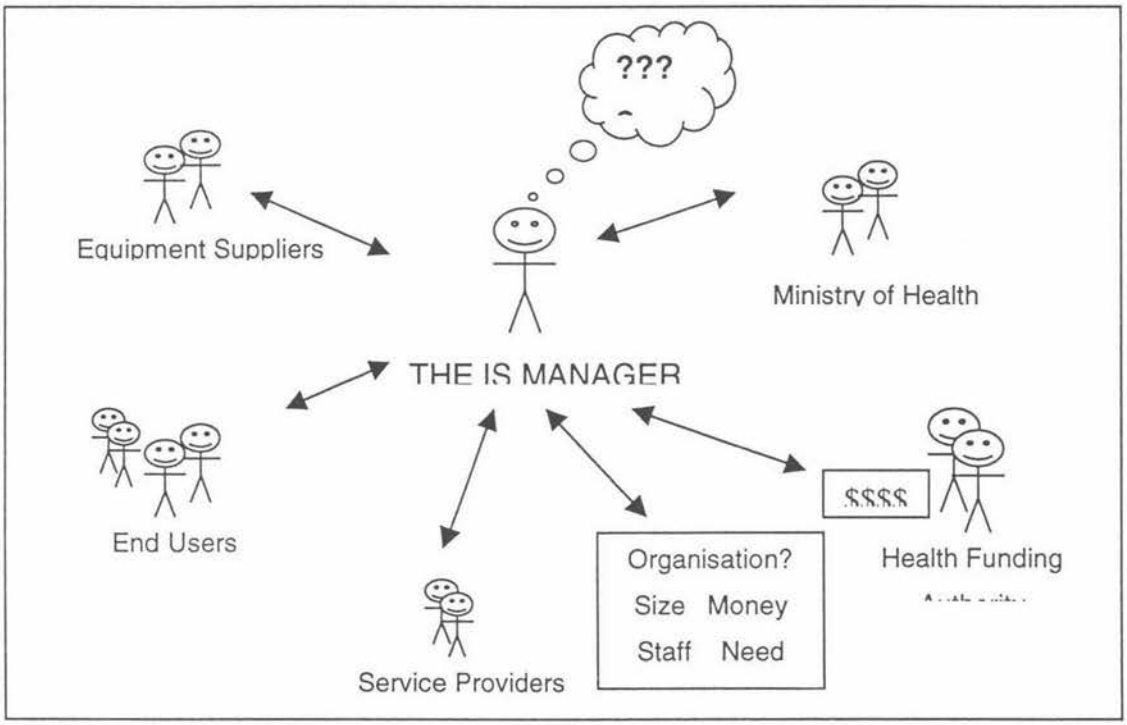

Figure 6 – IS Manager Rich Picture

Once all of the considerations of the IS manager were realised the hypotheses development could begin. This was completed (as previously stated) in a three-step process. Firstly, it was appropriate to consider the thoughts and actions as an IS manager for a hospital. Secondly, to think as an IS manager for an IPA. The third step was to compare and contrast the two, to create the final hypotheses. It is important to acknowledge at this point that hypotheses were only created for the ranking of the CSFs for overall adoption of standards and the different application areas.

3.5.6 Initial Hypotheses Development

Hospitals

Whilst thinking which CSFs would be most significant for a hospital the following hypotheses were created.

- *Completeness* will be the most important factor with overall standards adoption.
  This is because for a hospital to adopt a standard it would be necessary to ensure the standard is complete and functional and fulfils all the required and expected tasks. It would seem implausible to adopt a standard (for such a big enterprise) that is incomplete. Because of the need to transfer and share information with others *Interoperability* would also be an important CSF.

Different standards applications:

- Technology Infrastructure
  This has two important elements; the vendor (*Product Availability*) and *Completeness*. The infrastructure is the backbone behind the IS within a hospital which implies that it can be controlled by a vendor, yet at the same time it must provide the capabilities required to complete the appropriate functions.

- Clinical Information
  This CSF also has two important elements (that are somewhat entwined with each other). *Interoperability* is important because the nature of clinical information implies that it needs to work across different platforms and organisations. Secondly, the *Completeness* CSF is relevant, for it is assumed no one would be prepared to adopt a standard that is incomplete.

- Information Exchange Protocols
  The *Completeness* of the standard will be the most important CSF to ensure that the standard provides the appropriate functions and capabilities.

- Information Systems Management
  Would be governed either via the vendor (ie *Product Availability*) or by the *Interoperability* that the standard possesses in the presumption that it manages a vast number of different components that need to connect and communicate.

The next step was to think as an IS manager for an IPA. These ideas are provided below:

IPA

- *Interoperability* will be the most important CSF because of the physical division apparent within some IPAs. The *Completeness* of the standard would be the next most appropriate because a standard would need to ensure appropriate testing and functionality. In this sense *Level of Consensus* may also be significant to ensure the standard is appropriate

Different Standard applications:

- Technology Infrastructure

  Interoperability will again be the most important CSF within IPAs so to ensure the organisation can effectively communicate with other applications and organisations. The *Level of Consensus* of the standard will also be important to ensure that the standard is proven and efficient.

- Clinical Information

  When coding data it would seem appropriate that *Completeness* would be the most important CSF so to ensure that all the data is included and that it covers all of the required information. In this sense the *Maturity and Stability* CSF would also be relevant so to ensure that the standard does not need to be replaced or modified often.

- Information Exchange protocols

  Because of the physical division of IPAs *Interoperability* would be the most important factor to ensure that the many different components of the IS can connect and communicate.

- Information Systems Management

  The vendor (*Product Availability*) will be the most important CSF because of vendors introducing their own controlling mechanisms.

3.5.7 Final Hypotheses Development

The final step is to compare the different hypotheses for the hospital and the IPA to create the final hypotheses. These are provided below:

Hypothesis One – Overall Standards Adoption

- *Completeness* will be the most important CSF factor with regard to the overall standards adoption process for hospitals, whereas IPAs will focus on *Interoperability*.

Different standards applications:

Hypothesis Two – Technology Infrastructure

- *Completeness* and *Product Availability* will be the most important factors with regard to the overall standards adoption process for hospitals, whereas IPAs will focus on *Interoperability* and the *Level of Consensus.*

Hypothesis Three - Clinical Information

- *Interoperability* will be a primary CSF for hospitals to ensure that they can communicate with other hospitals. The *Completeness* CSF is the most important CSF for IPAs and it will also hold some importance for hospitals.

Hypothesis Four - Information Exchange Protocols

- The *Completeness* of the standard will hold relevance for hospitals, whereas IPAs will focus on *Interoperability*.

Hypothesis Five - Information Systems Management

- Both hospitals and IPAs will consider *Product Availability* to be the most important CSF.

3.5.8 Summary of Development of Research Models

Within ISR a number of problems exist, these include insufficient testing over time, and inadequate methodologies. When completing a research project ethical considerations are very significant. This includes acknowledging the participant's well being and providing guidelines to which the participant can choose to adhere to. Two separate Ethics committees were contacted (and their approval gained) with regard to this research project, so to assure the participants that a high standard of research was being achieved.

Economic considerations are also significant with regard to this research project, as time and cost have a great bearing on the scope of the research.

The research questions relied heavily on the creation of two theoretical models. The first model was the Standards Adoption Framework (SAF) and the Critical Success Factors (CSFs) within. This model had six different categories including: *Level of Consensus*, *Product Availability*, *Completeness*, *Maturity/Stability*, *Problems and Limitations* and *Interoperability*. The individual questions within each category were found from various literature pieces. The second model was the Standard Categorisation Scheme that was utilised to scope which standards would be surveyed. This model showed that the operation phase of the lifecycle, and the four different categories: Clinical Information, Information Systems Exchange, Information Systems Management and Technology Infrastructure would all be researched.

The next important issue (with regard to scope) was to understand the influences of the IS manager and their relevance with regard to hypotheses creation. The IS manager has a number of considerations when selecting or even utilising standards, the importance of the Supplier and Vendors, Organisational issues, HFA, MoH and the End Users were also found to be important.

The final section discussed the creation of the hypotheses. This was a three step process that involved thinking as an IS manager for a hospital, than for an IPA, and comparing the results.

The impact of the size of the organisation, the physical distance, and the number of patients that go through the organisation was also briefly discussed. This focussed on the influences of the IS manager, and some of the elements that an IS manager has to go through when adopting standards. Nolan's Stages of Growth Theory was also relevant to this discussion.

Chapter 4 Research Design

Thou shalt not sit with statisticians. Nor commit a social science.
(Reid and Boore, 1987)

This chapter introduces the instrument utilised and methods and tools that were used in its creation. A number of important stages of development were recognised during this phase, as were a number of rules and guidelines that were adhered to.

4.1 Research Methodology

Research can be carried out in a wide range of settings utilising a wide variety of strategies (Galliers in Nissen et al (Eds), 1991). These strategies all have their comparative strengths and weaknesses.

Baskerville (1991, in Nissen et al (1991) writes that when a researcher is trying to decide which strategy is most appropriate, three different options exist. The first approach is to assess research methodologies independently, without reference to the subject area in question. The second approach involves using a number of different research strategies to compensate for the limitations of each. Whereas the third approach is to select a strategy based on the purpose of the research and the nature of the research area.

It was the third research approach that was utilised predominantly within this research project, although the second method was also utilised via personal communications to some extent. It was decided at a relatively early stage that the use of mail out surveys would be employed. The strengths and weaknesses of the survey approach will be discussed in this section to expose the rationale behind the decision to implement surveys.

When completing sample surveys investigators elicit the opinions, attitudes, or beliefs of a certain group (for example managers) regarding some issue of interest. The data is collected through interviews and/or questionnaires. Respondents are contacted in their offices or homes through mail (Nissen et al, *ibid.*).

Surveys conducted for research purposes have three distinct characteristics. Firstly, the purpose of the survey is to produce quantitative descriptions of some aspects of the studied population. Survey analysis can be primarily concerned either with relationships between variables, or with projecting findings descriptively to a predefined population. Survey research is a quantitative method, requiring standardised information from and/or about the subjects being studied. The subjects studied might be individuals, groups, organisations, or communities; they might also be projects, applications, or systems (Pinsonneault and Kraemer, 1993).

Secondly, Pinsonneault and Kraemer (*ibid.*) continue that the main way of collecting information is by asking people structured and predefined questions. Their answers, which might refer to themselves or to some other unit of analysis, constitute the data to be analysed.

Thirdly, the information is generally collected about a fraction of the study population, a sample, but it is collected in such a way as to be able to generalise the findings to the population.

Newsted et al (1998) writes that overall the survey approach can be seen to have the following strengths and weaknesses (a commentary will be given after each, where appropriate):

Strengths

- Surveys are easy to administer.

  Surveys are not all that easy to administer, yet in comparison with many other techniques, they can be considered less detailed. There is no need to set up laboratory experiments, neither is it necessary to be present at the location such as with case studies, this point is especially relevant when the sample is geographically dispersed and/or large.

- Surveys are simple to score and code.

  Depending on statistical knowledge surveys, are not by default simple to score and code. It is however, a lot easier to quantify results and data that are gathered via questions, and therefore use it with set statistics, than when collecting qualitative data. However the importance of qualitative data is by no means ignored or neglected within this survey as questions of this nature are also utilised.

- Surveys determine the values and relations of variables and constructs.

  It is indeed the variables and relations that are relevant within this research project.

- Responses can be generalised to other members of the population studied, and often to other similar populations.

  Sample size and generalisation of the sample are very relevant to many research projects. A discussion on both of these elements is found in a following section.

- Surveys can be reused easily, and provide an objective way of comparing responses over different groups, times, and places.

  Utilising mail out surveys has made it possible to send the same survey to three different sample groups all spread throughout New Zealand. It would have been unrealistic to go and visit personally each and every member within the sample.

- Surveys can be used to predict behaviour.

- Specific theoretical propositions can be tested in an objective fashion.

  This is particularly relevant to this research project. As previously stated the theoretical models were set in place at a very early stage. It was important to understand what was being tested, and the relevance of the model.

- Surveys can help confirm and quantify the findings of qualitative research.

  Qualitative data is a very important part of this research, for that very reason, employing the use of surveys was beneficial.

Weaknesses

- Surveys are just a snapshot of behaviour at one place and time.
  This is indeed a fault of a large number of research attempts within information systems (Boland and Hirscheim, 1987). Due to time and cost considerations it is also a limitation within this research. It has indeed been noted as so in Chapter One.

- One must be careful about assuming that surveys are valid in different contexts. In particular different cultures may produce different results.
  This again refers to generalising the results. It has been important throughout this research that the sample is restrained and appropriate, this will also be the case for any generalisations that are made

- Surveys do not provide as rich or "thick" description of a situation as a case study.
  A valid comment, although it is more than inappropriate and not feasible to run a case study on every public hospital, IPA and private hospital within New Zealand.

- They do not provide as strong evidence for causality between surveyed constructs as a well designed experiment.
  Within this research project it is not appropriate to control all the variables, thereby negating this weakness.

A fault that Newsted et al (*ibid.*) does not mention but is found with Polgar and Thomas (1995) is also relevant.

- Surveys have high rejection or refusal rates, and allow for little control over how the response forms are filled out.
  This point is very relevant for ISR. Indeed it is not uncommon to experience return rates of less than 20 percent, accordingly it is important to increase the return rate. Means to do this are discussed in a following section.

In conclusion it was decided that a survey approach was to be utilised. It was beneficial because it compensated for a geographically disperse sample. It allows for variable and relationship comparison, as well utilising powerful statistical tools. It was appropriate in the overall scheme of cost and time constraints, and it allowed for three different sample groups to complete the same survey.

4.1.1 Different Classifications of Survey

Survey research can be used for exploration, description, or explanation purposes. The purpose of survey research is to become more familiar with a topic and to try out preliminary concepts about it. An exploratory survey may also be used to discover and raise new possibilities and dimensions of the population of interest.

The purpose of description within survey research is to find out what situations, events, attitudes, or opinions are occurring in a population. Survey research aimed at description asks simply about the distribution of some phenomena in a population or among subgroups of a population. The researcher's concern is simply to describe a distribution or to make comparisons between distributions.

Survey research used for explanation involves testing theory and causal relations. It can also ask questions about the relationships between variables. It does so from theoretically grounded expectations about how and why the variables ought to be related. The theory includes an element of cause and effect in that it not only assumes that relations exist between the variables, but also assumes directionality. Explanatory questions may extend not only to establishing the existence of a causal relationship but also to asking why the relationship exists.

The central research question in explanatory survey research [relevant to this research] is: "Does the hypothesised causal relationship exist, and does it exist for the reasons posited?

4.1.2 Research Design

Being sure to use an appropriate research design is one positive strategy for testing the hypotheses that stimulated the research in the first place. Survey designs may be distinguished as cross-sectional or longitudinal, depending upon whether they exclude or include explicit attention to the time dimension. As already mentioned time was not an element included within this survey therefore making this survey cross-sectional.

Once a theoretical model has been put in place, the activity of the survey process can begin. Grover (1998, cited in Newsted et al, 1998) provides a detailed checklist that should be followed in the development and use of an instrument. The significant steps included within this research project are:

- Determination of the unit of analysis
- Creation and use of multi-item scales
- Pre-testing and the use of pilot data
- Assessment of both construct and content validity
- Assessment of reliability
- Random sampling from a defined sample frame
- Determination of an appropriate response rate and evaluation of non-response bias
- Assessment of whether significant correlation's imply real causal relations
- Determination of statistical power of the final analysis

It is this checklist that will form the content and section headings for this chapter. Two additional elements will also be discussed:

- Survey construction
- Survey management

This checklist was very important as Grover (1998) writes that poorly designed and executed survey research is of little or no value. Following a guideline will help ensure quality research.

4.1.3 Unit of Analysis

Grover (*ibid.*) also acknowledges the significance of the Unit of Analysis; "Regardless of the design that is used it is imperative that the unit of analysis be clearly defined at the outset. In other words, all questions in the instrument should be collecting information at a consistent unit of analysis, whether it be the individual, work group, project function, organisation or even industry."

It is important (Grover continues) to understand that if the unit at question is the organisation, and an inappropriate person responds (i.e. the person is not qualified to answer the question), that some bias may be introduced to the research project. This can generally be lessened by stating who the most appropriate person will be to complete the survey.

The unit of analysis for this research is the organisation. The Cover Letter and the Information Sheet (Appendix One and Four respectively) clearly state that the survey would best be completed by an information systems manager or someone who had an understanding of information systems and the standards employed.

4.1.4 Use of Multi-Item Scales

Multi items scales are used to ensure that a question is answered without any idiosyncrasies of interpretation or experience the particular words chose bring with them. By asking several different questions, using various words, it is likely that researchers can produce an index that captures the answer better than any single question could have (Fowler, 1995).

Although multi-item scales (for the same question) were considered within this survey, their usage was deemed to be inappropriate. The survey was already considered very long, with a wide range of questions (refer to content of questionnaire in a later section) and it would seem unnecessary to make the questionnaire any longer. Acknowledging that the respondent is often pressed for time was also considered, as increasing the length of the questionnaire would indeed mean that it would take a longer time to complete, and lead to people feeling less inclined to respond.

Whilst it was acknowledged that the survey will include some open questions, it was felt that it would be beneficial to include questions which have to be answered on a form of scale (or rating). There were two possible response formats within attitudinal questions. The traditional five or seven point Likert-type format, or the four point Forced Choice format. The Forced Choice format does allow respondents to give a definite 'for or against' answer, yet at the same time does not allow for an answer to be 'indifferent' or 'unsure'. The Likert type format was selected, as it is possible that there may be some questions that do have an answer within the middle range.

Rank-Order scales were also utilised within this research project. This form of scale generated ordinal level data, and forced the respondent to compare one item with another (or a group of items against each other). This was essential as it allowed for the individual CSFs within the SAF to be compared.

4.1.5 Pre-testing and Pilot Data

The importance of pre-testing the survey is obvious. The ASA (1998) include pre-testing in the 'Shortcuts to Avoid' section. They note that a pre-test of the questionnaire and field procedures is the only way of finding out if everything works. It is especially important if a survey employs new techniques or a new set of questions. It is rarely possible to foresee all the potential misunderstandings or biasing effects of different questions and procedures, therefore making it vital for a well-designed survey to include provision for a pre-test.

Allison, O'Sullivan, Owen, Rice, Rothwell and Sanders (1996) introduce the need for a pilot study, they define a pilot survey as a scaled down version of the full survey. It involves:

- Collecting a small portion of the data
- Stopping the survey
- Assessing how it has gone
- Modifying the full survey as required before undertaking it

The pilot study can help answer many questions. This includes information about the adequacy of the sample, deciding if the sample design is appropriate and practical. As well as understanding if the survey is being conducted in the most cost effective and efficient way.

Allison et al (*ibid.*) contends that the key points are that a pilot study should not take too long to do, but should cover sufficient subjects. A survey having a sample size of 100 subjects taking one day to complete, would probably only need five subjects or so, taking about 30 minutes to do. If the completed pilot survey shows that there are no major changes required to the full survey, then there should be no problems with using the data from the pilot survey in the full survey. If, however, there are changes to the survey that mean that the pilot data may be different to the full survey data in some way, then you should be careful about including the pilot data in your results.

Pre-testing was a significant factor within this research project. The survey went through numerous alterations as it went from researcher to supervisor as the first check. This ensured that content was correct, as was the information that it was trying to gather. Using the supervisor as the first check meant that it was possible to pick up many of the little errors that had escaped inspection, as well as a check to see that the survey questions relate directly to the theoretical models that had been put in place.

After a number of editions of the survey had been created and checked between researcher and supervisor, a formal pre-test was completed. This test was undertaken on a person not included within the sample but rather as someone with significant understanding of both fields. The test was completed on a registered Medical Practitioner who had just recently completed a Masterate degree in information systems. This combined three relevant factions, firstly knowledge of healthcare and their imposed systems, secondly an understanding of information systems and their capabilities and thirdly an experienced knowledge on the practice of research.

This proved to be invaluable as some of the finer details were discussed and checked. Some of the issues that arose included:

- A tendency to create two possible correct answers for example:
  1 to 2 years or 2 to 3 years
  thereby creating two possible correct answers if the answer was '2'.

- An opposite numbering system for the same questions that may result in confusion for the respondents, for example:
  1 is highest [and at a later section having] 6 is highest
  thereby confusing the respondents, which may create incorrect results.

- A 'Not Applicable' option had not been included for many of the questions. This meant that if a respondent could not answer the question for an appropriate reason, there was no way of noting this. It would in essence have become a non-response, which would have been incorrect.

- The pre-test provided an understanding of which standards were in place and which organisations are required by legislation to use these standards. This was useful as it meant that awareness was gained of some of the possible results (even though the data gathered was not used within the survey).

- A need to list all of the possible standards in one place was found, rather than as separate sections throughout the survey.

- The need to better define the CSFs within the SAF so that respondents were better aware of what they were ranking, and what the CSFs actually meant.

- A need to express the scale numbers before each questions, to remind respondents what the required answers are.

The comments from the pre-test initiated a great deal of modification of the survey. The numbering of the individual questions, as well as the groupings within the question were checked and modified. A consistent numbering scheme was employed throughout the survey so to ensure that answering the questions was as easy and as consistent as possible. A 'Not Applicable' option was added for many of the questions, as was

'Other – Please Specify' to give the opportunity for the respondents to answer further than what was provided. An Appendix was included that could be referred to when respondents were asked to select which standards were being utilised. This was included to refresh memory, or define any abbreviations that may have been used. Better definitions were provided so to make the CSFs clearer, as were consistent directions throughout the survey as to how it should be answered.

Although it is acknowledged that designing the perfect survey questionnaire is impossible (Colorado State University, 1998), conducting a thorough pre-test does bring a survey to a higher level of competency.

4.1.6 Construct and Content Validity

Constructs (or concepts) are abstractions within the domain that express similar characteristics (eg, intelligence, organisational success, manufacturing effectiveness). These constructs are not directly observable or measurable, they are considered latent (Grover, 1998).

Therefore a theory attempts to explain observed phenomena by systematically setting out interrelationships between constructs. However since these constructs may not allow for direct measurement, it is important to provide a definition of what is observable and assign a symbol or a variable to which numeric values can be assigned.

Content validity involves the assessment of the appropriateness of the items to the domain. The testing can be done through the theoretical basis for the items from within literature or by experts who are well versed with the domain. Following the development of the instrument, pre-testing with practitioners in the field is highly desirable.

As already discussed, content validity was completed and assured by utilising literature, pre-testing; and numerous initial checking mechanisms.

Construct validity lies at the heart of the scientific process and addresses the question of what the instrument is actually measuring; that is determining how well it measures the construct that it is intended to measure (Colorado State University, 1998). Two components of construct validity, convergent and discriminant validity can be assessed. These collectively refer to whether the measure is similar within itself and yet sufficiently different from other measures.

4.1.7 Reliability

For a survey to be considered reliable the questions must be answered by respondents the same way each time (Colorado State University, 1998).

Internal consistency (reliability) is done to test whether items "hang together". Those questions that do not can be omitted from the survey. One form of testing reliability is Test-retest. This form provides evidence of the consistency of the instrument over time, and involves re-administration of the instrument and some correlation of the instrument over time. Although this is acknowledged, it is out of the scope of this research project to re-administer the surveys and complete the entire process again.

4.1.8 Sample Identification

The ASA (1998) write that a critical element in any survey is to locate (or 'cover') all the members of the population being studied so that they have a chance to be sampled. To achieve this a sampling frame is constructed. A sampling frame can consist of names, roles, or even geographic areas with well-defined natural or artificial boundaries.

New Zealand healthcare was the decided sample frame for this research project. Time and cost considerations make it not feasible to study out of New Zealand, whereas the relatively small size of New Zealand made it possible to study any location within.

When selecting the sample of people/organisations to receive surveys, it became prominent at an early stage that there were at least two main categories. The first of these were Independent Practitioner Associations (IPAs), the second were public hospitals. The last possible category consisted of private hospitals.

Each of these organisations were considered important because of the role that they play within New Zealand healthcare. Each IPA consists of a group of doctors and is a form of governing body for each. Public hospitals are relevant because they are the major organisations significant to New Zealand healthcare; they are often bigger in size, bigger in nature and therefore have more application for information systems and the different standards that exist. Finally Private hospitals were considered important because of the significant role that they play within New Zealand healthcare.

4.1.9 Sample Selection

Allison et al (1996) write that a sample is a sub-group of a population selected according to particular criteria and taken to represent the whole group. The size of the sample depends upon the size of the population ensuring that all the variables considered to be important are taken into account. The ASA (1998) continues this point by noting that the sample size required for a survey partly depends on the statistical quality needed. There is no simple rule for sample size that can be used for all surveys. Much depends on the professional and financial resources available.

Two different types of sample were acknowledged. Firstly a random sample, which is a group chosen randomly from the population in such a way that each item has an equal or calculable chance of inclusion in the sample, or in other words, with no concern other than frequency. The second type of sample suggested is an intact group, which is a specific group chosen for convenience (Allison et al, 1996).

The intact group was utilised within this research project.

Hospitals

On searching in the yellow pages on the Telecom web site an initial search for just 'hospitals' concluded with approximately 600 results. This amount decreased a small amount by the omission of 'Veterinary Hospitals'. This list had the advantage of being complete and already being grouped by region. However because of the high number of hospitals it includes ones in the smallest districts that will more likely have no form of Information System. This list was negated because it was impractical and beyond our resources to send a survey to every 'hospital'.

A second search was completed through the telecom web page moving from the major category 'Health' to a minor category 'Hospitals' provided within their own menu search system. This query found a response of only 118 hospitals. However as this list was being compiled it was found to consist of a large number of Rest Homes, and did not include any of the major hospitals. This list made it important to define hospitals and NZ healthcare. Accordingly hospitals were defined (more specifically) as being public or private and discounted Rest Homes.

Once the definition was finalised it was possible to search and contact the relevant organisations almost directly. Public hospitals had their own web site (www.hospitals.co.nz) which included contact details for each.

Private Hospitals

Private hospitals were located through the New Zealand Hospitals Association, and official communication with the executive director. This communication provided a complete mailing list, as well as some press within their SmartNews bulletin.

IPAs

Obtaining the sample for the IPA was straightforward because of the acquisition of a complete mailing list.

Mailing List

In an attempt to increase the response rate a message was also placed on a New Zealand Health Information Systems discussion group. Posting this proved to be beneficial as responses were received from an IT Service Provider, a Healthcare Service Provider, and a Hardware/Software Supplier. Although not technically within the sample frame, these responses may prove to make interesting comparisons.

4.1.10 Response rate and evaluation of non-response bias

When completing survey research the ASA (1998) write that, decisions are needed on how to handle missing items – cases in which the respondents did not know the answer … or refused to provide one.

Failure to follow up non-respondents can ruin an otherwise well designed survey. It is not uncommon for the initial response rate in many surveys to be under 50 percent (ASA, 1998).

When utilising mail surveys one method of increasing the response rate is to conduct several follow up mailings – spaced ideally, about three weeks apart. The follow up method was utilised within this research project. After the allotted time had elapsed a new cover letter, new information sheet and new survey were sent out (refer to Appendices).

Another method that was utilised to try and increase response rate was to obtain telephone contact with the IS Managers for the public hospitals. This was utilised specifically with the public hospitals sample for many reasons. Firstly, this had the smallest sample size, only 23 within New Zealand. Secondly, these managers were considered to be the busiest of the sample group. Thirdly the potential for this research may have the most impact on this group. Consequently it was felt that they would be most willing to listen to the concepts of the survey. The fourth reason was because of the size of a hospital, a survey would easily get lost if it were for an unnamed person, or role only, therefore having direct telephone contact meant that it was possible to direct the survey to the appropriate person within the hospital.

A final incentive provided to respondents to encourage them to complete the survey involved offering a summary of the results at the conclusion of the research project. This was used to offer something of importance and use back to those who responded.

4.1.11 Correlation Assessment

The correlation describes the strength of an association between variables. An association between variables means that the values of one variable can be predicted to some extent by the value of other (IFA, 1999).

Correlation testing was considered as being appropriate within this research project.

4.1.12 Statistical Analysis

A final issue within research design is data analysis. When exploration or description is the aim of the survey research, analysis frequently involves no more than developing the marginal and cross-tabulations for the variable and using simple descriptive statistics such as means and medians. When explanation is the aim, analysis must employ the full logic of survey and analysis.

The ASA (1998) write that once there is a 'clean' file the survey data is ready to undergo summarisation to gather what has been learned. Often the best way to start the analysis is with simple counts and related percentages for each question. Next, it is common to produce tables of growing complexity.

The statistics that will be used within this research project include Analysis of Variance (Anova) tests.

4.2 Design of Data Collection Instrument

This section discusses some of the important elements that were acknowledged during the design of the survey. This includes the types of questions and the order that they were placed in.

4.2.1 Survey Design

When creating a questionnaire it is important that the importance of the research is expressed. Polgar and Thomas (1995) write that we must convince the critical reader that our aims or the hypotheses that we are attempting to resolve are in fact of central importance. Asking the right research questions depends on being creative; for instance identifying previously ignored patterns in the data; or the construction of novel theories that predict new as yet unobserved behaviour.

It is important to justify why the research is important because many businesses appear to be inundated with both mail and telephone surveys, and unfortunately, salespeople masquerade as survey researchers. The result is that businesses have built up considerable resistance to answering mail and telephone surveys and response rates are likely to be unacceptably low unless special measures are taken. Attewell and Rule (1991) explain, that a person's motivation to endure lots of questions depends, for many of us, on a rapport that is developed with a questionnaire and a sense that one's answers are important to that person.

The ASA (1998) note that planning the questionnaire is one of the most critical stages in the survey development process. The ASA *(ibid.)* continue that questionnaire constructions have elements that often appear just plain common sense, but when the questions are actually implemented they may need to involve some subtlety. It is common sense to require that concepts be clearly defined and questions unambiguously phrased; otherwise the resulting data are apt to be seriously misleading.

Accordingly, whilst completing the survey many important points had to be taken into consideration. Polgar and Thomas (1995) acknowledges a useful questionnaire format and state that questionnaires can be structured in different ways, but typically the following components are included (with a commentary following):

- Introductory statement: Describes the purpose of the questionnaire, the information sought and how it is to be used. It also introduces the researchers and explains whether the information is confidential and/or anonymous.
  This was utilised in the survey as well as being provided on the Information Sheet.

- Demographic questions: It is usual to collect information about the respondents, age, sex, education, history and so on. It is best to position these questions first as they are easily answered and serve as a warm up to what follows.

- However within this questionnaire the information will be gathered on both the role of the participant, and of the organisation as a whole, rather than the individual. Demographic questions were relevant in this research project because of a theory that was being utilised.

- Factual Questions: It is generally easier for respondents to answer direct factual questions than to answer opinion questions.
  These questions included the installed base of computers and inquiring about the standards that are already being utilised.

- Opinion questions: Questions that require reflection on the part of the respondent are usually positioned after the demographic and factual questions. This section will include questions from the SAF and the overall impression of standards within healthcare.

- Closing Statements and return instructions. The closing statements in a questionnaire usually thank the respondent for their participation, invite the respondents to take up any issues they feel have not been satisfactorily addressed in the questionnaire and provide information on how to return the questionnaire.
  This was included within this survey as was the opportunity to get a summarised copy of the results at the conclusion.

Following a discussion of the overall design of the survey it is also important to clarify some of the individual questions that were used.

4.2.2 Question Design

The individual CSFs that were gathered from within literature were initially asked as broad questions. When completing the individual question design it was essential to re-word the questions into a format which would allow for a choice of answers and the ability to rank and or grade. For example, for the *Level of Consensus* CSF, the question was reworded to read:

When you are evaluating a standard or product, how important are the following factors to your choice?

Installed base	1	2	3	4	5
Level of acceptance	1	2	3	4	5
Demonstrated effectiveness	1	2	3	4	5
The current status	1	2	3	4	5

This allowed for minimal bias to be placed in the wording of the question, and meant the question was simple and clear.

4.2.3 Survey Management

The ASA (1998) write that no matter what type of data collection is used, there are a number of back-end processes that may be needed to get the data in a form so that aggregate totals, averages or statistics can be computed. For mail surveys (as for this research project) coded paper questionnaires are entered into the computer so that a computer file can be created.

Once a computer file has been generated, additional computing editing, separate from clerical editing can be accomplished to alter inconsistent or impossible entries.

The ASA (1998) note that there are several professional organisations that prescribe rules for keeping survey responses confidential. These rules were utilised within this research project. The rules plus a commentary are provided below:

- Using only number codes to link the respondent to a questionnaire and storing the name-to-code linkage information from the questionnaires.
  This practice was strictly adhered to. The names and addresses of respondents were assigned number codes so to ensure confidentiality of the respondents. The number-code sheet was kept separate from the survey responses.

- Refusing to give the names and addresses of survey respondents to anyone outside the survey organisation including clients.
  This rule was never tested, but the confidentiality of the respondents would have been (and was) kept at all times.

- Destroying questionnaires and identifying information about respondents after the respondents have been entered into the computer.
  Rather than destroy the surveys they were kept away from all other sources. This was considered important, to allow for double-checking and verification.

- Omitting the names and addresses of survey respondents from computer files used for analysis.

  It was not necessary for the names and addresses of the organisation to be entered into the computer, so this issue was not questioned.

- Presenting statistical tabulations by broad enough categories so that the individual respondents cannot be singled out by name.

  This was a significant part of the survey as there were at least two main categories of respondents. Once they were placed within the appropriate organisation (that is IPA or hospital) it would be impossible to decipher whose the individual results were. The results were only acknowledged in aggregate form.

4.3 Summary of Research Methodology

The research method that was utilised was that of mail-out surveys. Mail-out surveys were considered appropriate because of the geographic spread of the sample, the low cost, and the sample size. The disadvantages of using surveys include the potential for a low response rate, little control over how people answer questions and a lack of 'richness' of data in comparison with case studies.

A research design was utilised that stressed the importance of elements including, unit of analysis, pre-testing, sample identification and sample selection. Each of these (summarised) were:

- Unit of Analysis

  The organisation that the respondent works for, that is, the hospital, the IPA or the supplier or vendor.

- Pre-Testing

  Pre-testing (a pilot study) was completed to ensure that the survey had content and construct validity as well as appropriate formatting, question structure and instructions.

- Sample Identification

  This involved ascertaining what the individual elements of 'New Zealand healthcare' were. Public hospitals, private hospitals and IPAs were decided upon because of their definite roles and increased chance of utilising computers.

- Sample Selection

  The samples that were surveyed were found via complete mailing lists of the three different organisations. Support for the survey was gained from the Executive Director of the private hospitals association, which was considered very beneficial.

4.4 Summary of Data Collection Instrument

To ensure that the survey was administered at a competent level a number of details had to be ensured. The first and most important of these was privacy and confidentiality for the respondent. This meant that the names of the respondents had to be kept confidential, the data that they provided had to be kept in a form that made it impossible to recognise individual data, and that the participants were aware of their rights throughout the entire survey process.

Strict survey management rules and the use of appropriate coding, filing, and data entry guidelines managed the privacy and confidentiality aspect of this survey, an Information Sheet with the rights of the participants clearly laid out, kept the participants well-informed and aware of the entire survey process.

Chapter 5 Healthcare Survey Data Analysis

Research should not be an elevated and highly technical business conducted by academics in isolation from the real world.
(Reid and Boore, 1987)

This chapter will summarise the results gathered from 'The Use of Standards for Information Systems within New Zealand Healthcare' survey. The results will be discussed in order of the survey, and presented by public hospital, by IPA and then by other organisations as appropriate. The statistical comparisons between the sections will be included throughout. The order will be:

- Response rates
- Demographics of the respondent and staff at the organisation
- Organisational use of computers
- People involved in the standards selection process and for what reasons the standards are adopted
- Critical success factors acknowledged when adopting standards
- Important factors within the different CSFs
- Different applications of standards and how the CSFs ranked
- Open ended questions about standards for information systems within NZ healthcare

5.1 Response Rates

Within the sample there were three different sample groups; IPAs, public hospitals and private hospitals. 98 surveys were sent out in total, as well as a message being placed on a discussion board asking for any additional people who would be willing to participate in the survey to do so (this message is shown in Appendix Three). This lead to a total of 38 surveys being returned.

The break down of the survey responses is shown in Table 8. The surveys that were returned but not utilised within the survey were responses declining to partake in the survey because of lack of time, lack of understanding, or other reasons such as closure of the organisation.

Organisation	Total Surveys Sent	Total Surveys Received	Total Surveys Useable	Total Percent Received	Usable Percent
IPAs	46	21	15	45.65	32.60
Public hospitals	23	6	6	26.08	26.08
Private hospitals	29	8	6	27.58	20.68
Other		3	3		100
TOTALS	98	38	30	38.78	30.61

Table 8 – Total Response Rates

Whenever possible organisations that did respond but did not employ the use of computers were also acknowledged in the survey, even if many of the questions remained unanswered. It was decided when completing the statistical analysis to not use the private hospital results. This is because although six responses returned, four of these responses were not answering the majority of the questions because of their minimal uses of computers. It was consequently decided that doing statistical analysis on one (and part of two) responses would not be of any benefit. These results will however be used in a qualitative discussion and within certain sections.

IPAs had the highest response rate at 45.65% being returned. Although private hospitals did have a slightly higher return rate than public hospitals (26.08% compared to 27.58% respectively) more of these were not useable within the survey (26.08% useable for public hospitals and 20.68% for private hospitals). A useable response rate of 30.61% is more than adequate to gather information from, although it would be difficult to generalise against the entire population.

When considering the IPA results it is important to acknowledge that the respondent was asked to respond in terms of 'their organisation'. It may (in some circumstances) be difficult to ascertain which part of the IPA the results are for, that is if they are responding in terms of the 'head office' or as one of the affiliated doctors. It is however possible to assume that all the affiliated organisations will have the same use of technology and standard applications, which is of primary concern to this research project.

5.2 Demographics

The first section of the survey gathered information about the demographics of the organisation. Questions were asked about the respondent's role within the organisation as well as gathering some general information about the organisation.

5.2.1 Public Hospitals

Of the people who responded to the survey, 83% were in the role of IS Manager (in one circumstance General IS Manager), the role left was that of a Business Analyst which often encompasses many of the tasks associated with the IS Manager.

100% of the respondents had been in their organisation for less than five years, with 50% of them being there from two to five years.

50% of the organisations had three to five technical staff, and 33% had six to ten. 16% had more than ten staff. This result did not include any help desk operators.

5.2.2 IPAs

The respondents who completed the survey held a variety of positions. 78% of the respondents held some form of management position (albeit Projects, Practice or IS). The Chairman of the organisation answered 7% of the surveys. Medical Practitioners answered 14%.

42% of the respondents have worked in their current organisation between two to five years. 25% have worked there less than one year, or for more than five years.

41% of the organisations did not employ any IT or IS staff on a full-time basis and 41% employed one or two people (discounting any help desk operators).

5.2.3 Private Hospitals

The respondents who answered the survey were also from a variety of positions. 50% were overall Managers or Directors of the organisation. 33% were completed by the Head Nurse and 17% from Administration staff.

40% of the respondents have worked in their current organisation for two to five years and 40% have worked in the organisation for more than five years.

100% of the organisations employ two or less IT or IS staff. 60% of the organisations do not employ any full time staff (discounting any help desk operators).

5.2.4 Analysis of Demographics

The survey was more than likely completed by the IS Manager (as suggested within the Cover Letter and the Information Sheet). In the circumstance where an IS Manager did not exist, as was the case within many IPAs the head of the organisation was most often the person who completed the survey (that is the Chairman, Practice Manager or the like).

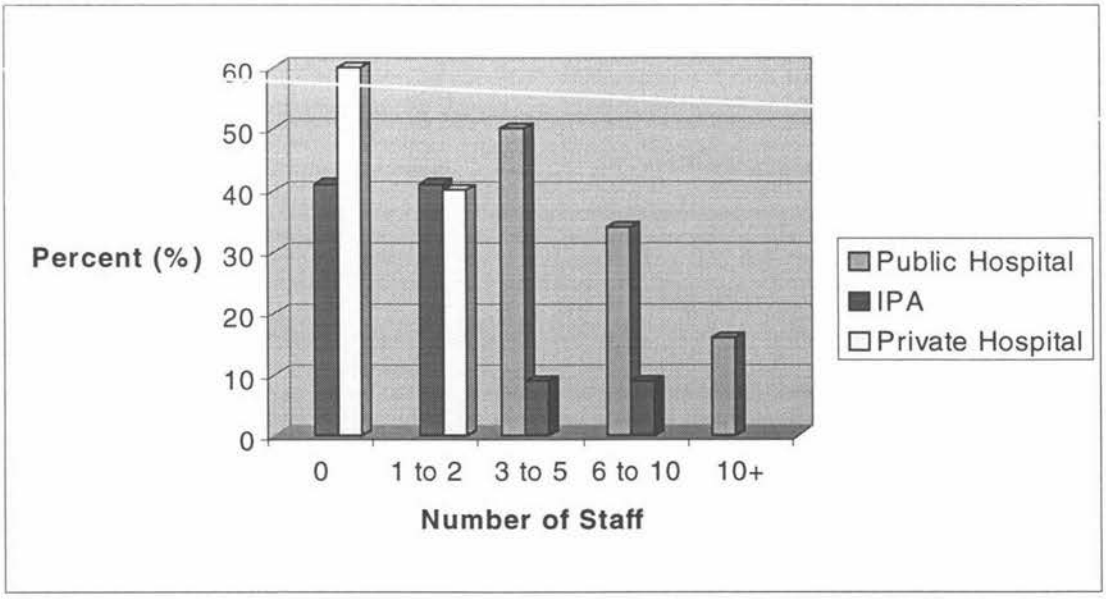

Figure 7 – Comparison of Number of Staff Employed

The amount of time that people had worked in their current organisation was variable.

There was an interesting difference between the amount of IS/IT staff employed by the three organisations. Figure 7 highlights the differences.

Figure 7 shows that public hospitals employ a greater number of staff than the other organisations. Private hospitals were more likely to employ zero to two staff, and IPAs had a range from zero to ten staff.

5.3 Organisational Use of Computers

This section presents the statistics about the use of computers and their application within the organisations.

5.3.1 Public Hospitals

100% of the respondent's organisations are computerised. The tasks that these organisations use the computers for are wide ranging. The tasks that they all utilise (100% usage) include:

- Appointments
- Laboratory Results
- Desktop Publishing
- E-mail
- Database
- Financial Management
- Spreadsheets and Report generation
- Word Processing

Some of the additional computerised tasks include prescriptions (66%), Letter writing/referrals (66%), and presentation software (83%).

100% of the organisations use a LAN and WAN network, with 83% utilising the Internet.

There were many tasks that required communications with an external location. These tasks included Laboratory Results (83%), Financial Management (66%) and linked Appointments (50%).

50% of the organisations employed the use of at least one mainframe computer. 100% had more than 2 mid-range/network servers and 100% of the organisations had more than 21 PC/Work Station/Terminals.

5.3.2 IPAs

86% of the organisations are computerised. The 14% that are not do not intend to computerise their organisation within the next 12 months.

There are a number of tasks that the computers are used for. The most common include:

- Spreadsheets (91%)
- Age Sex Register (91%)
- E-mail (83%)
- Word Processing(83%)

Some of the additional tasks include Presentation software (75%), Disease Register, Database and Financial Management (all at 60%).

83% of the organisations use e-mail and the Internet, with 75% utilising a LAN. 25% of the organisations have a dedicated WAN.

The tasks that require communication with an external location include the Age Sex Register and Laboratory Results (both at 50%). Other tasks include Financial Management and Letter Writing/Referrals (both at 33%).

16% of the organisations utilised at least one mainframe machine. 25% had only one mid-range network server, 33% had two to five and 16% had twenty-one or more. Of the organisations that utilise PC/Workstation/Terminals 10% had two to five machines. 45% had six to twenty and 45% had more than twenty-one machines.

5.3.3 Private Hospitals

83% of the respondent's organisations are computerised. The organisation that is not did not say whether they were going to computerise within the next 12 months. The tasks that computers are commonly used for include:

- Word Processing (100%)
- Financial Management (100%)
- Spreadsheets (80%)

Other computerised tasks include Databases, the Age-Sex Register, Letter Writing Referrals, E-mail, and Report Generation (all at 60%).

60% of these organisations are utilising the Internet. The same 60% also use e-mail. 20% use a LAN.

Very few tasks are linked with an external location. The ones that are include Laboratory results (60%), Appointments (40%) and Prescriptions (40%).

None of the organisations use a mainframe machine, or any Mid-range/Network servers. 20% have only one PC/Work Station/Terminals. 40% have two to five machines and 40% have six to twenty.

5.3.4 Analysis of the Organisational Use of Computers

When computers are utilised by organisations they fulfil a number of tasks. The tasks that are common across the three sample groups (and that were well utilised) include:

- Spreadsheets
- Word Processing
- E-mail
- Financial Management

There is a considerable difference between the three organisations with regard to the types of networks utilised. Figure 8 highlights these differences.

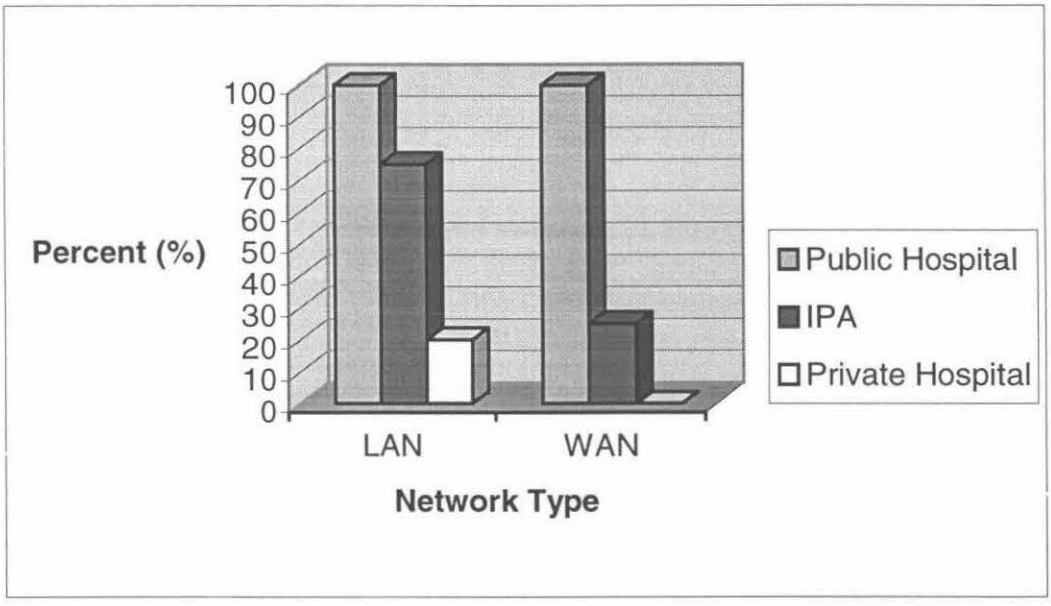

Figure 8 – Network Usage

This graph shows that Local Area Networks are more prominent than Wide Area Networks for IPAs. Private hospitals do not utilise WANs at all, whereas LANs are used occasionally. Public hospitals have full use of both forms of network.

Another important comparison that can be made is by the number of computers that are utilised. Figure 9 shows the difference between the organisations with the number of PC/Work Station/Terminals that are used. Public hospitals all utilise more than twenty-one machines, whereas private hospitals (in comparison) use predominantly two to five.

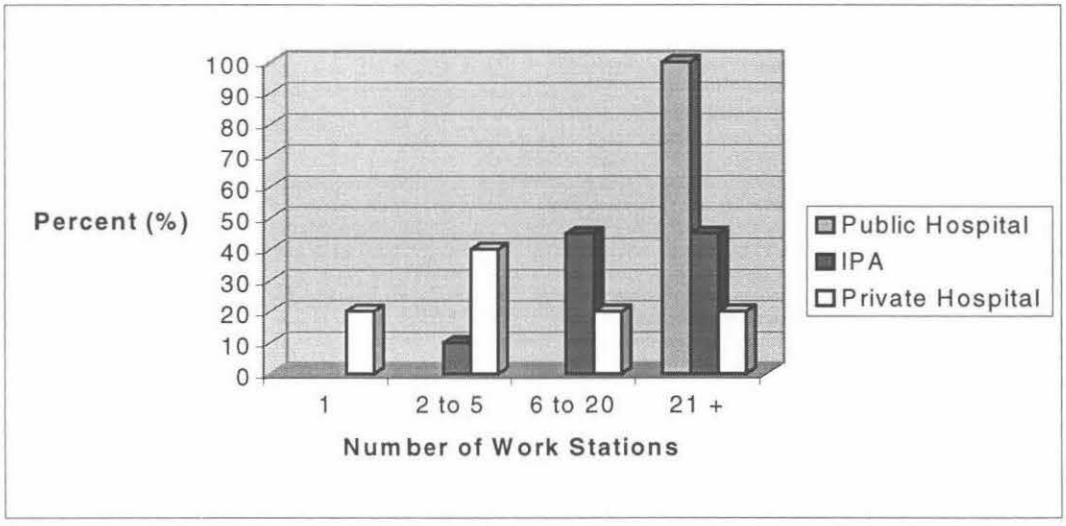

Figure 9 – Number of Work Stations Used

These results are consistent with the overall difference in size between public and private hospitals. A comparative example of the difference between organisations can be done with the number of beds.

A report presented by the NZHIS (1998b) shows that public hospitals are more than likely to have at least twice the number of beds, than a private hospital. Therefore justifying the increased use of work stations.

5.4 The Standards Selection Process

This section examines those involved with the standards selection process and gathers some of the details about the most recent standards that have been adopted.

5.4.1 Public Hospitals

The person who was most prominent when implementing standards (when done within the organisation) was the General/Manager of Information Systems (80%). The predominant person involved in ensuring that the standard is appropriate and maintained is also in the role of General/Manager of Information Systems (75%).

40% of the organisations had implemented HL7 as their most recent IS standard. Other recently implemented standards include: TCP/IP, IEEE Y2k compliance and ICD9-CMA.

The time frame for which these standards have been in place is wide ranging. 40% had been utilising this standard for less than six months, 20% for six months to one year, 20% for one to two years and 20% for more than two years.

The time that these standards took to be implemented was mostly less than six months (60%), 20% took six months to one year and 20% took one to two years to implement their most recent standard. Of these standards 80% of the respondents said that they were adopted by their own choice, those that were not were done because of contractual requirements.

The method for disseminating information about a new standard within the organisation was wide ranging. Methods used include meetings, memo, word of mouth and e-mail.

With regard to the overall adoption of standards, all of the organisations felt that they were able to adopt standards by their own choice.

The manner by which standards information is sought is vast. The list of places that this information is gathered from include IT Industry publications, the Internet, Vendors, NZHIS, the Ministry of Health and networking with other healthcare organisations.

5.4.2 IPAs

When standards are adopted by IPAs 50% of the organisations choose them using a collaborative approach, that is more than one person is involved in the process. These people usually include the Chairman of the IPA, the manager and a person with relevance or understanding of computers. The person that is actually involved in ensuring that the standards are used appropriately is wide ranging, 33% use a collaborative approach, and others such as Quality Facilitator (11%) and IT/IS Co-ordinators (22%) are also involved.

The most recent standards that have been implemented include HL7 (22%), Read Codes (22%), TCP/IP (11%) and Windows 95 (11%).

These standards have been in place for a range of time periods. 38% had been implemented for less than six months. 12.5% had been in use for six months to one year, 12.5% for one to two years and 38% of these standards had been in place for more than two years.

75% of the respondents found that the most recent standard took less than six months to be implemented. 25% of the organisations took one to two years to implement their most recent standard.

60% of the organisations implemented these standards by their own choice, whereas 30% of the standards were implemented as part of contractual requirements.

Standards' information is dispersed through the organisation predominantly via meetings. Memos, e-mail and word of mouth are other methods utilised.

80% of the organisations generally adopt standards by their own choice.

Information about IS Standards is not found by any common means. Information is sought from a variety of places, including the NZHIS, suppliers and vendors, the Internet, and by attending demonstrations and conferences.

It was not possible to gather any valid data from the Private Hospitals for this section.

5.4.3 Analysis of the Standards Selection Process

There was a diverse spread of people involved in the standards selection process. Public hospitals utilised the IS Manager for this task, IPAs used a collaborative approach and private hospitals use a collaborative approach or got someone in charge of the organisation to implement standards. The people that ensure these standards are appropriate and correct are more than likely the same as the people that implemented the standards originally.

The most recent standards that had been adopted were wide ranging. The greatest likeness was for IPAs and public hospitals who both had organisations implement HL7 and TCP/IP as their most recent standard. A private hospital had implemented ICD9-CMA, which was also implemented as the most recent standard within a public hospital.

Two important comparisons are made within this section. Firstly the timeframe that the most recent standards have been in place for, and secondly the length of time that was taken to implement the most recently adopted standards.

There is an interesting difference between the time frames that the standards have been in place (shown in Figure 10).

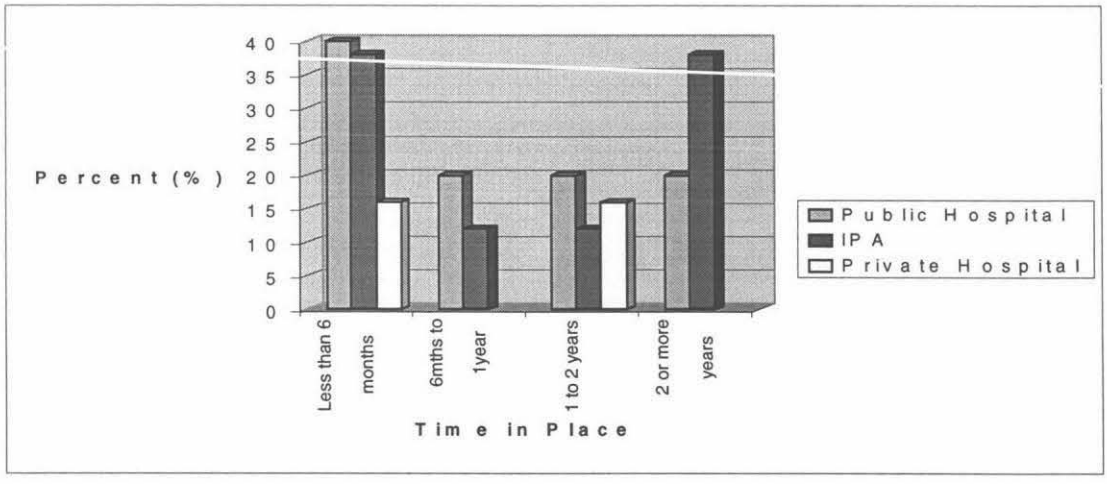

Figure 10 – Time standard has been in place

Figure 10 shows that although most of the standards have been in place for less than six months for IPAs (38%), and public hospitals (40%); 38% of the IPAs have also not implemented a new standard for two years.

Public hospitals however have a lower percent at two or more years (20% compared to IPAs 38%). Private hospitals have had their most recent standard for less than six months, or for one to two years (16% each).

Another relevant comparison that can be made is that of length of time that it took for the most recent standard to be implemented. Figure 11 shows the comparison between the organisations.

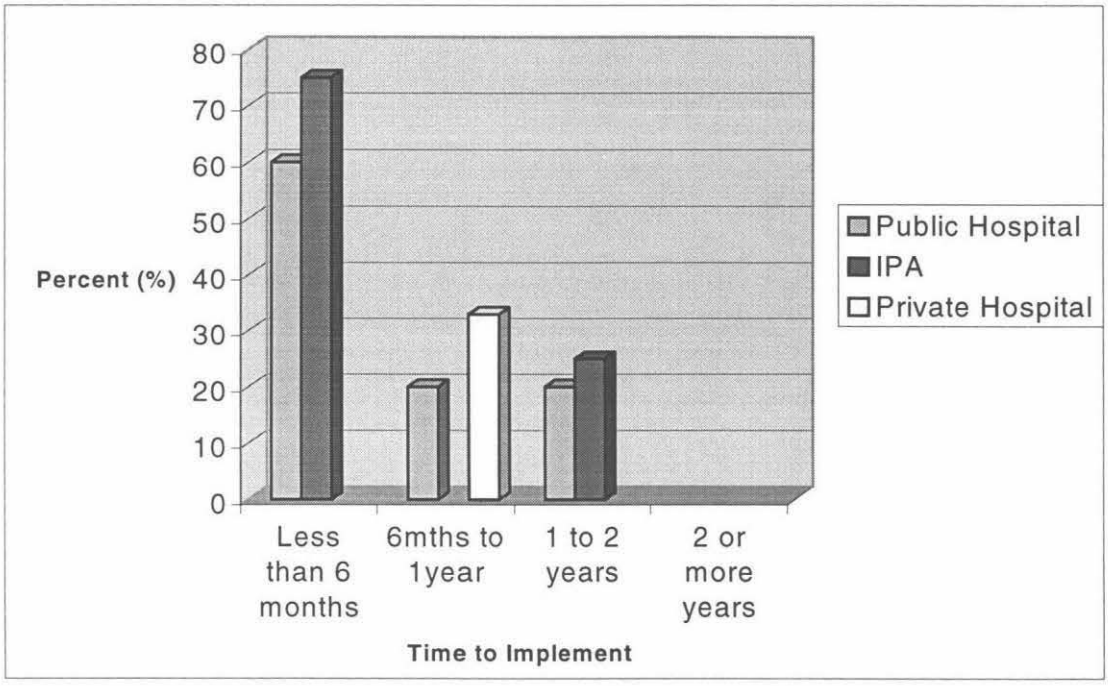

Figure 11 – Time Taken to Implement Standards

The most recent standards that were adopted took predominantly less than six months to be implemented (for both organisations). However if a standard is going to take longer than this it will more than likely take one to two years for an IPA and for a private hospital, or 6 months to two years for a public hospital.

Public hospitals and IPAs predominantly felt that these standards had been adopted by their own choice.

The method by which standards information is disseminated through the organisation is relatively common with all of the organisations utilising meetings, memos, e-mail (those organisations which have it) and word of mouth.

5.5 Critical Success Factors when Adopting Standards

This section utilises the Standards' Adoption Framework and gathers information about the different CSFs and their importance when adopting standards. It is important to note that for the ranking questions, the lower the mean the greater the importance of the CSF.

5.5.1 Overall Rankings

The next question in the survey asked the respondents to rank the different CSFs when adopting any IS standard. Six different CSFs were utilised, the CSFs with their associated abbreviations are shown in Table 9.

CSF	Abbreviation
Completeness	C
Interoperability	I
Level of Consensus	LOC
Product Availability	PA
Problems/Limitations	PL
Maturity/Stability	MS

Table 9 – CSF Abbreviations

Figure 12 presents the results of the overall rankings.

Both organisations had two CSFs that were equally as important. *Completeness* was most important for both categories (mean of 2.00 for IPAs, 2.67 for public hospitals). Whereas *Interoperability* was the other most important CSF for IPAs and *Product Availability* was as important for public hospitals.

The *Interoperability* CSF held a statistically significant difference between the two organisations, with IPAs finding it more important than public hospitals (at 0.05 level, using Tukeys Range Test).

There was not a significant difference between the organisations for the *Level of Consensus* CSF, although IPAs rank it more important (at 3.50) than hospitals (4.17).

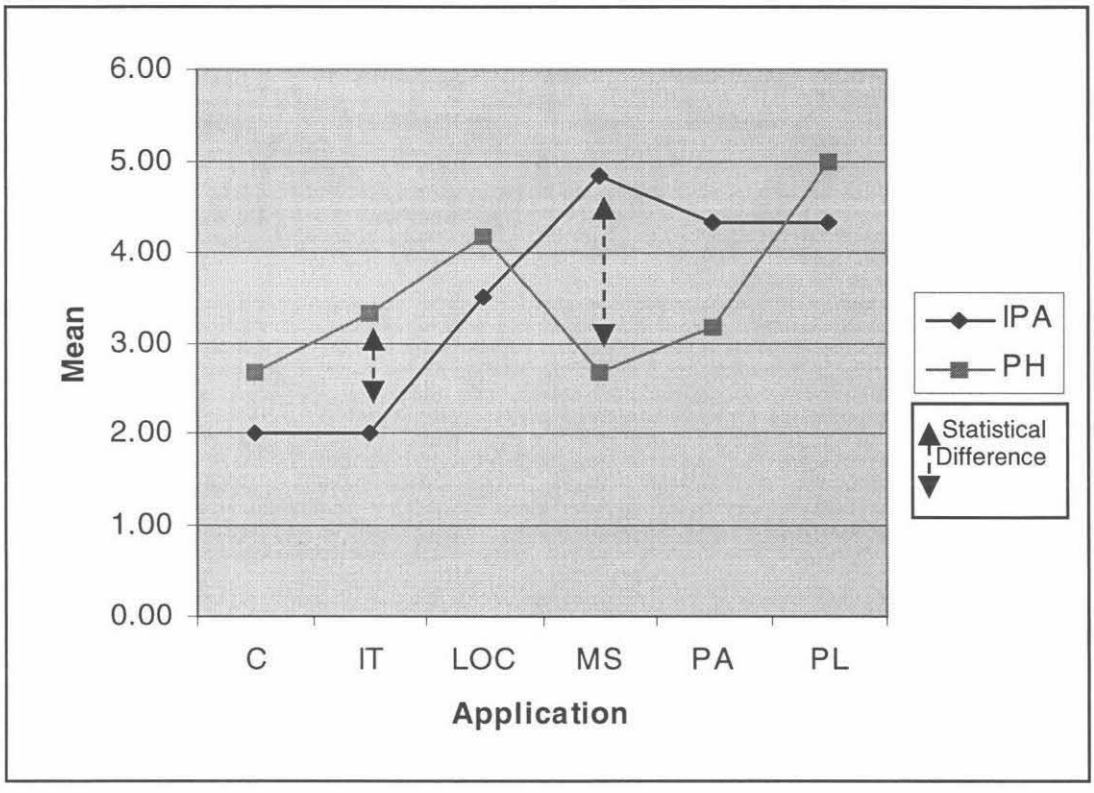

Figure 12 – Overall CSF Ranking for Adopting any IS Standard

The *Maturity and Stability* CSF had a statistically significant difference between the two organisations (where $P < 0.05$ using an Analysis of Variance test).

This implies that public hospitals find *Maturity and Stability* more important than IPAs.

Product Availability and *Problems and Limitations* did not have a significant difference between the organisations, even though public hospitals rank the CSF as being more important than IPAs (3.17 compared to 4.33).

Accordingly the order of importance of the CSFs for each organisation is shown in Table 10.

Order of Importance	IPA	Public Hospitals
1	Completeness	Completeness
	Interoperability	Maturity/Stability
3	Level of Consensus	Product Availability
4	Product Availability	Interoperability
5	Problems/Limitations	Level of Consensus
6	Maturity/Stability	Problems/Limitations

Table 10 – CSFs Ranked for IPA and Public Hospital

5.5.2 Additional Organisations' Ranking of the CSFs

The mean order of the overall CSFs ranking for standards adoption was different for IPAs and public hospitals. It may be appropriate at this point to discuss the other organisations that responded to the survey and compare their results. The other organisations include private hospitals, an IT service provider, a healthcare service provider and a hardware/software supplier. There will not be any statistical analysis because there was only one (or two) responses from these organisations, but they shall be compared to the mean rankings of the IPAs and public hospitals in a qualitative manner.

Private Hospitals

Remembering the lower the ranking the greater the importance; the mean rankings provided from the public hospitals took the form as shown in Table 11.

Order of Importance	CSF
1	Completeness
2	Product Availability
3	Level Of Consensus
4	Maturity/Stability
5	Problems/Limitations
5	Interoperability

Table 11 – Private Hospitals Overall Ranking of the CSFs

These results are interesting because of the difference in order to the IPAs and public hospitals. Once again *Completeness* was the most important CSF, however that is the only similarity. *Product Availability* was the next most important factor and introduces the importance of the vendor to smaller organisations. *Problems and Limitations* and *Interoperability* were both ranked as equally the least important CSF. That may be explained by the apparent lack of external communications needed or used within private hospitals.

Healthcare Service Provider

The order that this organisation ranked the CSFs for overall standards adoption is shown in Table 12.

Order of Importance	**CSF**
1	Completeness
2	Level Of Consensus
3	Maturity/Stability
4	Interoperability
5	Product Availability
6	Problems/Limitations

Table 12 – Healthcare Service Provider Overall Ranking of the CSFs

This once again shows the differences that exist between different organisations. Although *Completeness* is once again ranked as the most important CSF, there are no other obvious similarities.

As this organisation acts as a healthcare provider it seems appropriate that they give users something that they need (hence *Completeness* ranking first). The *Level of Consensus* is also important within this circumstance to ensure that people are utilising something common and/or accepted.

IT Service Provider

The order that this organisation ranked the CSFs for overall standards adoption is shown in Table 13.

Order of Importance	CSF
1	Maturity/Stability
2	Completeness
3	Interoperability
4	Product Availability
5	Problems/Limitations
6	Level Of Consensus

Table 13 – IT Service Providers Overall CSF Ranking

These results are important because of the different perspective the IT service providers have. *Maturity and Stability* is ranked first, possibly because of once having implemented a standard, they realise that organisations will not want to have to modify it straightaway. A common cost of IT is maintenance, and ideally a standard that does not need modification will keep maintenance cost to a minimum, therefore making the organisation less expensive than other competitors.

Once again *Completeness* is seen as being important, because of the intended need and use for the standard. *Level of Consensus* is ranked last, which is almost in direct opposition to the healthcare service provider's, but that could perhaps be explained by the current state of change and modification that is going on within IT.

Hardware/Software Provider

The order that this organisation ranked the CSFs for overall standards adoption is shown in Table 14.

Order of Importance	CSF
1	Level of Consensus
2	Completeness
3	Product Availability
4	Interoperability
5	Problems/Limitations
6	Maturity/Stability

Table 14 – Hardware/Software Overall CSF Ranking

Once again these results do not mirror any of the previous organisation's rankings. Although it is interesting that this organisation ranks *Level of Consensus* as the most important CSF, in complete opposition to the IT service provider.

In essence this may mean (in part) the difference between an IT service provider and an Hardware/Software provider. IT services are often unique or differentiated by some specific element therefore meaning that these organisations are not as constrained by the amount of publicity which exists about the standard. Hardware/Software Providers in comparison will need to utilise well-known and well-accepted utilities to gain acceptance and therefore gain market share.

This is highlighted again by the IT service provider ranking *Maturity and Stability* as the most important, and Hardware and Software suppliers ranking it as the least important. Within each CSF a number of different questions/points existed. The next section delves within the CSFs to find the relevant points.

5.5.3 Analysis of the CSFs when Adopting Standards

The results of this section found that *Completeness* was the most important CSF for public and private hospitals and IPAs. Other than that a great deal of disparity existed between the organisations rankings of the CSFs. The results of the additional organisations again highlighted the differences that exist across different organisations.

5.6 Individual Elements of the Critical Success Factors

Each CSF consisted of many different points. This section works with the individual elements of the CSFs to find what the important elements of each were. The results of the public hospitals and IPAs were combined at this stage as it was not necessary to see their individual differences but to find any difference that exist between the individual CSFs themselves. It is important to note that within this section the higher the mean the greater the importance of the question. The ratings were presented in the form of:

1 = no importance	2 = little importance	3 = some importance
4 = great importance	5 = very great importance	

5.6.1 Level of Consensus CSF Elements

The *Level of Consensus* was defined as 'The degree of awareness that exists about the standard'. Within this five individual questions were apparent:

4.2a The installed base of standards utilised in other locations

4.2b The level of acceptance the standard has

4.2c The level of support the standard has

4.2d The demonstrated effectiveness of the standard

4.2e The current status of the standard

The mean ratings are shown in Figure 13.

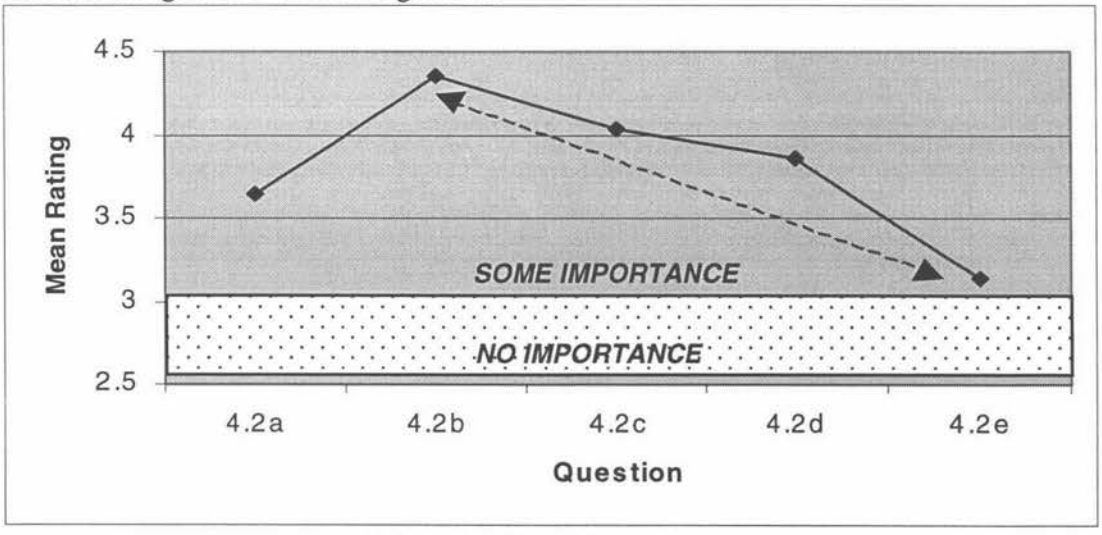

Figure 13 – Individual Level of Consensus Means

Within this CSF, all of the means were above 3 implying that all of the questions have some importance when adopting standards. It is important to note there was a statistically significant difference between questions 4.2b and 4.2e (shown by the dashed line).

This implies that (where $P < 0.05$ using an Analysis of Variance test) the level of acceptance the standard has (4.2b) is considered to be more important than the current status of the standard (4.2e).

5.6.2 Product Availability CSF Elements

Product Availability was defined as 'The range of applications and accessibility of the standard' and incorporated the importance of the vendor. Two questions were included within this CSF:

4.3a The standard is available from a number of vendors
4.3b The vendor has viability

Both of these questions had a mean of above three, which implies that they are of some importance when adopting a standard, although there was no statistical difference between the questions (shown in Figure 14).

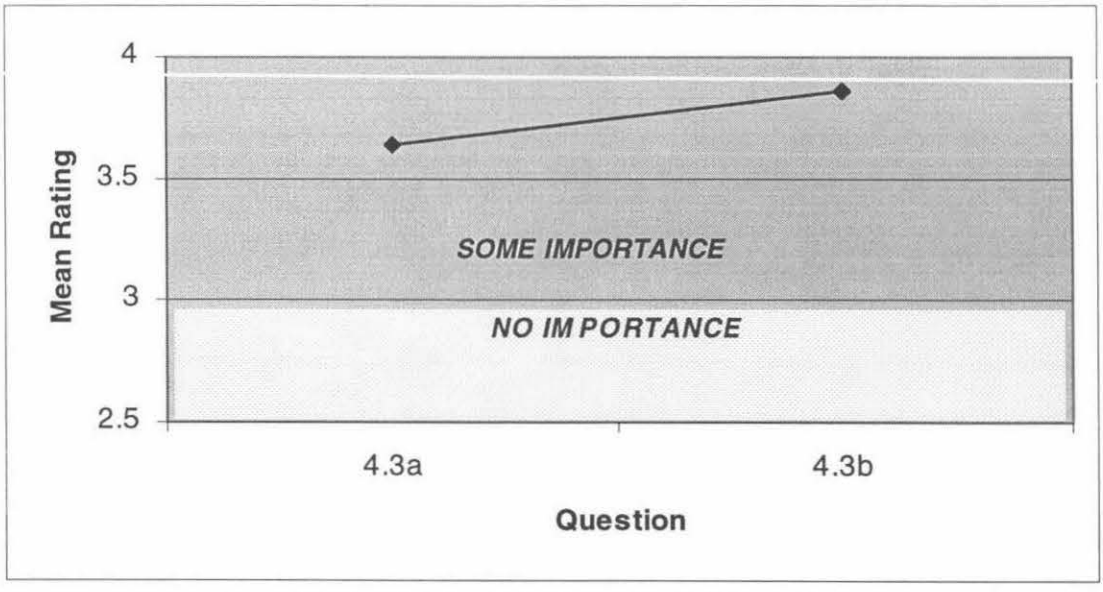

Figure 14 – Individual Product Availability Means

5.6.3 Completeness CSF Elements

The *Completeness* CSF was defined as 'The ability of the standard to cover the required features'. Within this seven different questions existed:

Q4.4a That the standard is based on an understood technology
Q4.4b That the standard is compatible with other standards
Q4.4c That the standard has procedures for testing and proving compliance
Q4.4d The standard meets the required need
Q4.4e The standard provides the required functionality
Q4.4f The standard is free from legal issues
Q4.4g The standards is clear

The mean ratings of the individual questions are shown in Figure 15. All of the responses came back as being above 3 implying that the individual questions do have at least 'Some Importance' when adopting standards. There was a statistically significant difference between questions 4.4d and 4.4de when compared to questions 4.4c, 4.4f and 4.4g (where $P < 0.05$ using an Analysis of Variance test). The statistical differences are highlighted by the dashed arrows in Figure 15.

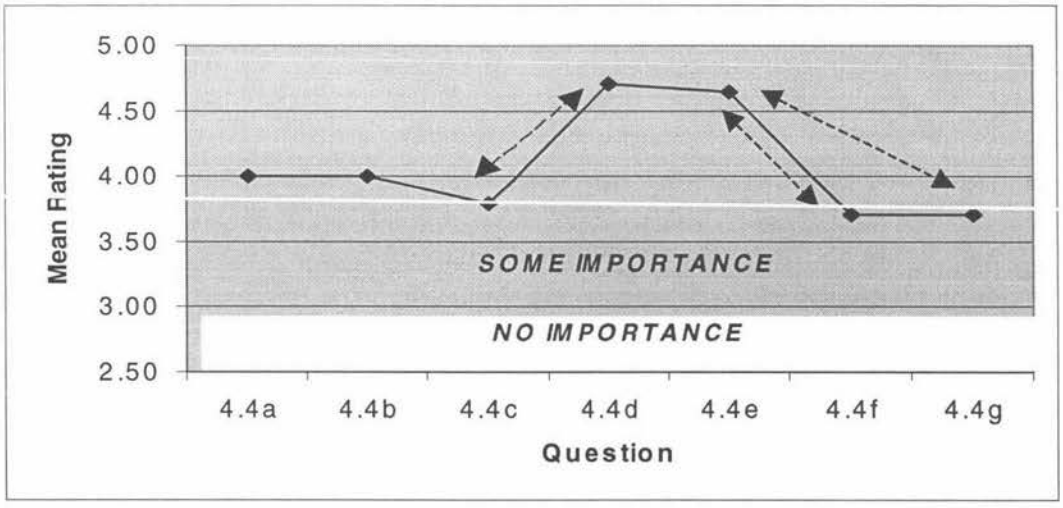

Figure 15 – Individual Completeness Means

This implies that the most important factors within the *Completeness* CSF include the ability of the standard to meet the required need, and that the standard provides the required functionality.

5.6.4 Maturity/Stability CSF Elements

This CSF was defined as 'The length of time the standard has been known'. Within this two individual questions were apparent:

4.5a Conformant products already on the market
4.5b Matured enough to ensure no major changes will occur immediately

These questions both had the mean of 3.65 and were therefore of some importance when adopting standards.

5.6.5 Problems/Limitations CSF Elements

This CSF was defined as 'The number of faults within the standard'. This had two individual questions of which there was no statistical difference between:

4.6a the problems which exist with the standard
4.6b the limitations which exist with the standard

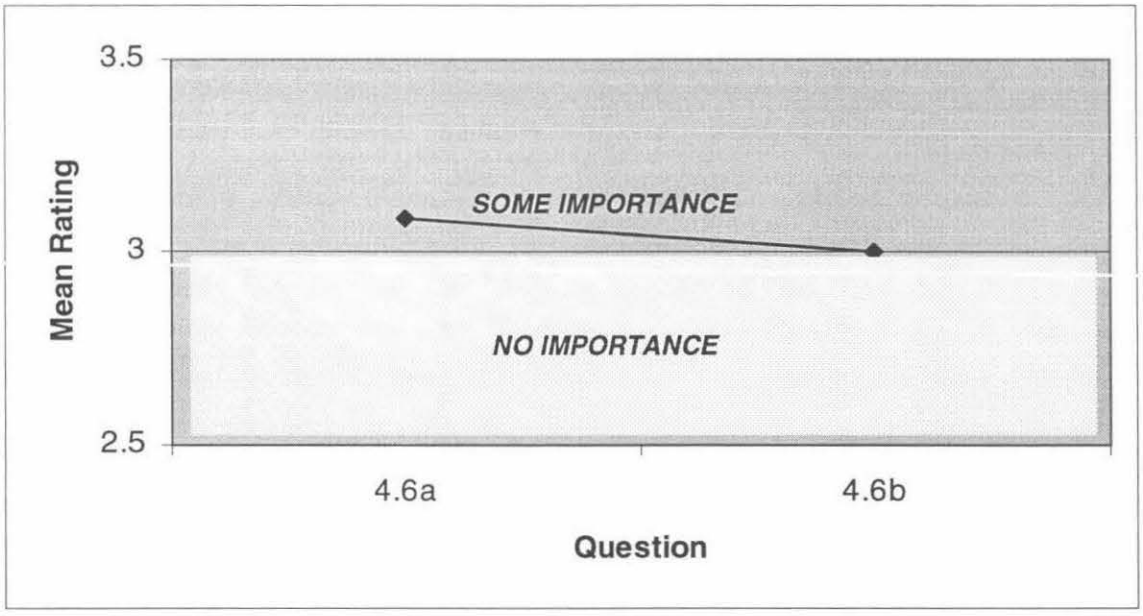

Figure 16 – Individual Problems/Limitations Means

Figure 16 shows that both of these questions are on three or just above, meaning that they are only just of some importance when adopting a standard.

5.6.6 Interoperability CSF Elements

Interoperability was defined as 'The ability of the standard to co-operate with other applications'. This CSF consisted of four different questions:

4.7a Ability to add new technologies

4.7b Interoperability with other standards

4.7c The application is portable

4.7d The scale to which the standard can be applied

The means of the individual questions are shown in Figure 17. There was no statistically significant difference between the questions, although all scored above 3, meaning they are of some importance in the selection process.

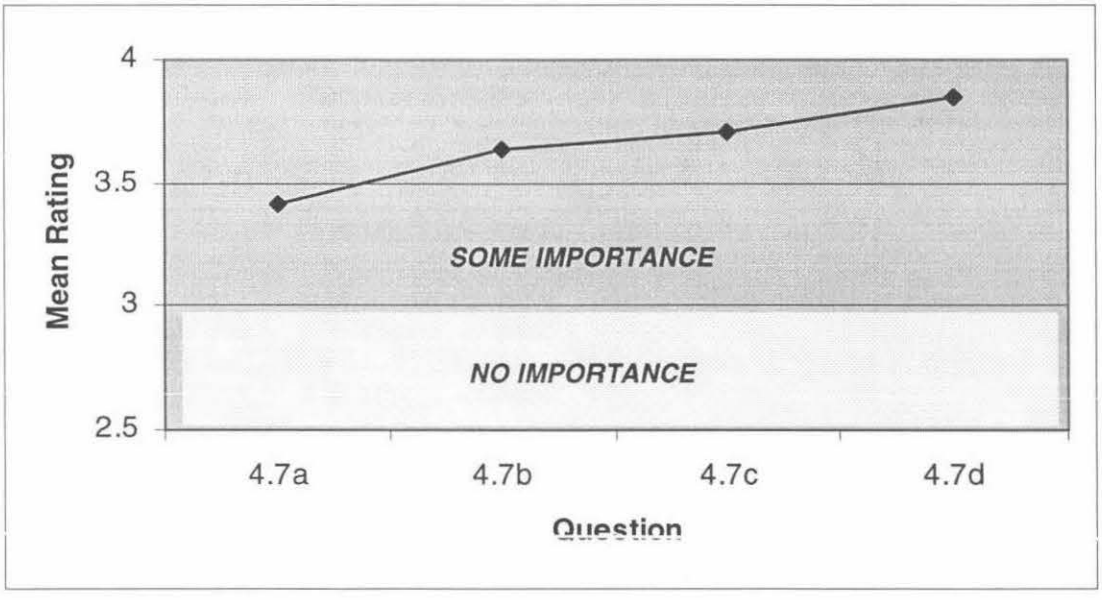

Figure 17 – Individual Interoperability Means

5.6.7 Extra Elements

It was appropriate within this section to ask the respondent if they felt that there were any other important factors that go into the decision making process when adopting standards.

A total of eight other suggestions were included. These eight were placed into two main groups.

The first of these is 'Acceptance' and includes elements such as being acceptable to NZ business and having market penetration. The second is 'Ease of Use', and includes elements such as the standard being straightforward, easy to learn and being affordable.

5.6.8 Additional Organisations Rating of the Individual Elements of the CSFs

The ratings of the IPAs and public hospitals have been analysed for statistical difference between individual questions, between organisations and between a combination of the two. All of these results had a mean of above three implying that all of the individuals questions were relevant in the decision making process of these organisations. This section will go through the four additional organisations to note if any of the organisations found any of the individual elements to be of no importance in their decision making process.

Private Hospitals

Within the *Completeness* CSF seven individual questions were used. Each question was (for IPAs and public hospitals) of at least 'Some Importance' in the decision making process. There was however, a statistically significant difference between the ratings of the questions within this category (questions 4.4c, 4.4f and 4.4g were not as important as questions 4.4d and 4.4e).

This result is mirrored by the private hospitals in the sense that Question 4.4c:

- That the standard has procedures for testing and proving compliance

was rated as being of very little to no importance in their decision making process (it was given a rating of two).

Healthcare Service Providers

All of the individual questions had a rating of above three implying that all of the individual factors are of 'some' importance when adopting standards.

IT Service Providers

This respondent did have one rating that was considered as being of 'little' to 'no importance'. Question 4.2e:

- The Current status of the standard

This is consistent with two important elements, firstly it is consistent with the IT Services Providers overall ranking of the CSFs (in that *Level of Consensus* was ranked last) and secondly it mirrors the responses taken from the IPAs and public hospitals.

That is, within the IPAs and public hospitals question 4.2e was rated lowest, and held a statistically significant difference between question 4.2b ('The Level of Acceptance of the Standard').

Hardware/Software Provider

The respondent did have one individual element that was considered to be of 'Little' to 'No Importance'. That was Question 4.3a

- That the standard be available from a number of vendors

This rating was somewhat out of the norm, with all of the other organisations finding it of at least some importance.

5.7 Different Standards Applications in Use

The next section of the survey placed the use of standards into specific application areas. These applications were Technology Infrastructure, Clinical Coding, Information Exchange Protocols and Information Systems Management. The respondents were asked which standards were in place within their organisation, and to then rank the CSFs with specific regard to the application area.

5.7.1 Technology Infrastructu re

The Technology Infrastructure application involves gathering information about operating systems, databases and communication protocols (hardware).

Public Hospitals

A range of operating systems software exists within the public hospitals. 100% use Windows NT. 60% use Windows95/98 or Windows 3.11. Unix is also a prominent system at 83%.

Database Software is relatively common with 100% using Access and 50% using Oracle as well. Unidata is also utilised at 33%. Other databases utilised include Paradox, SQL and Informix.

100% of the organisations use TCP/IP as a communication protocol, with ISDN used by 83%. IPX/SPX and X25 are utilised by 50% of the organisations with IEEE 802 (33%) and FDDI (16%) also utilised.

IPAs

Windows operating systems software are well utilised within IPAs. 66% use Windows 95/98 and 50% are using Windows NT. Unix was also utilised by 33% of the organisations.

Access was the most common database (50%) with Oracle and Foxpro also utilised at 25%.

75% of the organisations use TCP/IP, with ISDN and IPX/SPX also used by 25% of the organisations.

The next section of the survey involved ranking the CSFs. It is important to remember that within this circumstance the lower the mean, the more important the CSF.

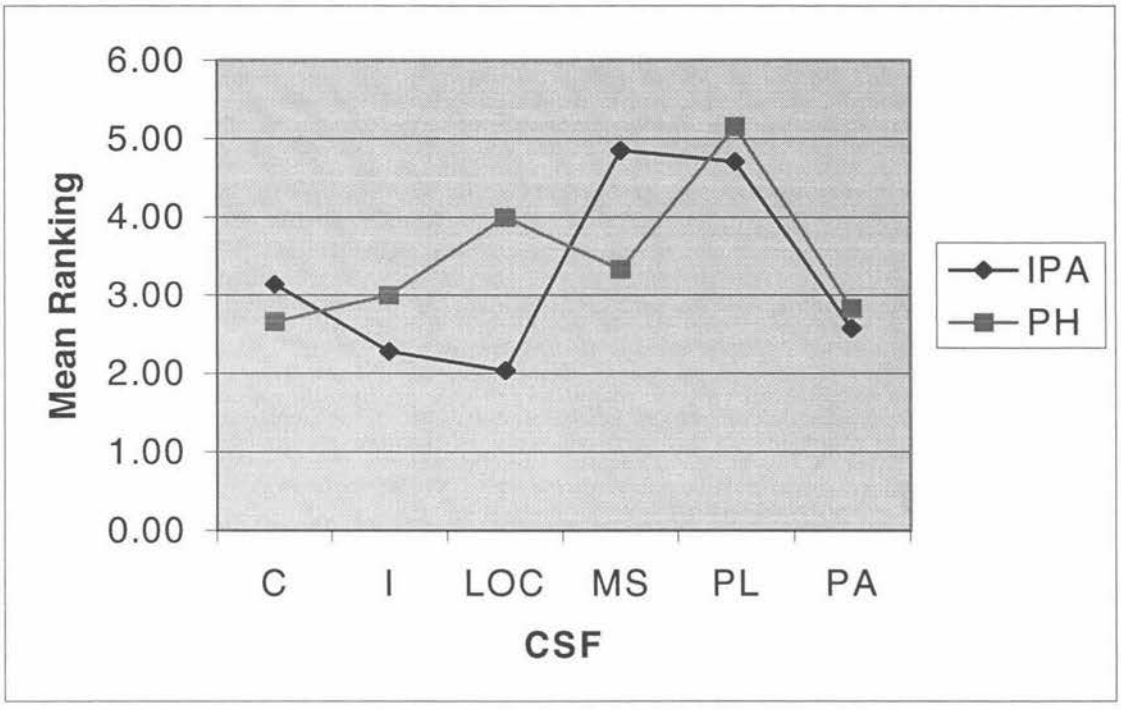

Figure 18 – CSFs ranked by Technology Infrastructure Application

Figure 18 shows that IPAs found *Level of Consensus* to be the most important CSF whereas public hospitals found *Completeness* to be of the most importance. The *Interoperability* CSF was ranked as the second most important for IPAs.

This may be explained by the concept that IPAs will only adopt standards that are well known or utilised, thereby ranking *Level of Consensus* as most important. Public hospitals did rank *Product Availability* second, behind *Completeness*, which was considered most important. This could be explained by public hospitals not wanting to adopt a standard until it was needed.

5.7.2 Clinical Coding

Within the public hospitals 100% utilise ICD9-CMA with a shift soon to ICD10-CMA. Within IPAs Read Codes are the most prominent clinical coding standard at 58%. ICD10-CMA is also used by 25% of the IPAs.

The mean ranking of the CSFs are shown in Figure 19.

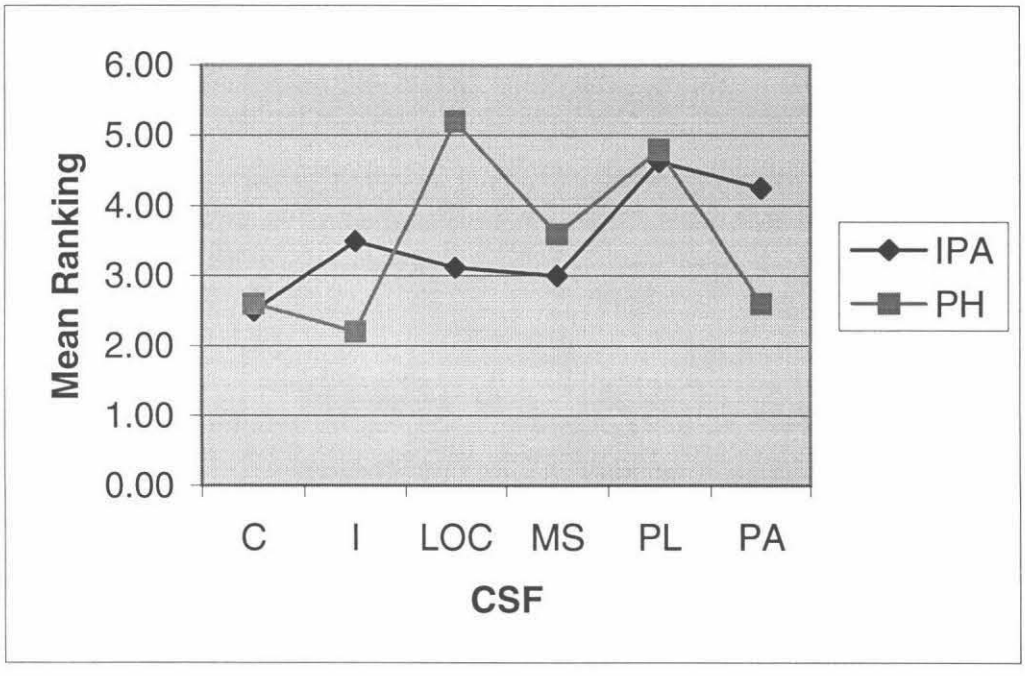

Figure 19 – CSFs ranked by Clinical Coding Application

Figure 19 shows that *Completeness* was the most important CSF for IPAs but *Interoperability* was the most important for public hospitals. This may be because of the distributed location of an IPA as opposed to a public hospital.

5.7.3 Information Exchange Protocols

33% of the public hospitals are utilising NZHIS standards for NHI and MWS, with 30% also using Laboratory and Radiology Results. Laboratory and Radiology orders are also used (33%). EDIFACT standards are not utilised, and 33% of the public hospitals use DICOM.

41% of the IPAs are utilising NZHIS standards for NHI and MWS, with 41% also utilising Laboratory and Radiology Results. Other standards used by IPAs include Referral Status and Discharge at 33%. EDIFACT and DICOM standards are not utilised by IPAs.

The mean ranking of the CSFs are shown in Figure 20.

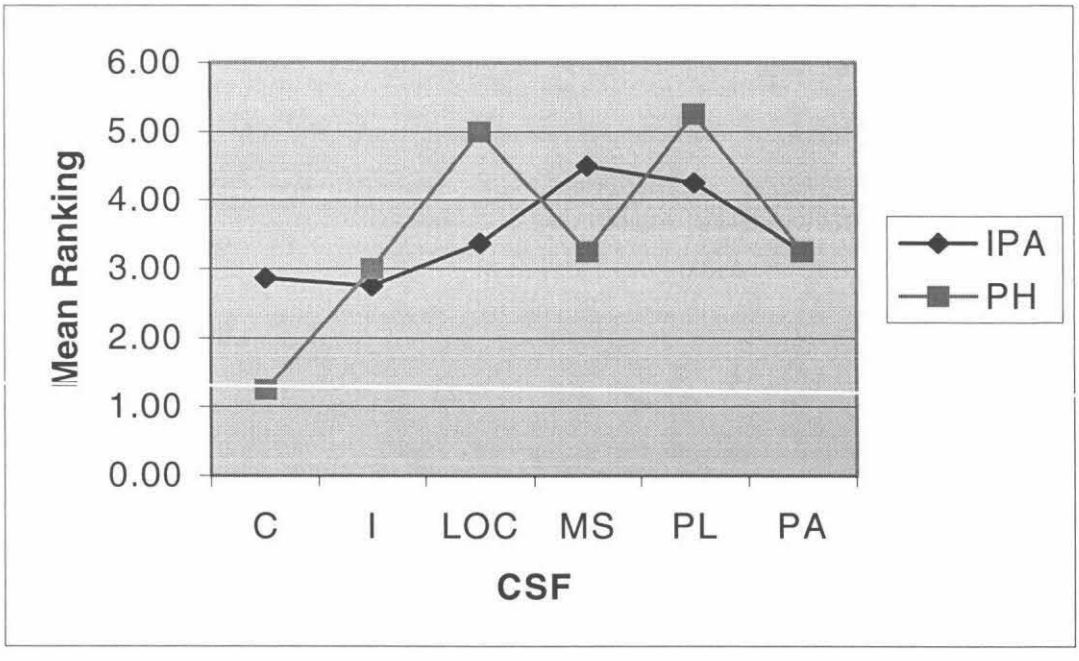

Figure 20 – CSFs ranked by Information Exchange Application

It was found that *Completeness* was the most important CSF for public hospitals and that *Interoperability* was the most important for IPAs.

5.7.4 Information Systems Management

For both IPAs and public hospitals, standards for IS Management were not well utilised. Security was predominantly not applicable for hospitals whereas 16% of the IPAs utilise the NZS 4444 standard.

Privacy was also not applicable for both groups with only 11% (of the entire sample) using a formal standard (AS4400). Disaster recovery was also not catered for with only one organisation out of both groups using a formal standard (NFPA 1600).

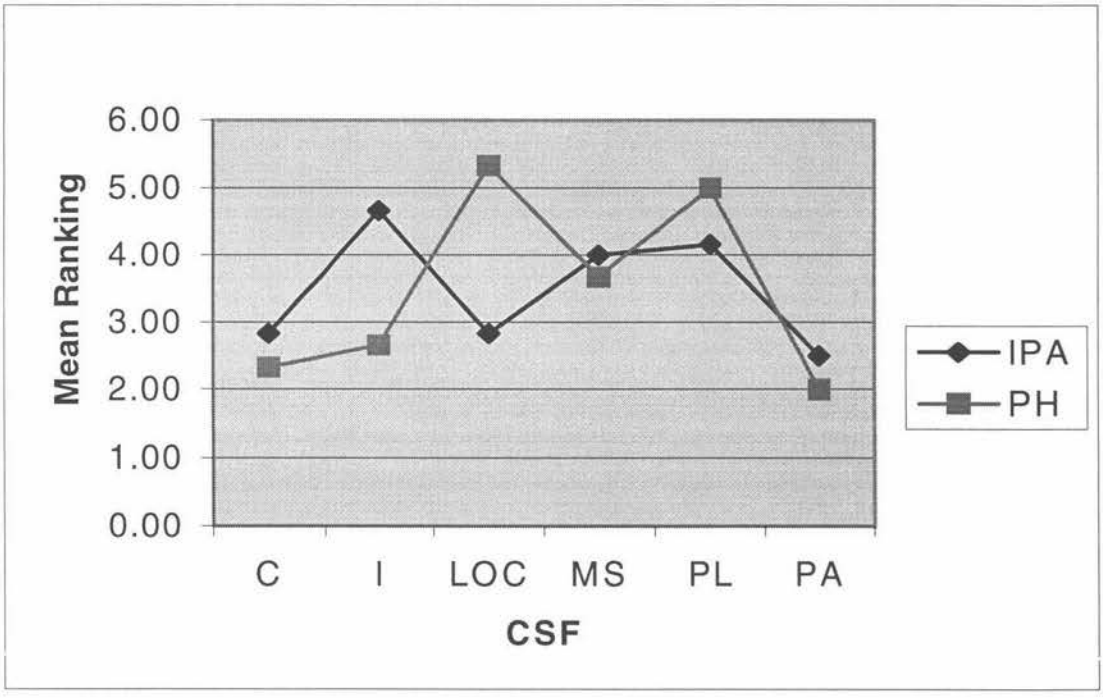

Figure 21 – CSFs ranked by Information Systems Management Application

Figure 21 shows that there is a great deal of disagreement between the importance of the CSFs between the public hospitals and IPAs. The Figure also shows that organisations do not place great emphasis of IS management standards (shown by the lowest ranking being two).

5.7.5 Analysis of Standard Usage within Different Applications

This section will compare the different standards that were in use across the three main organisations (public hospitals, IPAs and private hospitals).

Technology Infrastructure

Windows operating systems were prominent across all three of the organisations. A number of different versions were being utilised. Windows 95/98 were used predominantly for private hospitals, Windows NT was used for public hospitals and a mix of Windows 95/98 and Windows NT for IPAs. IPAs and public hospitals also had an important use for Unix machines whereas private hospitals did not.

The common database across the three organisations was Microsoft Access, with some public hospitals and IPAs also utilising Oracle. None of the private hospitals used Oracle, but used Paradox instead.

Communication protocols can only be compared across IPAs and public hospitals as none of the respondents from the private hospitals answered this question. TCP/IP was common across both organisations (100% and 75% respectively) whilst IPX/SPX and ISDN protocols are also utilised by both organisations.

Clinical Coding

ICD10-CMA was common across all three of the organisations (and most recognised within public hospitals) however Read Codes are the most prominent coding standard within IPAs.

Information Exchange Protocols

All three of the organisations utilise NZHIS Standards for NHI and MWS. Both IPAs and public hospitals also utilise Laboratory and Radiology Results whereas private hospitals do not.

Information Systems Management

Each of the organisations have a very low to minimal application of IS Management standards.

5.8 Critical Success Factors within Different Applications

As stated earlier this section of the survey also included ranking the different CSFs as per the different applications.

The most appropriate method of testing these statistically was to use Analysis of Variance tests, thereby looking at each CSF and comparing the different organisations within. When looking at the numeric means it is important to remember the lower the mean, the more important the CSF.

5.8.1 Completeness CSF

Figure 22 presents the mean ranking of the *Completeness* CSF category as grouped by the different application areas. This graph shows that *Completeness* is the most important CSF for the public hospitals for Information Exchange (1.25), and most important for Clinical Coding for IPAs (2.50).

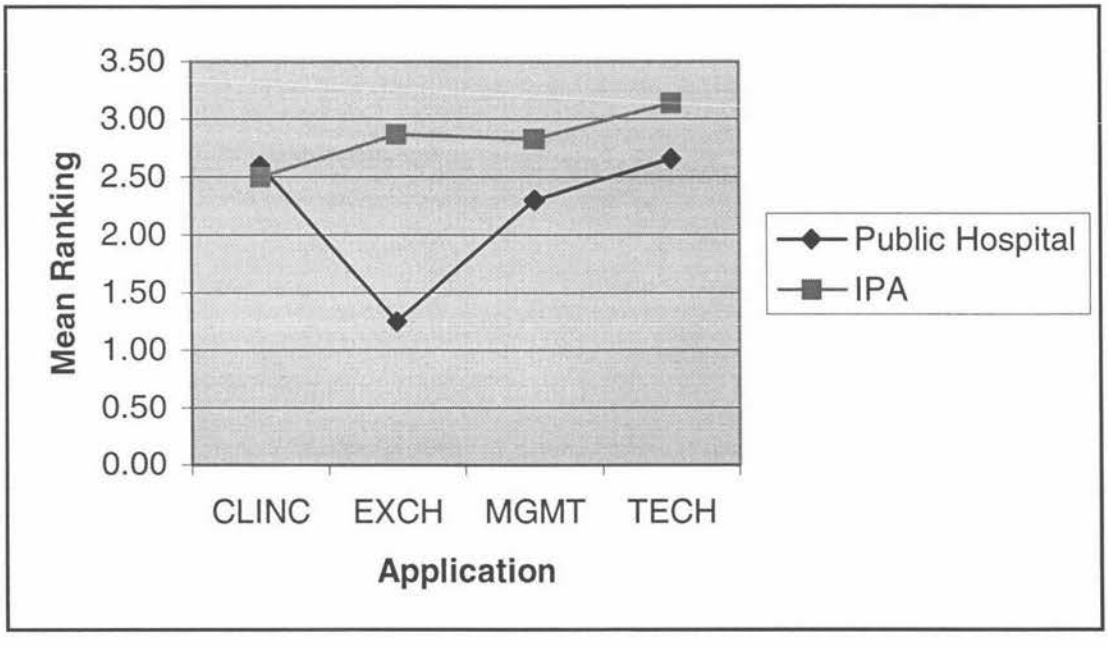

Figure 22 – Completeness CSF Ranked by Application

Although there is a considerable difference between the ranking of the CSFs for IPAs and public hospitals with regard to Information Exchange, there is no statistical significance between the two groups.

5.8.2 Interoperability CSF

Figure 23 presents the *Interoperability* CSF as ranked within each application.

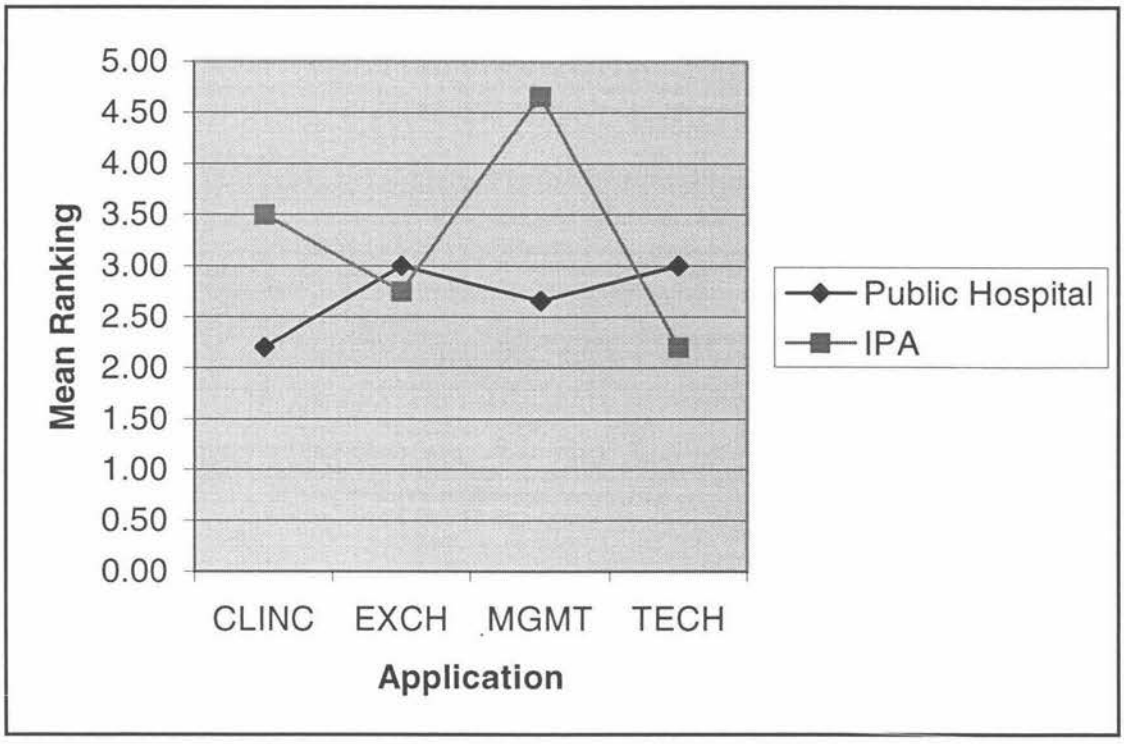

Figure 23 – Interoperability CSF Ranked by Application

Figure 23 shows a statistically significant difference between the application areas. *Interoperability* is more important (where $P < 0.05$) for Information Systems Management than it is for the Technology Infrastructure application area.

Public hospitals rank *Interoperability* the most important CSF for Clinical coding (2.20), whereas IPAs find it the most important for Technology Infrastructure (mean of 2.28).

5.8.3 Level of Consensus CSF

Figure 24 presents the *Level of Consensus* CSF as ranked within each application.

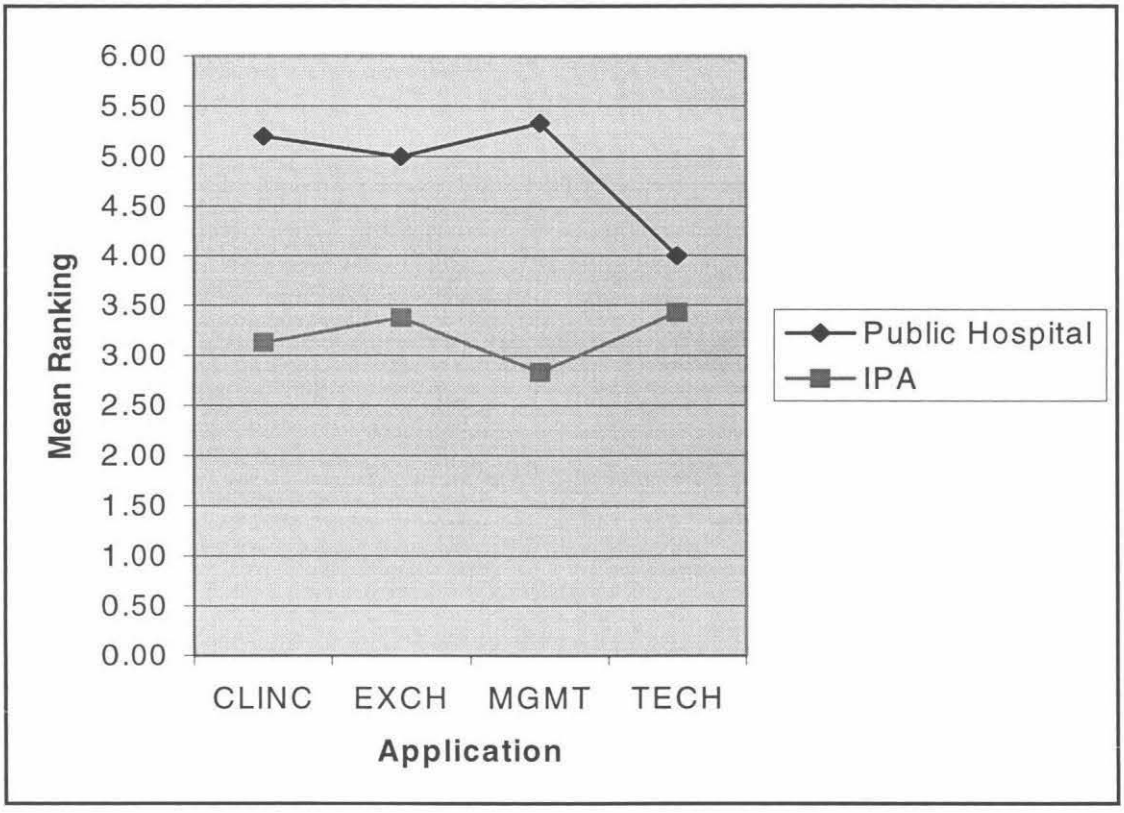

Figure 24 – Level of Consensus CSF Ranked by Application

This graph shows a statistically significant difference between the two organisations at the 0.05 level. This shows that the *Level of Consensus* is considered more important for IPAs than it is for Public hospitals.

IPAs find the *Level of Consensus* more important for Information Systems Management (mean of 2.83) whereas hospitals find it important for Technology Infrastructure (with a mean of 4.00).

5.8.4 Maturity/Stability CSF

Figure 25 presents the *Maturity/Stability* CSF as ranked within each application.

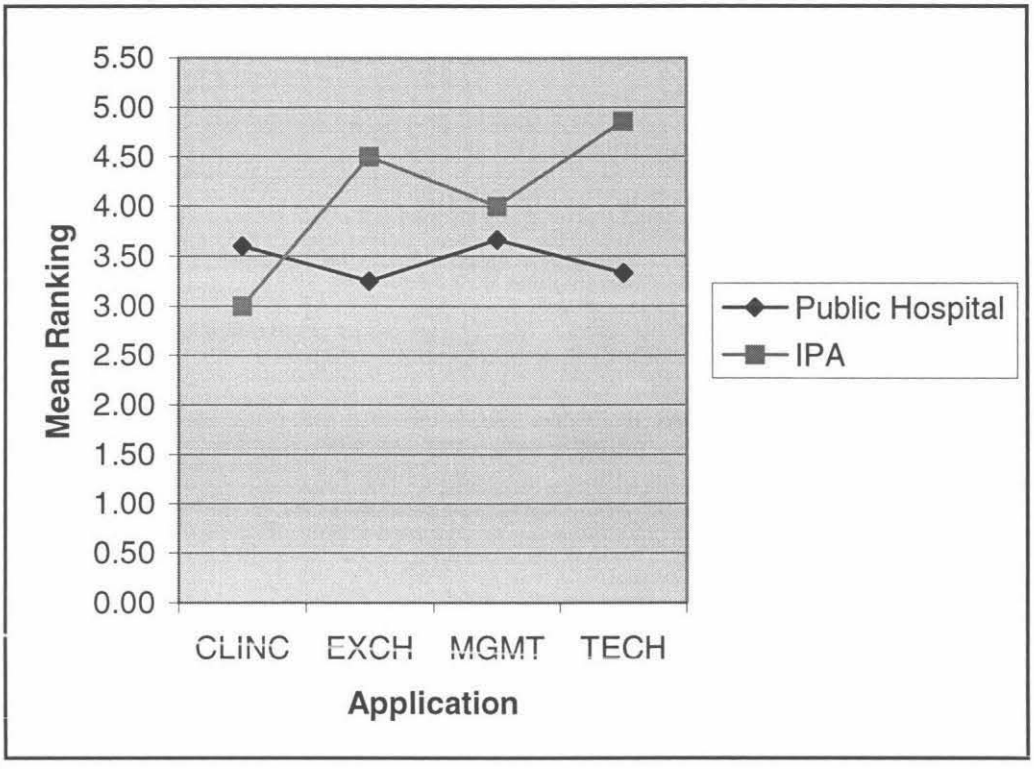

Figure 25 – Maturity/Stability CSF Ranked by Application

There is no statistical difference between either organisation or application areas with *Maturity/Stability* being most important for Clinical Coding for IPAs (3.00) and Information Exchange being most important for public hospitals (3.25).

5.8.5 Product Availability CSF

Figure 26 presents the *Product Availability* CSF as ranked within each application. Within this CSF there is a slight statistically significant difference (where $P < 0.06$) between the application groups.

The statistically significant difference shows that *Product Availability* is more important for Information Systems Management than it is for Clinical Coding. However both groups find Information Systems Management the most important application of *Product Availability* (2.50 for IPAs, and 2.00 for hospitals).

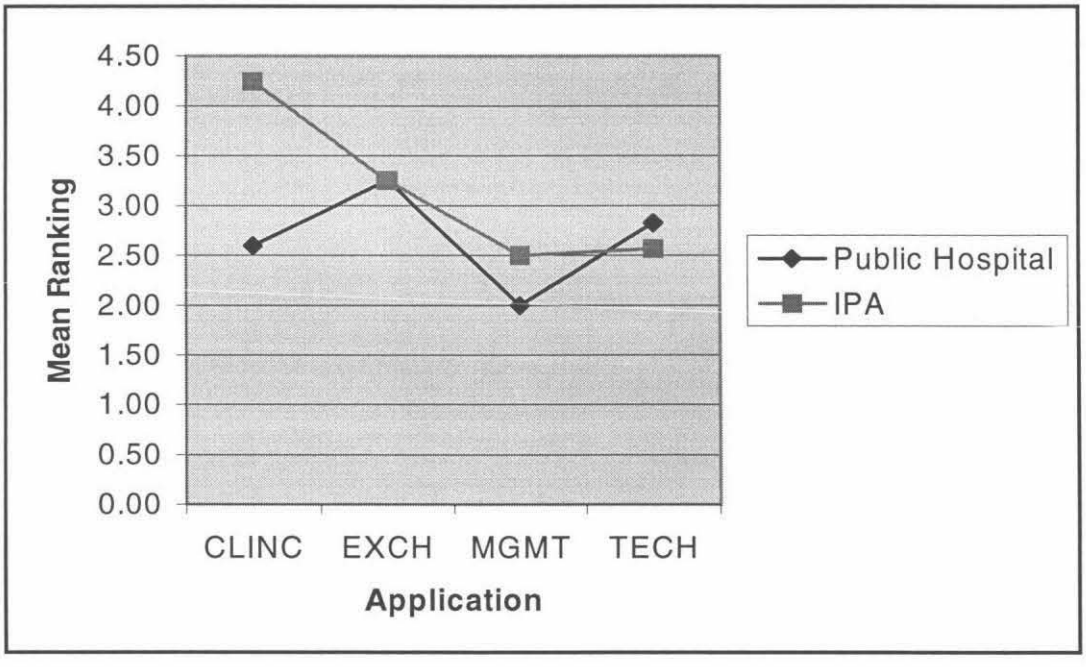

Figure 26 – Product Availability CSF Ranked by Application

5.8.6 Problems/Limitations CSF

Figure 27 presents the *Problems and Limitations* CSF as ranked within each application.

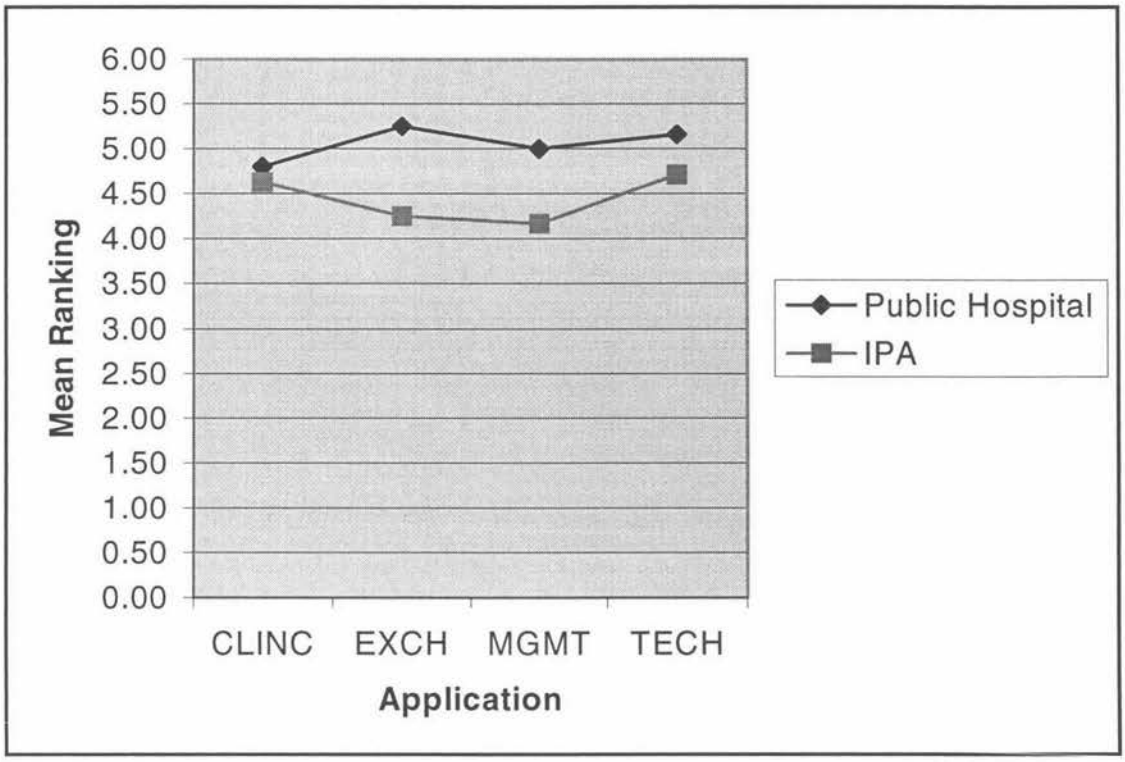

Figure 27 – Problems/Limitations CSF Ranked by Application

There are not any statistically significant differences between the organisations or application areas, although the mean ranking's are quite high, thereby implying that they are not of much importance.

The most important application of *Problems and Limitations* for IPAs is Information Systems Management (4.16) and Clinical Coding (4.80) for hospitals.

5.8.7 Analysis of the CSFs within Different Applications

These results highlighted the differences that exist between both the application areas and the organisations. Statistically significant differences existed between the application areas of Information Systems Management and Technology Infrastructure with the *Interoperability* CSF. This implies *Interoperability* is of far greater concern to Technology Infrastructure considerations than for Information Systems Management.

Another statistical difference was found between the two organisations. *Level of Consensus* was found to be more important for IPAs than for hospitals.

A number of other important differences were found between the organisations and their different ranking of the CSFs for different applications.

5.9 Open Ended Questions

This section presents the results of the final section of the survey. This section asked four questions about information systems standards within healthcare. These questions did not have any definitive or correct answers. They were questions that required a degree of reflection and individual opinion.

The first question asked 'What do you think differentiates a Health Information Systems Standard from any other standards application?'

This question prompted the largest number of written responses, although most of the answers could fit into three main schools of thinking. The majority of the respondents felt that standards for health information systems (HIS) were significant because of the expressed need for privacy and confidentiality of the data. The second set felt that HIS standards were different because the standards are so unique to health and all that is encompassed within that (ADT, Coding needs etc). The final group felt that there was no real difference to HIS standards than with any other form of standard. Some of the responses are shown below:

- Subject focus on health and confidential client data
- The need for privacy and accuracy
- Privacy, Urgency, Real time access, access rights, database size(s), object orientation
- Difficulties of categorising/coding health/disease related information into a suitable electronic framework
- Plethora of disparate systems that have been developed to satisfy local and national requirements
- Lack of central guidance and funding for standards development
- Lack of central guidance and funding for standards promulgation (meetings, workshops, research)
- The rate of change in healthcare developments continues to increase rapidly
- People are involved which do not always adhere to standards
- The differentiation between HIS and others rest almost solely on the type of information and its perceived value in the privacy of the individual
- The possible consequences of incorrect information

The second question asked 'What do you perceive the usage of health standards to be at present?'

The answer to this question could essentially be placed into one main group. The majority of the respondents felt that the use of standards was low, and uncertain. A common theme associated with this was an apparent lack of guidance or leadership. Some of the responses include:

- Low, and understanding lower
- Very slow behind world standards
- Nominal
- Generally inconsistent and little understanding of needs of systems
- Little usage – pitiful level of IS and organisational management – indicates that the level of maturity where standards are an issue has not yet been realised
- Piecemeal with significant lack of direction
- Lack of informed national policy on adoption/research/implementation

- Expense in developing intercommunication between healthcare systems has now become unnecessarily high due to the lack of pro-action in previous years. Such expense due to lack of foresight is going to increase
- Reasonable use but without a focus. Standards are still being developed (through lack of resources) by commercial firms, sometimes with a commercial agenda rather than a standards agenda. Widespread use will come when a true use is seen for the standards or when legislation requires the use.

Some of the responses out of the norm include:

- Low in public, high in private
- Largely a CHE Based system
- Very good, HL7 has been a big success as has the work done by Sectornet in providing the mechanism
- Low world wide – but very high in NZ
-

The third question was looking towards the future use of standards and asked 'What do you perceive the usage of standards to be in the future?'

The general theme of the responses to this question implied that the usage of standards will increase as their need and benefit becomes more understood. Once again a need for leadership and guidance was apparent. Some of the responses include:

- Greater as technology usage increases
- Depends on leadership from the Ministry and the HFA
- It would be desirable to have one system of standards throughout NZ which were consistently applied
- The reality is that a variety of standards are likely to be used with the differing rates of effectiveness.
- Standards will become more wide-spread in their use
- Increasing need, but will evolve slowly
- Very high

- Support for national initiatives such as coding, research, implementation and promulgation must increase, but current health funding policies do not seem to have acknowledged this
- Adoption of further disparate systems and mutually exclusivity will continue for some years as new vendors enter the market place, many offering systems which do not complement existing ones
- Standards in the future will be used to gain a better understandable HIS for NZ as long as issues such as privacy do not overwhelm the ultimate aim of potential enhancement
- Important for cross-communication
- High – will be required for contracting
- Greater use as systems incorporate more standards natively within applications within the health sector

The final question was asked to get an understanding of what people require with their standards, accordingly the question asked, 'Which areas do you feel require the most urgent attention with regard to standards within New Zealand healthcare?'
This question prompted the widest variety of answers, some of the responses include:

- Referral and discharge
- Diagnosis, Lab, pharmacy and radiology code
- Referral status and discharge
- Pharmaceutical's (eg PINS)
- Clinical event coding
- Information systems – data collection, disaster recovery
- Communication
- Primarycare Systems – Portability of patient data
- NHI Identification
- Pharmaceutical data and utilisation figures (coding systems)
- X-ray images (radiology)
- Disease coding
- Simplified coding systems for disease/procedures for non in-patient visits to hospitals/clinics

- Coordination and support in selection/development of procedure/data item coding
- Co-ordination/standardisation of clinical orders creation (pharmacy, laboratory, radiology, nutrition etc)
- Adoption of guidelines to vendors/service providers developing and/or implementing clinical health records
- Patients and Clinicians
- LOINC for Lab orders and results
- Agreement on the EMR
- Clinical practice
- Transaction standards between health providers, and the associated privacy issues that information exchange

One response was less specific than the rest but equally as important:

- A clear focus as to where health standards can fit into the overall scheme of better health

5.10 Summary of Results

This chapter presented data gathered from the survey. A total response rate of 38% was gained, of these just over 30% were usable within the data analysis. Responses were more than likely completed by the IS manager, or by someone who holds authority within the healthcare organisation.

The vast majority of the organisations surveyed utilise computers, and the few that did not, were not going to computerise their organisation within the next 12 months. The most common uses for computers were spreadsheets, word processing, email and financial management.

Public hospitals had the greatest number of computers, and had the most use for LANs and WANS, IPAs also utilised LANs. Private hospitals had minimal computers and very few utilised LANs.

Chapter 6 Discussion

The world might not understand the details, but it is has recognised that standards exist, and have an impact on the market.

(Robinson, 1998)

This chapter aims to discuss a number of important elements with regard to the healthcare survey results and analysis. The elements discussed within this chapter include:

- The generalisability of the results
- The people involved within the standards adoption process
- The applicability of the SAF
- The findings from the hypotheses
- The standards utilised by the organisations
- Comments from the open-ended questions

Within this chapter a discussion of some other elements of the survey will also be held. These include:

- The *Completeness* CSF
- The issue of time
- Nolan's Stages of Growth

6.1 Generalisability of Results

The first issue that needs to be discussed is the possibility of generalising the results obtained across the entire population. As already discussed a total response rate of 38% was achieved. 31% of the responses were usable within the survey.

These results do constitute enough to do research with, although they are relatively low for general survey responses. The low response rate could almost be expected because of the very low return rate of surveys for information systems research in general, and the combination of this element with surveying people within the healthcare arena.

This research project concentrated on surveying doctors, hospitals, (both public and private) and the IS managers within. The sample selection process was relatively straightforward. Two mailing lists were provided, and after thorough searching on the Internet the third (complete) list was also found. This meant in essence that the research involved sampling an entire population within New Zealand healthcare.

Unfortunately as easy as it was for the researchers here to receive mailing lists, it was also for other researchers, thereby creating a problem. We were made aware throughout the entire data gathering process that at least two other surveys had been sent to some of the same people very recently. As discussed in previous chapters, people in general have a relatively low tolerance for surveys, when (as in this situation) three have just recently been sent to them, therefore it is only fair to expect a relatively low return rate.

Of the people that did respond it is unlikely that they will hold a great bias towards or against standards. Standards are at present at a phase where people are starting to realise their potential. Any bias that does exist may simply imply that they have considered standards and all that they encompass.

Consequently, because of the acceptable response rate, and the well-defined scope that was defined, it may be possible to generalise across these aspects of New Zealand healthcare. These results are also of benefit to many people within New Zealand healthcare including those who implement standards, those who develop standards, and those who have authority within New Zealand healthcare.

6.2 People involved with Standards Adoption

The people that were involved with standards adoption were wide ranging. When an IS manager existed (as with the public hospitals) they were more likely to be the person to adopt healthcare standards. When an IS manager did not exist (as for some IPAs) it was often a collaborative approach, in that two or three people would help in the decision making process.

It was found that the people who adopted the standards originally are commonly the people who ensure that the standard is working effectively and appropriately.

Information about the standard adopted are disseminated to other staff via means of memos, email, meetings and word of mouth.

The people involved with the standards adoption process find information via a number of different and diverse means. Some of these places include the Internet, suppliers and vendors, and by attending demonstrations and conferences.

6.3 Applicability of the Standards' Adoption Framework

A number of important points can be taken from the survey results about both the usefulness and the completeness of the SAF.

Firstly, the different rankings of the CSFs for the overall adoption of standards between the two organisations show that there is a significant difference between the two. This point was highlighted in earlier aspects of the research project, noting the different sizes of the organisations, and the different factors that an IS manager would have to take into consideration when adopting standards.

This in turn is a positive point about the SAF. This implies that the SAF can be used across different organisations as an overview of the important aspects of standards adoption.

A second important point that can be taken from the SAF is that all of the CSFs and the components within are important. Very few of the respondents rated any factor as being not important (less than or equal to two) within the standards adoption process, implying that the framework is appropriate and relevant to the standards adoption framework.

A third relevant point can be found from the minimal additions people could give to the SAF. Two other categories became apparent from the sample including 'Acceptance'

and 'Ease of Use'. Both of these were covered within the SAF; 'Acceptance' was in the Level of Consensus CSF:

- 4.2b The level of acceptance the standard has

Whereas 'Ease of Use' was found within the *Completeness* CSF:

- 4.4g The standard is clear

This in turn implies that the SAF is a relatively complete guide for the introduction of standards within the healthcare arena.

The next aspect to discuss is the differences found between the organisations and the application areas; this was formalised within the hypotheses.

6.4 Hypotheses Findings

Within this research project a number of different hypotheses were created. They were based on the assumption that the IPA and the public hospital would rank the CSFs differently across different application areas because of the different considerations of the organisations. The hypotheses and their findings are discussed below.

6.4.1 Hypothesis One – Overall Standards Adoption

- *Completeness* will be the most important factor with regard to the overall standards adoption process for hospitals, whereas IPAs will focus on *Interoperability.*

This was indeed found to be correct. The results found that both organisations had two most important CSF. For IPAs it was *Completeness and Interoperability*, whereas for hospitals it was *Completeness* and *Maturity and Stability.*

The next phase of the hypotheses was to compare the four different application areas to ascertain if there was another difference across applications areas as well as across organisations.

6.4.2 Hypothesis Two – Technology Infrastructure

The technology infrastructure application had the hypothesis that:

- *Completeness* and *Product Availability* will be the most important factors with regard to the overall standards adoption process for hospitals, whereas IPAs will focus on *Interoperability* and the *Level of Consensus.*

Figure 18 shows that the hypothesis was found to be correct. IPAs found *Level of Consensus* to be the most important CSF whereas public hospitals found *Completeness* to be of the most importance. The *Interoperability* CSF was ranked as the second most important for IPAs. This was explained by the concept that IPAs will only adopt standards that are well known or utilised, consequently ranking the *Level of Consensus* CSF as most important. Public hospitals ranked *Product Availability* second behind *Completeness* which was considered most important, which was also explained.

6.4.3 Hypothesis Three – Clinical Coding

The Clinical Information Application had the hypothesis that:

- *Interoperability* will be a primary CSF for hospitals to ensure that they can communicate with other hospitals. The *Completeness* CSF is the most important CSF for IPAs and it will also hold some importance for hospitals.

Figure 19 shows the initial hypothesis to be correct. *Completeness* was the most important CSF for IPAs and *Interoperability* was the most important for public hospitals.

6.4.4 Hypothesis Four – Information Exchange Protocols

The Information Exchange application had the hypothesis that:

- The *Completeness* CSF will hold relevance for hospitals, whereas IPAs will focus on the *Interoperability* CSF.

The hypothesis for this application area was correct. It was found that *Completeness* was the most important CSF for public hospitals and that *Interoperability* was the most important for IPAs.

6.4.5 Hypothesis Five – Information Systems Management

The final hypothesis was for Information Systems Management, it had the hypothesis that:

- Both public hospitals and IPAs will consider *Product Availability* to be the most important CSF.

Two important elements can be taken from Figure 21. Firstly, the initial hypothesis was found to be correct, and secondly that there is a great deal of disagreement between the importance of the CSFs between the two organisations, (also shown by the lowest ranking being two).

6.4.6 Summary of Hypotheses

The hypothesis for the overall adoption of standards had the most important result. It found that *Completeness* was the most important CSF for IPAs, public hospitals and private hospitals, although IPAs and public hospitals had two ranked first equal (*Interoperability* was the other for IPAs, and *Maturity and Stability* for public hospitals).

The other hypotheses were also significant in that they established that public hospitals and IPAs organisations rank the CSFs for different application areas differently. This consequently implies that the SAF can not be generalised across organisations but does encompass all of the crucial elements for each organisation.

6.5 Comments from Open-Ended Questions

It was appropriate when completing the survey to include an area for the respondents to write comments answering specific questions and about the survey overall.

The first question asked, "What do you think differentiates a Health Information Systems standard from any other standards application?"

As already noted three main schools of thinking were identified. The first felt that HIS standards were different because of the direct need for confidentiality and privacy. The second school felt that HIS standards were different because they were involved with health, and all that health encompasses. The final group felt that they were not different from any other standards adoption process.

This result is consistent with the completed literature review in the fact that standards are essential within healthcare as they can help control security and privacy issues, as well as allow for reliable data exchange and interoperability across organisations and platforms. However, standards are also relevant within society in general, in that it can help create uniformity amongst products and consumer and buyer (for example).

The second question asked, "What do you perceive the usage of health standards to be at present?"

The answer to this question, was an almost unanimous low or poor. This result was expected although it is in direct opposition to an interesting article presented by Healthlink New Zealand (1998). This article was written about the use of EDI in the New Zealand Health Sector. It wrote that the "second largest electronic commerce

application in New Zealand is in fact that of transmission of pathology and radiology data amongst 37 laboratories, 16 hospitals and over 300 medical practices from Kaikohe in the north to Invercargill in the south and everywhere in between. Since 1994 when Electronic Data Interchange (EDI) arrived in the health sector, growth has been dramatic."

This article is an important one with regard to New Zealand healthcare. Perhaps people are aware of the possibilities that standards encompass yet are not aware of the extent to which New Zealand is already utilising them.

The third question was looking to the future and asked, "What do you perceive the usage of standards to be in the future?"

The general theme from this question was that standards usage will increase as their needs and benefits become more understood. An interesting sub-theme that became apparent was the lack of guidance and leadership for these organisations.

It seems that once people have realised that they need a standard (the first step), there is no obvious place where they can look to find information about a standard (the second step), and this is indeed a problem. In essence who exactly owns the problem, is also a problem. Do the doctors, managers, CEO's, NZHIS or even the MoH have to provide information about standards?

One possible solution to this would be for someone to provide a mechanism that would allow for IS standards to be stored in one common location. At present common places for people to get information include the Internet, conferences and by communication with other people. Ideally a discussion group or notice board may prove effective in this circumstance. The NZHIS has initiated something like this on the web, but it seems that its usage is relatively uncommon at this stage.

The final question asked, "Which areas do you feel require the most urgent attention with regard to standards within New Zealand healthcare?"

This question resulted in a form of 'wish-list' for standards adoption that covered areas from referral and discharge, to disease coding, to patients and clinicians. The basic premise that can be taken from the responses to this question is that there exists a wide range of possibilities for standards adoption within New Zealand healthcare.

The open-ended questions concluded with a section for comments, questions and criticisms about the survey in general. While the vast majority of respondents left this section blank or gave positive comments, there were a few who felt that the survey was:

- Confusing
- Most of this IT information requirements is too far above general knowledge for most GP's
- Most of what this document refers to is foreign to me. I'm sure its all important but I'm only a user. Our priorities lie elsewhere

Although these responses were somewhat negative, they are not of great concern to the overall undertaking of the project. The survey was meant for the IS Manager (when they existed) and did not consciously encompass any information gathering about patients and their problems. It was felt that it was made relatively clear within both the Cover Letter and the Information Sheet who the survey was designed to be completed by. When in certain situations the IS manager did not complete the survey it was still possible to get detailed and accurate information.

One point that must be mentioned with regard to the lack of an IS manager within some organisations, would be to question how well they can do without one. Often it is a doctor or someone with a medical background that will have to take charge of the information system. This in itself may be an unnecessary risk, and may be detrimental in the long term. At the very least an IS manager could help ensure that the data (whatever form it may take) is stored securely with back up and virus detection facilities. After all it is the raw data which is of primary concern to many people.

The next section will discuss some of the broader issues of the research.

6.6 General Issues

Once the compilation of the results had been done, and the hypotheses and models checked a number of important issues became apparent.

6.6.1 Issues within the CSFs

It became apparent that *Completeness* CSF was the most important, as were the individual components within. The two most important components of this CSF were that the standard:

- Meets the required need
- Provides the required functionality

These two points are interesting because they both seem to be very re-active rather than pro-active with regard to the uptake of standards. It seems that people are more willing to adopt a standard once a need for it has been established rather than adopting a standard initially to solve a problem.

Perhaps as people understand the potential benefits and possibilities of standards they may start to be adopted before a foreseen need or problem has arisen.

Another interesting result was the relative unimportance of the CSF *Problems and Limitations*. This however could possibly be explained. A standard (in general) has undergone a lot of testing and compliance assurance through vendors and committees (at least) before it can be called a standard, hence the different level of standards which exist.

Perhaps when people adopt standards they presume that the problems and limitations have been eradicated. Another possibility is that the standards are scrutinised for problems and limitations somewhat sub-consciously. That is, a standard that is known to have problems would not even be selected for possible adoption anyway.

6.6.2 The Issue of Time

Another significant issue within this research project, as discussed within the literature review was the concept of the timing of a standard. That is, is it better for developers to spend more time developing a standard, thereby making it more correct and usable, thereby making itself out-of-date? Or is it more appropriate to have a relatively fast turn over of standards, meaning that standards may be released with faults and limitations not properly resolved?

The continuation of this question involves the timeframe that the standard should be adopted in by a user. Should an organisation delay adopting a standard, so to ensure that other organisations will utilise it as well, or should an organisation be the first to uptake the standard to be on the leading edge, at the risk that other organisations may choose to utilise another standard?

The answers to these questions are not obvious. It would however, almost seem more harmful for standards developers to release a standard with faults and errors, creating an even worse perspective of standards, and a less than positive impression of their organisation.

Similarly, an organisation would have to go through an appropriate decision making process to ensure that the standard they were about to adopt was correct and appropriate.

6.6.3 Nolan's Stages of Growth

It became apparent (relatively early on in the results gathering process) that many of the surveyed organisations do not utilise IS Management standards. This came as a revelation, as it would seem obvious (to an IS graduate) that data of this nature would need as much protection, security, and disaster recovery procedures, as humanly possible (indeed this sort of data is why standards are adopted).

Reasons why these standards are not adopted could be somewhat similar as to the reasons why many other standards are not adopted, they are perhaps too costly, too hard

to implement, and (as with many other tasks) inadequate resources are available to complete the task properly.

Nolan's Stages of Growth theory (shown in Table 7) may provide another reason why these standards are not yet adopted.

The final stage of Nolan's theory involved 'Maturity', and discusses the technology and management process as being integrated. The issues of management integration (and therefore the associated standards) as per Nolan are apparently one of the last things to occur. From this it is possible to note that NZ healthcare is not yet at the 'Maturity' stage of Nolan's theory.

As already discussed Nolan's theory introduces a number of phases that technology tends to go through as it evolves throughout an organisation.

Accordingly another relevant component of the Nolan's Stages of Growth theory is the 'Control' phase. This phase is concerned with the monetary costs associated with the technology. It became apparent that many of the organisations are at this phase, as they try to deal with increased costs, increased output and decreased monetary input.

As already discussed within literature it seems apparent that those organisations who are unwilling to increase their use of technology, and therefore apply the appropriate standards, will be unlikely to succeed in the new era of computerised healthcare.

Chapter 7 Conclusion

Incunabula. An art or industry in the early stages of development.
(Oksala et al, 1996)

In order to conclude this research project, it is appropriate to go to the initial research questions, and formally note what was found. Conclusions from the overall aspect of this research will also be discussed. These conclusions are made taking into account the literature review from Chapter Two, the limitations noted in Chapter One and the results from the Healthcare survey (as shown in Chapter Five).

7.1 Research Questions

Four major research questions were identified at the beginning of this research project. The researched answers to these questions are as follows.

7.1.1 Question One

The first question was used to initiate the literature review:

- Identify why people adopt standards

Hogan and Radack (1997) stated that standards are essential because they allow for different products, developed by different vendors to inter-operate. Scott-Hill suggested that standards facilitate trade and manufacture, and provide a platform for business process re-engineering among other things.

Within healthcare, standards were deemed as being essential for many reasons. The need for confidentiality and privacy was prominent because of the nature of the data. The modernisation of Medical Health Records was another reason, as was the capabilities of technology and communications as introduced by Zelmer (1998).

There was no question within the survey that asked why the organisations adopted standards, although when standards were adopted they were nearly always adopted by the organisations own choice. This implies that there is a certain amount of freedom with regard to people choosing to adopt a particular standard.

The most critical reason for adopting standards is provided by Hovenga et al (1996). Hovenga et al states that within health informatics the widespread adoption of standards is expected to improve the health of the nation's population at a lower cost by improving the ability of health professionals, public and health service administrators to share and make better use of the information generated.

7.1.2 Question Two

The next research question involved model creation:

- Identify the critical success factors that are proposed within literature which encourage the adoption of a specific standard.

This research question initiated the development of the Standards Adoption Framework (Figure 3). This model was created taking into account a number of different pieces of literature. The different pieces of literature were used to help increase the validity of the model and to secondly ensure that the framework is taking into account the largest number of appropriate variables as possible.

The final SAF had six individual categories (named CSF): *Completeness*, *Interoperability*, *Level of Consensus*, *Maturity/Stability*, *Product Availability* and *Problems and Limitations*, that were tested over four different application areas (namely Technology Infrastructure, Clinical Coding, Information Systems Management and Information Exchange protocols.

7.1.3 Question Three

The next research question brought NZ healthcare into focus:

- Identify which information systems standards are being adopted within New Zealand healthcare.

The results of this question are interesting. Seven standards came through as being utilised by all three types of organisations, or well utilised by both IPAs and public hospitals. These are shown within their appropriate application area in Table 15.

Application	Utilised Standard
Technology Infrastructure	Windows Operating Systems
	Access Database
	Unix Database
	TCP/IP Communication Protocol
Clinical Coding	ICD10-CMA
Information Systems Exchange – HL7	NZHIS Standards for NHI and MWS
	Laboratory and Radiology Results
Information Systems Management	None

Table 15 – Standards Used within New Zealand Healthcare

The Technology Infrastructure standards are well known across many different organisations and application areas. The Clinical Coding standard is being implemented by legislation later this year, so it is no real surprise that this is the most common Clinical coding standard. The NZHIS have dispersed their standard through many healthcare organisations, and Information Systems Management has no common standard or apparent usage.

7.1.4 Question Four

The final research question involved testing of the SAF and the different application areas:

- Ascertain if the SAF is generalisable across different application areas, and different organisations.

The results of the survey found that the *Completeness* CSF was the most important factor across all of the analysed organisations of public and private hospitals and IPAs. Therefore implying that organisations want a standard that:

- Is based on an understood technology
- Is compatible with other standards
- Can be tested to prove compliance
- Meets the required need
- Provides the required functionality
- Is free from legal issues
- Is clear

Within the CSFs many individual questions were posed. The majority of the questions (that were statistically measured) had a mean rating of above three implying that all of the questions were of at least 'Some Importance' in the decision making process. This consequently validates all of the components within the SAF making it a relevant tool within the decision making process.

Figure 1 also presented a method for testing the research model. This questioned whether the model was generalisable across the different sample groups, and if it was not generalisable if there was a significant difference between the applications.

The results of the survey found that the SAF was not generalisable across all three organisations but does show that the SAF was broad enough to encompass all of the requirements for each different organisation.

That is, different organisations have their own view of what is important when adopting standards, and that these views will differ across different applications. This was highlighted by the different application areas each having different CSF rankings for different organisations.

This implies all of the aspects of the SAF are of importance when adopting standards and cannot be discarded to make a more definitive model.

This is consistent with Nolan's Stages of Growth theory that was proposed, suggesting that different sized organisations are at different stages with their use of computers. This theory was very useful as it emphasised that although organisations may be completing the same tasks, the degree of usage of the computers may in fact be different. The difference between public hospitals and private hospitals was a clear indication of this theory.

7.2 Recommendations

People within NZ healthcare recognise a need for standards. Unfortunately, that is where the positive solidarity for HIS standards ends. The organisations that constitute NZ healthcare are being controlled by their ever-increasing need for more money, and the associated problem of having to do more with even less money. Consequently best practices can not always be completed (either consciously or sub-consciously).

People within NZ healthcare also acknowledge that standard usage is low at present, but that it is going to going to expand soon.

For information systems standards to be utilised effectively within NZ healthcare a number of important elements will have to occur:

For standards adopters:

- Information on appropriate standards must be placed in one appropriate store and disseminated to the appropriate people within the organisations, whether they be IS managers, or doctors.

- A concerted effort must be made to ensure that information about standards is provided to everyone, not just obvious users so, that people will be less resistant and more educated about standards usage.

- Technology, and its associated benefits and pit-falls will have to be acknowledged and used by organisations that do not presently acknowledge it.

- Information Systems Management standards should become more prominent in their use within healthcare organisations. This will help ensure that data is safe and secure and is being stored in the most appropriate manner. Ideally these standards will be adopted before any data is lost or corrupted in some way; ideally these standards will be adopted in a pro-active manner.

For standards developers:

- A link between the IS manager and standards developers will help ensure that the standards are being developed appropriately and efficiently.

- Developers should aim to focus on standards that are appropriate specifically to healthcare, in that the data may have high confidentiality risks, and need to be transported in different forms.

Ideally once these goals have been achieved, and the communication between the relevant parties increases, the uses of standards and their appropriateness within healthcare will be openly acknowledged and well utilised.

7.3 Future Work

There are many interesting questions that could be developed from this research; these include:

- Repeating the survey at a later stage to identify any changes, thereby making it more reliable as a longitudinal survey rather than as a cross sectional survey.
- Adapting the SAF to cater for any standard adoption process, not just within healthcare.
- Increasing the application of standards surveyed taking into account images (X-Rays), physical results and the like.
- Completing case studies within organisations that deal with the actual implementation of a standard, to ascertain what, or how the process of standards' adoption is completed. This could be extended to allow for inter-organisation comparisons, and making a form of Standards Adoption Methodology.
- A study to compare New Zealand HIS standards with Australian HIS standards and possibly other countries.
- Compare which standards New Zealand and Australia are using and why these particular standards were adopted. A very real possibility because of both the New Zealand and Australian Standards Organisations aiming to work together.
- Ascertain if the standards adopted within New Zealand healthcare appear to match the CSFs as explained by the SAF. This offers the opportunity to get into the individual standards and learn what each encompasses.

Endless opportunities exist within this area. The field is growing at such a fast rate, that it seems that the more information that is gathered, the more that will be required, and the more conscious the decision making process for standards adoption will become.

7.4 Thesis Summary

The overall aim of this research project was to ascertain why organisations within healthcare choose to adopt one standard over another. To aid this the Standards Adoption Framework was created which groups specific questions into appropriate categories.

A survey was then provided to people within three groups of New Zealand healthcare, namely public hospitals, private hospitals and IPAs. The survey gathered data about the nature of computer usage within the organisation, the different standards adopted and their ranking of the different categories of the standards adoption framework.

The results found that different organisations differ in their choice of standards, and that they also differ within application areas. The 'Completeness' of the standard was the most important factor for the organisations, as they want a standard that meets the required need and provides the required functionality.

This research project touches on a number of important elements that could be extended into many research possibilities. This report is an accurate portrayal of a growing and changing environment, which is fast paced and evolving at a pace faster than many are comfortable with. It is hoped that this will help those involved in the standards adoption process become aware of what standards exist, and why they are (or are not) utilised.

Glossary

ADT – Admission, Discharge, Transfer

ASA – American Statistical Association

Completeness CSF

The ability of the standard to cover the required features.

CSF – Critical Success Factor

Created from different pieces of literature to be able to test why one standard would be adopted over another standard.

DICOM - Digital Imaging and Communications in Medicine

DICOM protocols are image messaging formats (Jachinowski et al, 1997).

EMR – Electronic Medical Record

An EMR encompasses the paper based medical records placed onto an electronic medium.

GPs – General Practitioners

HFA – Health Funding Authority

The HFA funds personal health, disability support, and public health services.

HIS – Health Information Systems

HL7 – Health Level 7

HL7 is a computer application protocol for electronic data exchange in healthcare environments.

ICD10-CMA – International Statistical Classification of Diseases and Related Health Problems - Tenth Revision.

This classification superseded ICD9-CMA for morbidity coding in healthcare facilities.

ICD9-CMA – International Statistical Classification of Diseases and Related Health Problems - Ninth Revision

Interoperability CSF

The ability of the standard to co-operate with other applications.

IPA – Independent Practitioners Association

Groups of General Practitioners working together as a single organisation.

IS – Information systems

Information systems incorporate technology to share, transfer, store and manipulate the data requirements of an organisation or between organisations.

ISO – International Organisation for Standards

An international organisation concerned with the development of standards.

ISR – Information systems research

Involves research in the area of information systems.

IT – Information Technology

Level Of Consensus CSF

The degree of awareness which exists about the standard.

Maturity/Stability CSF

The length of time the standard has been known.

MoH – Ministry of Health

Ministry of Health which provides overarching policy advice to the Government.

MRI – Medical Records Institute

New Zealand healthcare

Has been defined within this research project to consist of three essential components namely, public hospitals, private hospitals and IPAs.

NIST –National Institute of Standards and Technology

NZHIS – New Zealand Health Information Service

The New Zealand Health Information Service (NZHIS) is a group within the Ministry of Health responsible for the collection and dissemination of health-related information (NZHISa, 1998).

Private Hospitals

Private healthcare providers include private hospitals, laboratories, and radiology centres and general practitioners (NZ Health, 1998).

Problems/Limitations CSF

The number of faults within the standard.

Product Availability CSF

The range of applications and accessibility of the standard.

Public Hospital

New Zealand public hospitals are owned by organisations called Health and Hospital Services. Some HHS have one hospital, others have several. The 23 main hospitals were included within the sample group for this research project (New Zealand Hospitals Online, 1998).

SAF – Standards' Adoption Framework

A framework developed specifically for use within this research project.

SANZ – Standards Association of New Zealand

The old name of Standards New Zealand.

SEER – Surveillance, Epidemiology and End Results

A project that collects cancer data on a routine basis from designated population-based cancer registries in various areas of the country of the National Cancer Institute.

SNZ – Standards New Zealand

Standard

Defined within this research project to be a published document that sets out (at least) the minimum requirements necessary for a material, structure, product, method, system or even systems which are interconnected to do the job that it (or they) are intended for.

Appendix 1 Initial Cover Letter

<Name>
<Role>
<Address1>
<Address2>
<Location>
«Location»

<Date>

Dear <Name>,

We are conducting a survey on the Use of Standards for Information Systems within New Zealand Healthcare. The findings of the survey will be used by the Standards New Zealand committee on Electronic Medical Records of which I am the chair.

The research involves gaining an understanding of which information systems standards are presently used within New Zealand healthcare and why these particular standards have been adopted.

With the help of Liz Weston (Research Assistant) a questionnaire has been prepared that would best be completed by an Information Systems/Technologist staff member. The survey has been sent to both healthcare organisations and those who supply services or products to such healthcare organisations. It would be greatly appreciated if you could aid our research by giving this survey to the appropriate person in your organisation, or by completing it yourself.

A stamped, self-addressed envelope is enclosed for you to return the completed questionnaire, as well as a detailed information sheet answering any initial questions that you may have. We would be grateful to receive a response before 18 October 1998. The envelopes may be numerically coded to ensure the highest response rate possible, however once collected, utmost confidentiality can be assured.

Any questions or doubts can be directed towards:
Dr Richard Whiddett
Liz Weston
Department of Information Systems
Massey University
Ph (06) 356 9099
R.J.Whiddett@massey.ac.nz
L.S.Weston@massey.ac.nz

Thank you for your time and attention.
Yours faithfully

pp. Dr Richard Whiddett

Appendix 2 Re-send Cover Letter

«Name»
«Role»
«Organisation»
«Address»
«Address2»
«Location»

5 November, 1998

Dear «Name»,

Re: A survey on the Use of Standards for Information Systems within New Zealand Healthcare

You may remember the above survey that was sent to you in early October. As of <date>, our records show that we have not yet received a response from your organisation. If you have subsequently sent the survey, thank you, and please disregard this letter.

It would be greatly appreciated if you could complete this survey or pass it on to the most appropriate person in your organisation to do so. The survey is a vital part of my Masters degree as well as of great importance to the development of Health Informatics Standards in New Zealand. The findings of this survey will be used by the Standards New Zealand Committee on electronic medical records which is chaired by my supervisor Dr Whiddett.

I have enclosed another copy of the survey in case you mislaid the initial copy. It is possible to obtain a summary of the results if the form on page 17 of the survey is completed. We would appreciate for the survey to be returned by <date> 1998.

Please feel free to direct any questions or doubts towards:
Liz Weston
Dr Richard Whiddett
Department of Information Systems
Massey University
Ph (06) 356 9099
L.S.Weston@massey.ac.nz
R.J.Whiddett@massey.ac.nz

Thank you for your time and attention.

Yours faithfully

Liz Weston

Appendix 3 Message on Discussion Board

Dear Subscribers,

I am a lecturer in Information Systems at Massey University with a particular interest in Health Informatics and I sit on a number of Health Informatics standards committees.

We are conducting research into the adoption of information systems standards in healthcare in New Zealand.

The aim of the research is to identify which standards are being adopted in New Zealand, what qualities people see as being important in a standard and what influences the adoption of a particular standard.

The research is questionnaire based. If anyone reading this email would be willing to participate in the study would they please contact myself or my research assistant and we will send you a copy of the questionnaire by post or as an attachment.

A report of the findings will be sent to participants if they request one.

Dick Whiddett and Liz Weston

Appendix 4 Information Sheet

The Adoption of Standards for Information Systems within New Zealand Healthcare

INFORMATION SHEET

Researcher: Liz Weston, Masterate student enrolled in a MSc.

Supervisor: Dr Richard Whiddett.

Contact Details: Department of Information Systems
Massey University
Telephone: 06-356 9099
Facsimile: 06-350 5725
Email L.S.Weston@massey.ac.nz, R.J.Whiddett@massey.ac.nz

The purpose of this study is to gain an understanding of which Information Systems standards are being utilised within the New Zealand healthcare environment. This will extend to an understanding of why these standards are being utilised and the identification of critical success factors which cause particular standards to be adopted.

A standard can be defined as a published document that sets out (at least) the minimum requirements necessary for a material, structure, product, method, system or even systems which are interconnected to do the job that it (or they) are intended for. Standards have many benefits associated with them, these include the acceleration of information transfer and retrieval, the ability to introduce new and improved commerce services, the facilitation of trade and manufacture, as well as a platform for business process re-engineering.

Standards within healthcare hold these benefits and many more. Whether Healthcare agencies are being threatened by government reform, the onset of managed care, or decreasing reimbursements, providers are experiencing increased pressure to reduce costs. At the same time they are being asked to better document all aspects of patient care, accurately measure utilisation, track treatment effectiveness via outcomes, and refine practice guidelines based on cost/outcome information, often across multiple modalities. Suggested ways for providers to meet such varied challenges are through utilising wide area communication, improving documentation and reporting, and increasing documentation - not via a traditional paper, medical chart. The only way this can be carried out is through the use of Information Systems that conform to standards to control and ensure compliance between all of the individual components.

Whilst many acknowledge that standards are important, few are willing to put forward what is exactly required from a standard, or indeed why one standard is considered to be more appropriate over another standard. Accordingly, this research project, aims to validate a framework which has been created, to ascertain what the critical success factors are when selecting and utilising a standard.

You will be asked to complete and return the survey covering a range of issues with regard to the adoption and application of standards. It is hoped that you will answer each question with regard to your entire organisation rather than with your own personal view. This will then determine the desirable characteristics for a standard related to an Information System that is to be used within the health arena.

Participation

There are at least two groups of potential participants within this project. The first of these will be the Information Systems/Technology specialist within each Hospital and each Independent Practitioners Association (IPA's).

The second group is the Service providers and suppliers to these Healthcare Organisations.

Both groups of potential participants will have the ability to not reply and/or not answer to the survey. However, it will be assumed that filling in and returning of the questionnaire implies consent. You have the right to decline to answer any particular questions.

The information that you provide in the questionnaire should take into account your organisation's policy. It is envisioned that a questionnaire will take no more than one hour of your time. I am very aware of the limited amount of time that you have available to participate in this research project.

The data obtained during the project will be kept in a secure manner, either in a locked filing cabinet or securely on a stand-alone computer and will be collated in an anonymous manner as it is indeed the aggregate data that is of interest.

Anonymity and confidentiality

Any information given to the project will be confidential to the research project and any publications arising from it. Your individual identity will be anonymous. In some instances the return envelope may be numerically coded to ensure the highest possible return rate, however once the survey is collected utmost confidentiality can be assured.

Your Rights

You have the right to:

- Decline to participate in the questionnaire.
- Take time to consider and discuss participation with others if desired.
- Refuse to answer any particular questions.
- Ask any questions about the study at any time during participation.
- Provide information on the understanding that your name will not be used unless permission is given to the researcher.
- Be given access to a summary of the findings of the study.

There is no penalty from declining to participate or from withdrawing from the research project at any stage.

I hope that the aspirations of this research have become clear to you, and that the short time required to complete the survey will be worth your while. It is important that standards within the health sector, become recognised, understood and adhered to.

Thank you for taking the time to read this information.

Liz Weston

Appendix 5 Healthcare Survey

The Use of Standards for Information Systems within New Zealand Healthcare

Healthcare Organisation

Please complete each item on this questionnaire by circling the appropriate answer or supplying the appropriate information and returning the completed questionnaire, with privacy and confidentiality assured, in the enclosed stamped self-addressed envelope.

Section One: Demographics

The purpose of this section is to gather information about the background of the respondent and the associated organisation.

1.1) Please indicate your current job title _____

1.2) Please indicate how long you have been working within this organisation

Less than 1 year	1 to 2 Years
2 to 5 Years	5 + years

1.3) Please indicate which category your organisation could best be considered as

Hospital	IPA
IT Service Provider	Healthcare Service Provider
Hardware or Software Supplier	Other – please specify

1.4) Please indicate the number of Information Technologist/Systems staff that are employed within your organisation (excluding those working solely as help desk operators)

0	1- 2
3 - 5	6 - 10
10 +	

Section Two: Organisational Characteristics

The purpose of this section is to gather information about the nature and extent of the use of Information Systems within your organisation.

2.1) Is your health care organisation computerised? Yes No

If your health care organisation **is not** computerised, do you intend to computerise within the next 12 months? Yes No

2.2) Please indicate what tasks are computerised or are likely to be in the near future. Please circle as many as needed, and add any as required:

Appointments	Age-sex register
Recalls	Prescriptions
Disease register	Letter writing/referrals
Laboratory results	E-mail
Clinical notes	Desktop Publishing
Word processing (eg. Word)	Presentation software (eg. Powerpoint)
Databases (eg. Access)	Games
Financial management	Programming
Spreadsheets (eg. Excel)	Report Generation
Other – please specify	

2.3) Please circle what forms of internal/external electronic communications are used?

Phone	Fax
E-mail	Internet
Local Area Network (LAN)	Dedicated Wide Area Network
Other – please specify	

2.4) Please circle which tasks require communication with another location?

Appointments	Financial management
Recalls	Age-sex register
Disease register	Prescriptions
Laboratory results	Letter writing/referrals
Clinical notes	Other - please specify

2.5) Please indicate the approximate number of machines you have responsibility for and/or influence over

Mainframe	1	2-5	6-20	21+
Mid-range/Network servers	1	2-5	6-20	21+
PC/Work station/Terminal	1	2-5	6-20	21+

Section Three: Standards Selection Process

The purpose of this section is to identify factors which influence the process by which particular standards are selected for adoption. Please refer to Appendix One for a list of examples.

3.1) Please indicate the job title(s) of the person (or persons) who selects standards for adoption _____

3.2) Please indicate the job title of the person who ensures that these standards are adhered to _____

3.3) Please indicate the most recent IT standard that has been adopted by your organisation? _____

3.3a) How long has this standard been in place?

Less than 6 months	6 months to 1 Year
1 to 2 Years	2 + years

3.3b) How long did this standard take to be adopted?

Less than 6 months	6 months to 1 Year
1 to- 2 Years	2 + years

3.3c) Please indicate for what reason was this standard was adopted?

Legislation	Contractual requirements
Own choice	Other – please specify

3.4) Please indicate how people within your organisation are made aware of the adoption of new standards?

Meetings	Memo
E-mail	Word of Mouth
Other – please specify	

3.5) In general does your organisation choose to follow or adopt standards through choice? Yes No

If standards **are not** adopted through choice, please indicate who imposes them, and under what circumstances.

_____

_____

_____

_____

3.6) Please indicate where the information about different health information systems standards is found.

_____

_____

_____

_____

Section Four: Characteristics Influencing the Adoption of Standards

The purpose of this section is to identify the importance of different characteristics that may influence the choice of a particular standard.

From our research we have identified six categories that influence that choice of a standard, this has been named the **Standards' Adoption Framework**.

4.1) In the first instance, please **rank** the relative importance of these categories from one to six, with one being the most significant category when adopting a standard and six being the least significant category. Please use each number only once.

Standards' Adoption Framework

Rank 1– Most significant 6 -Least significant

Level Of Consensus [ ]
The degree of awareness which exists about the standard.

Product Availability [ ]
The range of applications and accessibility of the standard.

Completeness [ ]
The ability of the standard to cover the required features.

Maturity/Stability [ ]
The length of time the standard has been known.

Problems/Limitations [ ]
The number of faults within the standard.

Interoperability [ ]
The ability of the standard to cooperate with other applications.

The next section asks you to consider the importance of individual factors within each category. Please **score** each item below according to the importance that item has for you when adopting a standard for Information Systems. Please answer each item independently of the others. This question may take some time to answer.

1 = no importance	2 = little importance	3 = some importance
4 = great importance	5 = very great importance	

4.2) When you are evaluating a standard or product how important are the following factors to your choice?

The installed base of standards utilised in other locations	1	2	3	4	5
The level of acceptance the standard has	1	2	3	4	5
The level of support the standard has	1	2	3	4	5
The demonstrated effectiveness of the standard	1	2	3	4	5
The current status of the standard (ie selecting a de jure standard over a de facto one)?	1	2	3	4	5

4.3) When considering the availability of standards, how important are the following factors to your choice?

That the standard be available from a number of vendors	1	2	3	4	5
The vendor has viability	1	2	3	4	5

1 = no importance	2 = little importance	3 = some importance
4 = great importance	5 = very great importance	

4.4) When considering the completeness of a standard, how important are the following factors to your choice?

That the standard is based on an understood technology	1	2	3	4	5
That the standard is compatible with other standards	1	2	3	4	5
That the standard has procedures for testing and proving compliance	1	2	3	4	5
The standard meets the required need	1	2	3	4	5
The standard provides the required functionality	1	2	3	4	5
The standard is free from legal issues E.g. copyright or ownership disputes	1	2	3	4	5
The standards is clear	1	2	3	4	5

4.5) When considering the maturity and stability of a standard, how important are the following factors to your choice?

That there are conformant products already on the market	1	2	3	4	5
That it has matured enough to ensure no major changes will occur immediately	1	2	3	4	5

4.6) When considering the problems and limitations of a standard, how important are the following factors to your choice?

Problems which exist with the standard	1	2	3	4	5
Please give an example?	_____				
Limitations which exist with the standard	1	2	3	4	5
Please give an example?	_____				

1 = no importance	2 = little importance	3 = some importance
4 = great importance	5 = very great importance	

4.7) When considering the portability of a standard, how important are the following factors to your choice?

The application is portable	1	2	3	4	5
The scale to which the standard can be applied	1	2	3	4	5
Interoperability with other standards	1	2	3	4	5
Ability to add new technologies	1	2	3	4	5

4.8) Please add any additional factors that are important for you below, with a score from 1-5.

_____	1	2	3	4	5
_____	1	2	3	4	5
_____	1	2	3	4	5
_____	1	2	3	4	5
_____	1	2	3	4	5

Section Five: Standard Usage

Standards can be used in a wide variety of areas. The survey will only focus on a small number of areas. These are Technology Infrastructure, Clinical Information, Information Exchange Protocols and Information Systems Management. For each of these areas please indicate which standards are used by your organisation and indicate which category of the Standards' Adoption Framework is the most significant for each particular area. A list of additional possible standards can be found in Appendix One.

Technology Infrastructure

Please indicate which (if any) standards are being utilised within your organisation by circling those in use. If none of the indicated standards are used please indicate any other standards which are used.

5.1) Operating Systems Software	Windows 95/98	Windows NT	OS2	
	Unix	Windows 3.11	Pick	
	Not Applicable			
	Other – please specify			
5.2) Database Software	Access	Oracle	DB2	Paradox
	Object Store	Gemstone	Foxpro	
	Not Applicable			
	Other – please specify			
5.3) Communications Protocols	TCP IP	IPX/SPX	X25	
	ISDN	FDDI	IEEE 802	
	Not Applicable			
	Other – please specify			

Please **rank** the relative importance that the categories from the Standards' Adoption Framework have on the adoption of a **Technology Infrastructure Standard**. Please use each number only once.

Rank 1 – Most Significant 6 –Least Significant

Level Of Consensus	[ ]
Product Availability	[ ]
Completeness	[ ]
Maturity/Stability	[ ]
Problems/Limitations	[ ]
Interoperability	[ ]

Clinical Information

Please indicate which (if any) standards are being utilised within your organisation by circling those in use. If none of the indicated standards are used please indicate any other standards which are used.

5.5) Clinical Codes

ICD9-CMA ICD-10-AM

Read Codes

LOINC - Laboratory and Radiology Codes

Not Applicable

Other – please specify

5.6) Please **rank** the relative importance that the categories from the Standards' Adoption Framework have on the adoption of a **Clinical Information Standard**. Please use each number only once.

Rank 1 – Most significant 6 –Least significant

Level Of Consensus	[ ]
Product Availability	[ ]
Completeness	[ ]
Maturity/Stability	[ ]
Problems/Limitations	[ ]
Interoperability	[ ]

Information Exchange Protocols

Please indicate which (if any) standards are being utilised within your organisation by circling those in use. If none of the indicated standards are used please indicate any other standards which are used.

5.7) Health Level 7 Communication Standards	NZHIS standards for NHI and MWS Referral, Status and Discharge Laboratory and Radiology Orders Laboratory and Radiology Results HBL GMS Claims and Payments Not Applicable Other – please specify

5.8) Please indicate which version of HL7 you are using _____

5.9) EDIFACT Standards	ACC Billing and Payments Not Applicable Other – please specify
5.10) Information Exchange	NEMA PS 3.1 Digital imaging and Communications in Medicine (DICOM) Other – please specify

5.11) Please **rank** the relative importance that the categories from the Standards' Adoption Framework have on the adoption of an **Information Exchange Protocol**. Please use each number only once.

Rank	1 – Most significant	6 – Least significant
Level Of Consensus		[ ]
Product Availability		[ ]
Completeness		[ ]
Maturity/Stability		[ ]
Problems/Limitations		[ ]
Interoperability		[ ]

Information Systems Management

Please indicate which (if any) standards are being utilised within your organisation by circling those in use. If none of the indicated standards are used please indicate any other standards which are used.

5.12) Security	NZS 4444 Information Security Management Not Applicable Other – please specify
5.13) Privacy	AS4400 Personal Privacy Protection in Healthcare Information Systems Not Applicable Other – please specify
5.14) Disaster Recovery	NFPA 1600 Recommended Practice for Disaster Management Not Applicable Other – please specify

5.15) Please **rank** the relative importance that the categories from the Standards' Adoption Framework have on the adoption of an **Information Systems Management Standard**. Please use each number only once.

Rank 1 – Most significant 6 -Least significant

Level Of Consensus	[ ]
Product Availability	[ ]
Completeness	[ ]
Maturity/Stability	[ ]
Problems/Limitations	[ ]
Interoperability	[ ]

Section Six – Open Ended Questions

This final section asks questions for which there is no definitive answer, they are questions which may require thought and/or individual opinion. If you run out of space please continue on separate sheets.

6.1) What do you think differentiates a Health Information Systems Standard from any other standard application?

6.2) What do you perceive the usage of health standards to be at present?

6.3) What do you perceive the usage of standards to be in the future?

6.4) Which areas do you feel require the most urgent attention with regard to Standards within New Zealand Healthcare?

6.5) Please feel free to make any points or comments that you would like to make with regard to this questionnaire or any of the issues within.

Thank you for taking the time to fill in this questionnaire. When finished please return it in the stamped, addressed envelope included. Any questions can be directed to either of the researchers at:

Liz Weston, Dr Richard Whiddett
Department of Information Systems
Massey University
Telephone: 06-356 9099
Facsimile: 06-350 5725
Email: L.S.Weston@massey.ac.nz, R.J.Whiddett@massey.ac.nz

If you would like to receive a summary of the finding please complete the request form on the following page.

Send a copy of the research findings to:

Name _____

_____

Address _____

_____

_____

_____

APPENDIX FOR SURVEY

Additional Health Informatics Standards

ICD9-CMA

ICD-10-AM

Read Codes

LOINC Laboratory and Radiology Codes

ASTM E1633 – Coded Values used in the Computer Based Patient Record

ASTM E1672 – Standard guide for Electronic Authentication of Health Care Information

ASTM E1769 – Standard Guide for Properties of Electronic Health and Record Systems

ATA SPEC 2000 – ASC x12 Implementation guide for Electronic Data Interchange

BSI DD ENV 1068 (CEN ENV 1068)– 1994 Medical Informatics – Healthcare Information Interchange – Registration of Coding Schemes

BSI PD 652 – Investigation of Syntaxes for Existing Interchange Formats to be Used in Healthcare

ASTM E1384 – Standard Guide for Content and Structure of the Computer Based Patient Record

ASTM E1869 – Standard Guide for Confidentiality, privacy Access and Data security Principles for Health Information Including Computer-Based Patient Records

ASTM F1221 – Standard Guide for Interagency Information Exchange E1-1995 R(1995)

BSV DD ENV 1613 – 1996 Medical Informatics – Messages for Exchange of Laboratory Information

BSI PD 6610 – Medical Informatics – Methodology for the Development of Healthcare Messages

NEMA PS 3.1 – Digital Imaging and Communications in Medicine (DICOM)

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[2] ** indicate that the reference was used within the body of literature.

[3] The date that the file was accessed has been used (~1998) hence the use of a '~'. This is because there is no common means of recognising when the file was actually written.

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