Chapter One

Introduction

The developments in information technology and information systems (IT) have brought about changes to the ways in which individuals and organisations are able to create, process, store, and transmit information. From the creation of the first computers in the 1940s to the growing use of the information super highway, technology has changed the way we view, use and value information. IT provides organisations with the ability to improve their efficiency and effectiveness. Rockart and Crescenzi (1984, 3) identified the link between IT and the improvement of business operations:

> Today, ... [IT] ... gives managers an opportunity (1) to improve delivery of their products and service and (2) to potentially increase their effectiveness and productivity in managing the businesses.

In identifying the vital importance of IT, Scott-Morton (1988, 28) wrote:

> There is no question that the new information technologies ... are having a major impact on the range of strategic options open to an organization. .... IT is not only creating an environment that is making it imperative for organizations to evolve, it is also helping them adjust to the enormous changes outside their own boundaries.

Thus IT is identified as an important ingredient in the success of an organisation.

Despite the benefits to be derived from an IT system for an organisation, many instances can be found in the literature indicating that IT initiatives have been unsuccessful. Many attempts at implementation (a sub-set of progressive use) of an integrated IT system within an organisation have been unsuccessful. Table 1.1 identifies references in the literature to problems associated with the progressive use of IT, and presents examples of quotations referring to these problems in chronological order.

Some of the quotes in Table 1.1 refer to SISP, (strategic information systems planning). This is the process of identifying a portfolio of computer-based applications that will assist an organisation in executing its business plans and realising its business goals (Lederer & Sethi 1988, 446). SISP can be identified as an example of the progressive use of IT by an organisation, as its adoption indicates the commitment of an organisation to integrate IT into its strategy plans.

Table 1.1 Problems for progressive use of IT identified in the literature

Date	Problem Statement	Author(s)	Journal
1971	It has long been recognised that SISP is an intricate and complex activity fraught with problems (p. 78)	McFarlan	*Harvard Business Review*
1976	[studies on the impact of MIS across industries] indicated that current, or planned, computer-based management information systems and their usage fall far short of their theoretical capabilities. (p. 579)	Schewe	*Academy of Management Journal*
1985	Top management and MIS directors have been increasingly urged to improve the way in which their information systems development efforts are being managed (p. 17)	Doll	*MIS Quarterly*
1987	Reports abound of systems implemented late and over budget with the anticipated savings being unrealised.(p. 390)	Lederer & Mendelow	*MIS Quarterly*
1992	... failure to execute the [SISP] plan is a serious problem ... (p. 26)	Lederer & Sethi	*Journal of MIS*
1993	The track record for [IT] implementation is not very good. (p. 23)	Benjamin & Levinson	*Sloan Management Review*

1.1 Definition of the problem

The difficulties that have been encountered with the various aspects of progressive use of IT indicate the need for research aimed at identifying factors that will facilitate successful IT initiatives. The main aim of this research dissertation is to clarify one of these factors; that is, executive support.

Chief executive officers (CEOs) of organisations need to address the extent of their commitment to progressive use of IT. Different organisation have different goals. Examples include the profit motive for business firms, efficient provision of services for government departments, and provision of quality facilities for clubs. Regardless of the specific goals adopted by an organisation, the progressive use of IT is important. This dissertation examines the role played by the CEO. This was the approach taken by Jarvenpaa and Ives (1991), whose work this dissertation sought to replicate and extend. That support provided by top management is a necessary ingredient in the progressive use of IT is well documented (Jarvenpaa and & Ives 1991, 204) . However, the appropriate behaviour of CEOs for the progressive use of IT is unclear. The research in this dissertation aimed at clarifying this behaviour.

1.2 Significance of the problem

CEOs take responsibility for the total performance of the organisation. Their time is scarce and they are required to oversee a number of different departments within the organisation. In communicating the degree of importance placed on IT, CEOs

must be able to identify the most appropriate type of support to be provided to the IT function. They need to identify the extent to which they personally engage in IT-related management activities. Examples include: participation in IT committees; developing IT skills and keeping abreast of IT developments relevant to their organisations.

It may be, however, that CEOs can better support IT by maintaining a psychological state in which they communicate to staff the critical importance of IT to the success of the organisation. Jarvenpaa and Ives (1991) identified that CEO support of a psychological nature was more effective than a set of IT-related management behaviours. This dissertation undertook similar statistical analysis and research methods to determine whether their findings could be supported in a different environment.

It was anticipated that this dissertation would add to the literature on the appropriate role of CEOs in the progressive use of IT. Specifically, it was hypothesised that the findings of Jarvenpaa and Ives (1991) would hold true in a different industry, in a different country, and at a later time. The results of testing set out in this dissertation support the theory developed in Jarvenpaa and Ives (1991), thereby strengthening general understanding of executive support for IT.

1.3 Research framework

The data for analysis in this study was collected from CEOs of Australian hospitals. This industry was chosen because its value chain (Porter & Millar 1985) can be

seen to be high in information intensity. The value chain of hospitals is one highly dependent upon information because of the critical nature of information for their output (diagnosis and treatment), internal and external communication, and establishment and operation of funding and costing systems.

Hospitals are organisations where IT is not only creating an environment where it is imperative that changes take place, but also where changes are taking place outside their own boundaries. Public hospitals are adjusting to enormous changes in funding formulae imposed by the Australian federal government and the various state governments, whilst private hospitals are undergoing similar changes to the ways in which they receive allocations from health funds. As a result of these changes, pressure is mounting within hospitals to set up cost centres and to devise and implement costing systems, thereby moving away from traditional funding allocations. In this way wards and service departments within hospitals will be able to measure their costs, and devise ways of controlling them. This is the type of evolution in IT referred to by Scott-Morton (1988, 28).

The data processing requirements needed to be developed, installed and operated to facilitate these costing systems require hospital top management to be progressive in their use of IT. Thus the hospital industry in Australia is an appropriate setting in which to test the findings of Jarvenpaa and Ives (1991).

1.4 Organisation of the dissertation

The question hierarchy as proposed by Emory and Cooper (1991, 77-80) is used as a framework for this dissertation. The management question, the research question, and the investigative questions are presented in Chapter Two, along with a consideration of the literature in relation to the progressive use of IT and the role of the CEO.

The management question is the decision that a manager must make and the problem prompting the research (Emory & Cooper 1991, 77). The research question is the single question or hypothesis that best states the objective of the research study (Emory & Cooper 1991, 78). Investigative questions are those that the researcher must answer in order to satisfactorily answer the general research question (Emory & Cooper 1991, 78-79), and are presented in the form of models describing hypothesised relationships between key variables in Chapter Two. This chapter concludes with a presentation of hypotheses developed to test the models. Chapter Three describes the methods used in the research to collect, compile, and analyse the data on which statistical analyses are carried out. Measurement questions that quantify the variables (Emory & Cooper 1991, 79-80) are presented in this chapter. Chapter Four begins with a restatement of the hypotheses and then outlines the results of the research in terms of the statistical analysis. Chapter Five provides an overview of the dissertation and a discussion of the results. It includes a consideration of the implications of the research from management and theory

perspectives. It also concludes with a discussion of the limitations of the research and areas for future research.

Throughout this dissertation executive support is defined as the support provided by the chief executive officer (CEO). The term "IT" includes information technology as well as information systems.

Chapter Two

Research and theory

In this chapter executive support and three contextual factors are examined for their effect upon the progressive use of information technology and information systems. The theoretical models used to examine executive support were those developed by Jarvenpaa and Ives (1991). This research dissertation replicates Jarvenpaa and Ives (1991) by using similar data collection and statistical analysis techniques. The sample used in this dissertation to test the models developed in Jarvenpaa and Ives (1991) was taken from the population of Australian hospitals.

The management question is presented in Section 2.1. This is the question that identifies the usefulness of the research to decision-makers or others who may benefit in practical terms. In Section 2.2 the theoretical background to the concept of executive support is presented, outlining the research of Barki and Hartwick (1989) and Jarvenpaa and Ives (1991). In Section 2.3 the research questions are presented. These are the aims of the dissertation in terms of usefulness to theory development. In Section 2.4 the investigative questions are presented. These are the questions that must be addressed to answer the research question, and are presented as theoretical models and related hypotheses. Section 2.5 contains a chapter summary.

2.1 The management question

2.1.1 Executive support

There seems to be agreement that executive support is critical to the development of effective information technology and information systems (IT). Jarvenpaa and Ives (1991, 205) wrote:

> Few nostrums have been prescribed so religiously and ignored as regularly as executive support in the development and implementation of management information systems.

The main question for examination in this dissertation is how CEOs can best support the progressive use of IT within their organisations. In recognising the need to be progressive in the use of IT, CEOs need to communicate their belief in the role to be played by IT effectively. This dissertation compares two ways in which CEOs can do this. The management question relating to executive support considers two possibilities. Is it is more effective for CEOs to take an active hands-on approach in the progressive use of IT? Conversely, is it more effective for CEOs to communicate their belief that progressive use of IT is critical for the success of the organisation?

2.1.2 Other contextual factors

Other questions for examination in this dissertation relate to ways that selected contextual factors influence the progressive use of IT in Australian hospitals.

These are the type of funding formula used by the hospital; the ownership mode of the hospital (private or public); and the size of the hospital.

Funding formulae

Broadhead (1991, 223-224) identified the predominant type of system for funding hospitals prior to 1991 as historical funding because:

> ... the primary determinant of a service's allocation is the history of past funding. That is, the allocation is based upon previous years' allocations plus or minus X percent.

A publication of the Department of Health, Housing, Local Government and Community Services (1993, 2) makes the following comment on the type of information generated using traditional systems:

> The need for better information has never been more apparent - clinicians are demanding faster and more accurate information about their patients, managers need good information about their services, and funders require improved information to ensure that the health dollar is being spent in the best possible way.

Thus the historical funding basis is not providing managers of Australian hospitals with appropriate information. Broadhead (1991, 226) characterises output-based funding as:

> ... [the] ... allocation of resources according to what is actually done, regardless of who or how many there are to be served.

Casemix funding is part of a scientific approach to producing good information about health care. It focuses on building useful classifications of patient care episodes and making good use of patient care classifications to manage health care (Eagar & Hindle 1994, 5). The form of casemix used in Australia is the Australian National Diagnosis Related Groups (DRGs). It became available in 1992 and had 527 classes (Eagar & Hindle 1994, 6). DRGs are useful because they help to understand variations in outcome, quality, or cost of care (Eagar & Hindle 1994, 9). They can therefore help build costing, and hence funding formulae.

The distinctive feature of the DRG-based funding system is that a funding (or payment) rate is agreed in advance for each type of episode of care. The hospital receives that amount every time an episode occurs. Therefore the total payments change according to changes in casemix and the number of episodes (Eagar & Hindle 1994, 20).

DRG-based funding systems give special attention to three features. These are clinical meaning; resource use homogeneity; and the right number of classes (Eagar & Hindle 1994, 1-2). Clinical meaning relates to patients in the same class having clinical similarities. Resource use homogeneity relates to patients in the same class costing roughly the same to treat.

Such systems are necessarily complex, and require the development and use of IT.

An example is a software program called COSMOS, developed to support costing of patient types. It was designed to assist hospitals that had few detailed or precise data for costing episodes of care. It allocates costs from line items in the general ledger to cost centres. Four steps are identified in Hindle (1994, 4-9) as follows:

1. Passing the costs from the general ledger to the cost centres,
2. Allocating overhead costs to patient care cost centres,
3. Removing costs not related to inpatients,
4. Distributing patient care costs among final products,
5. Data validation and analysis of the results.

Private hospitals have been moving towards a casemix system since 1994 through the establishment of the Private Insurer and Private Hospital Working Group. The executive summary sets out the level of commitment of member organisations to casemix funding (Private Insurer and Private Hospital Working Group 1994, 1):

> Private hospitals and private insurers have agreed to activate a transition process from 1 April 1995, with respect to the way in which bills are structured and benefits are paid. Emphasis has been given to the ways in which greater use might be made of casemix information. This document is intended to provide advice on appropriate ways to respond to the new opportunities.

This dissertation attempts to link the introduction of the DRG system with the progressive use of IT within Australian hospitals. It examines the proposition that

the hospitals that derive more than 50% of their funding from a DRG system will be more progressive in their use of IT than hospitals that derive their funds from other formulae.

Ownership mode

The ownership mode factor was included in this analysis to take account of the fact that many of the units included in the sample were from the public sector. Jarvenpaa and Ives (1991) drew their sample from firms listed in *Fortune 500.* These were organisations belonging to the private sector, and therefore motivated by profit.

Including the ownership mode factor in the analysis controls for the fact that CEOs of organisations in the private sector may act differently to those from the public sector. The proposition in this dissertation is that private hospitals are more progressive in their use of IT than public hospitals.

Size

The size factor was included in this analysis to identify whether larger hospitals are more progressive in their use of IT than smaller hospitals. Galbraith (1973, 4) stated:

> ... the greater the uncertainty of the task, the greater the amount of information that has to be processed between decision makers during its execution.

Galbraith (1973, 5) defines uncertainty as:

> ... the difference between the amount of information required to perform the task and the amount of information already possessed by the organisation.

One of the factors determining the amount of information needed to perform the task is the diversity of the outputs of the organisation. This can be measured by its number of different products, services, or clients (Galbraith 1973, 5). The size factor in this dissertation was measured in each hospital by its number of maintained beds. The proposition argued in this dissertation is that larger hospitals are more progressive in their use of IT than smaller hospitals.

2.2 Background to the research

To develop an understanding of executive involvement Jarvenpaa and Ives (1991) built on the theoretical foundations of the user involvement construct developed by Barki and Hartwick (1989).

2.2.1 Barki and Hartwick (1989)

Barki and Hartwick (1989) undertook a review of user involvement as it has been used in IT research and compared this with the way it has been developed in other disciplines. They began their paper with a statement of the importance of user involvement in the success of IT development:

> For more than two decades, the concept of user involvement has been

> proclaimed a critical ingredient in the success of systems development efforts (Barki & Hartwick 1989, 53).

They observed, however, that IT research to date had produced only weak correlation between user involvement and indicators of success for IT. Barki and Hartwick (1989, 55) suggested that research is needed that:

> ... attempts to delineate the intervening mechanisms that exist between user involvement and various indicants of system success.

Their study examined user involvement as applied in IT research, believing that that future research should adopt a common definition in line with that used by other disciplines:

> [IT] researchers can benefit from the accumulated knowledge of [other disciplines], learning from the mistakes, adapting the achievements, and thereby avoiding a lot of unnecessary effort (Barki & Hartwick 1989, 61).

They argued that addressing this question may explain the failure of IT research to find strong correlations in this area. Barki and Hartwick (1989, 59) found that in the IT literature, user involvement has been defined as:

> ... a series of activities or behaviours performed by potential users or their representatives in the systems development.

They compared their findings with the way in which involvement has been defined

in the literature of the psychology, marketing, and organisational behaviour, and showed that not only are these disciplines undertaking a refinement of the construct, but that they seem to be coming to uniform conclusions:

> ... researchers in these disciplines now show strikingly similar patterns of thought, having converged in their conceptualizations of the involvement construct (Barki & Hartwick 1989, 61).

In these other disciplines Barki and Hartwick (1989, 59) argue that involvement is used to describe a subjective psychological state, and that the involvement construct is used in a very different way in the IT literature to the way that it is used in the other disciplines. They recommended four changes to the ways in which the construct should be used in IT research. Firstly:

> The term "user participation" should be used instead of "user involvement" when referring to the behaviours and activities that the target users or their representatives perform in the systems development process (Barki & Hartwick 1989, 59).

Secondly, in order to attain consistency with the work of other disciplines, the term user involvement should be used to refer to:

> ... a subjective psychological state of the individual and defined as the importance and personal relevance that users attach either to a particular system or to IS in general, depending on the users' focus (Barki & Hartwick 1989, 59-60).

Their third recommendation was that further testing be carried out on user participation and user involvement. The fourth recommendation was that there is a need to:

> ... ground the concepts of user participation and user involvement in a theoretical network that explains when and how these factors influence key criterion variables ... (Barki & Hartwick 1989, 60).

Thus involvement is to be distinguished from participation.

2.2.2 Jarvenpaa and Ives (1991)

Jarvenpaa and Ives (1991) tested the framework developed by Barki and Hartwick (1989). They examined involvement and participation empirically as constructs of executive, rather than user, support. Jarvenpaa and Ives (1991) developed and tested three models that described the impact of these and other factors on what was called "progressive use of IT". This was a conceptualisation of many facets of IT evolution. They linked the problem of defining involvement, as identified by Barki and Hartwick (1989), to the problems associated with the lack of understanding of executive support. Jarvenpaa and Ives (1991, 206) wrote:

> Despite the enthusiastic calls for executive support and intuitively compelling evidence in the case study literature, little is known about the concept, and its utility remains largely unproven.

Executive support has been used to describe a wide range of activities and

attitudes. These have never been clearly defined and measured. Jarvenpaa and Ives (1991, 206) identified the failure of the IT literature to distinguish executive participation from executive involvement in the following way:

> The terms "executive participation" and "executive involvement" have been used interchangeably in much of the information systems literature to describe or prescribe the chief executive's role in IT activities.

To carry out an empirical examination of executive support, Jarvenpaa and Ives (1991) developed measurements for executive participation and executive involvement. They developed two models to describe the relationships between these and the progressive use of IT. They then tested the relative strength of each relationship to identify the more effective form of support provided by the CEO.

A third model introduced certain organisational and environmental factors into the analysis, and was designed to explore the more complex theoretical formulation suggested by Barki and Hartwick (1989). The main aim of this research, however, was to identify the relative importance of executive participation and executive involvement. Since Jarvenpaa and Ives (1991, 216) found only "partial" support for the third model it was not included in the analysis. Instead, three other contextual factors were examined for their effect upon the progressive use of IT within Australian hospitals. These factors were funding formula, ownership mode and size.

Jarvenpaa and Ives (1991) used progressive use of IT as the dependent variable. No operational definition was provided, but the definition referred to a broad conceptualisation of evolution of IT. For example, Jarvenpaa and Ives (1991, 205) referred to the progressive use of IT as:

> ... the development and implementation of management information systems [fully exploiting] the benefits of information technology.

Progressive use of IT for each company was measured by Jarvenpaa and Ives (1991, 214) as a single-item subjective performance item. Respondents were asked to rate their company's relative IT use within their industry, ranging from industry leader to laggard. They justified use of this measure with reference to Dess and Robinson (1984) who argued that subjective performance measures examining a firm's relative performance within an industry can be appropriate substitutes for objective performance measures. In an earlier work, Jarvenpaa and Ives (1990) found convergent validity with one objective measure, that is the counting of IT-related phrases in the CEO's letter to shareholders. Jarvenpaa and Ives (1990, 351) found that:

> ... the number of IT related phrases in the CEOs' letters to the shareholders was positively correlated with the firm's yearly net profits as a percentage of sales.

The independent factors were executive involvement and executive participation. Executive participation was used to refer to:

> ... the CEO's activities or substantive personal interventions in the management of IT. Executive participation is concerned with CEO behaviours related to information systems planning, development and implementation.

Figure 2.1 presents the model showing the impact of executive participation on the progressive use of IT within the organisation as hypothesised by Jarvenpaa and Ives (1991, 207).

Figure 2.1 The effect of executive participation on the progressive use of IT in the firm

The hypothesis developed by Jarvenpaa and Ives (1991, 208) to test this model was:

> A CEO's active personal participation in IT management is associated with a firm being highly progressive in its use of IT.

Jarvenpaa and Ives (1991, 206) used executive involvement to refer to:

> ... the psychological state of the CEO, reflecting the degree of importance placed on information technology by the chief executive. Involvement refers to the perceptions and attitudes of the CEO concerning information technology.

Executive involvement was also referred to as (Jarvenpaa and Ives (1991, 210):

> ... the degree to which the CEO views IT as critical or instrumental to accomplishment of organizational goals.

Figure 2.2 presents the model showing the impact of executive involvement on the progressive use of IT within the organisation hypothesised by Jarvenpaa and Ives (1991, 208).

Figure 2.2 The effect of executive involvement on the progressive use of IT in the firm

The hypothesis developed by Jarvenpaa and Ives (1991, 209) to test this model was:

> A CEO's high involvement in IT (or favourable perception of IT) is associated with a firm being highly progressive in its use of IT.

Jarvenpaa and Ives (1991) collected data from 83 firms belonging to four industries: banking, publishing, petroleum, and retailing. Industries were chosen to represent a wide spectrum of information intensity:

> Industries were selected so that they represented a wide diversity in the information intensity of the products and thereby hopefully provided differing opportunities for progressive use of IT within firms (p. 212).

Banking and publishing were identified as industries whose products and processes

focus on information. Retailing and petroleum, whilst having little information within the product, have considerable information within the production, distribution, and/or selling processes. Each of the industries was given a rating or score from 1 to 4. Banking received a score of 4, publishing 3, retailing 2 and petroleum 1. These scores were developed from the information intensity matrix developed by Porter and Millar (1985, 153). Each was intended to reflect the relative organisational potential for progressive use of IT for each industry chosen (one from each quadrant of the matrix):

> The more prevailing the strategic use of and search for IT within an industry, the more likely the organizational conditions are favorable for the progressive use of IT within the firm (Jarvenpaa & Ives 1991, 212).

Firms within each industry were selected according to growth in revenues (or in the case of banks, total assets). On average, eleven firms with the greatest average annual growth were selected. Another ten were selected because they had the lowest growth average. Firms were selected in this way to ensure variability in firms in each industry (Jarvenpaa & Ives 1991, 212).

Jarvenpaa and Ives (1991, 208-209) tested their models using simple regression analysis. They described the support for the model describing the relationship between executive involvement and progressive use of IT as "strong" (Jarvenpaa & Ives 1991, 216). They described the support for the model describing the relationship between executive participation and progressive use of IT as

"moderate" (Jarvenpaa & Ives 1991, 216). The conclusion about the relative strength of the two factors measuring executive support is expressed in the following way (Jarvenpaa and Ives 1991, 216):

> ... the CEO's psychological state about IT appeared to be a more powerful predictor of the firm's progressive use of IT than a CEO's personal participation in IT management.

2.3 Development of the research question

The main aim of this research dissertation is to test the findings of Jarvenpaa and Ives (1991). Their work was replicated by testing the two models using similar measurement questions and statistical analysis techniques. It was hypothesised that statistical support could be found for these two models. It was also hypothesised that stronger support could be found between executive involvement and the progressive use of IT than between executive participation and the progressive use of IT.

The work of Jarvenpaa and Ives (1991) was extended by testing these models in a different industry in Australia. This approach provided an understanding of the extent to which the models developed by Jarvenpaa and Ives (1991) hold in another setting. Attention is now given to factors that exist in this research environment.

2.3.1 Cultural considerations

Undertaking research in Australia enabled the models to be tested in a different country, but one with a similar culture. Cultural similarities between the United States of America and Australia are identified in an analysis undertaken by Hofstede (1987). This study identified two dimensions of value patterns as measures of culture (Hofstede 1987, 4). They are (1) power distance and (2) uncertainty avoidance. The power distance dimension identifies the extent to which members of a society accept that power is distributed unequally. Uncertainty avoidance is the level of anxiety within members of society in the face of unstructured or ambiguous situations. A matrix that positioned 50 countries on these two scales shows that Australia and the United States of America appear in the same quadrant. It also shows that they cluster together with countries like New Zealand, South Africa, and Canada within that quadrant (Hofstede 1987, 6).

2.3.2 Australian hospitals

The sample used in this dissertation was selected from the population of CEOs in Australian hospitals. Hospitals have a product of relatively high information intensity (Porter & Millar, 1985), and are therefore suitable for this analysis (Jarvenpaa & Ives 1991, 212). The framework for selecting Australian hospitals as an industry of high information intensity was provided by Johnston and Carrico (1988). That work identified three industry factors that significantly influence the likelihood of strategic IT potential, and based its analysis on the operation of the

value chain as developed by Porter (1985, 39). The industry factors identified were said to arise from:

> ... the nature of the primary products and services and the structure of the processes that are used to produce value.

Comments have already been made on the changes that are taking place with regard to both funding and costing within Australian hospitals. The argument supporting the appropriateness of this population in terms of the conclusions of Johnston and Carrico (1988) is best understood in the light of these changes. The three factors influencing strategic IT potential as identified by Johnston and Carrico (1988) are presented next, along with an explanation of how Australian hospitals relate to each of these factors.

Significant information content in key relationships

> Businesses that have a high volume of transactions within and between organizations in their value added chain usually lead in the development of competitive uses of IT (Johnston & Carrico 1988, 39-40).

Hospitals have a high volume of transactions in terms of the number of patients treated, and also need to record the incidents of care for each patient. Hospital reimbursement is increasingly linked to patient throughput, measured by numbers of patients discharged, as well as total incidents of care (Douglas & Hirth 1991, 8). This method of funding is more in evidence as hospitals move to the casemix

funding formula, resulting in an increasingly complex system.

Other evidence of the high volume and complexity of transactions is evident when considering purchasing and distribution procedures. Hospitals purchase and distribute a wide variety of goods including foodstuffs, administration support materials and drugs. Timeliness of these purchases is often critical. Further, the high labour intensity of hospitals requires personnel to support medical, para-medical, administration, maintenance and other support functions. Organisation of staff in terms of rosters, payroll, and human relations systems is necessarily complex.

Products or services that have a limited life

> Companies with large inventories of products or services that have high market values prior to some moment or period of time and little or no value afterwards are candidates for IT applications that increase the probability of sale prior to the loss of value (Johnston & Carrico 1988, 40).

Hospitals have products with high market values prior to some moment or period of time and little or no value afterwards. Therefore they are candidates for IT applications. Just as airlines aim at filling all seats and hotels aim at filling all rooms, hospitals aim to optimise the use of beds. To overcome their problems airlines have developed frequent flier and standby schemes. Hotels have developed systems that prevent the error of turning away requests for accommodation

(Johnston & Carrico 1988, 40). Costs for hospitals are generated partly by the length of stay of patients. Similar schemes must be developed minimise these costs.

Increased competitive pressure within the industry

This category identifies that companies turn to the strategic use of IT:

> ... as a means of responding to increased competitive pressure in their industry (Johnston & Carrico 1988, 40-41).

The increased competition is said to arise from diverse sources. Examples of increased competition are deregulation, increase foreign competition, entry of strong competitors from another industry, changes in technology or successful introduction of an IT initiative by a competitor.

Governments at both state and federal levels are imposing increased competitive pressure on Australian hospitals by altering the ways in which they are funded. Broadhead (1991, 226) identifies casemix funding as an output-based system, and makes the following comment on its advantages:

> A major advantage of output-based funding is that it promotes greater productive efficiency by rewarding greater output with increased revenue, thus ensuring that health services produce as much as possible. It is also possible under output-based payment to promote efficiency by setting fixed prices for outputs which are parsimonious.

Broadhead (1991, 226) argues that output-based systems increase competition within the industry:

> ... efficient providers who can provide services for less cost than the fixed price would flourish, while inefficient providers who cannot achieve this must either improve their efficiency or cease to be financially viable.

Therefore the environment within which Australian hospitals operate is becoming more competitive as funding allocation formulae become based upon casemix systems.

2.3.3 Research questions

The main research question testing the relative strengths of two sub-sets of executive support, as identified by Jarvenpaa and Ives (1991) is:

> Which subset of executive support, "executive participation" (a set of IT-related management activities of the CEO) or "executive involvement" (as a psychological state reflecting the degree of importance placed on IT by the CEO) better correlates with progressive use of IT within Australian hospitals?

The work of Jarvenpaa and Ives (1991) is extended by examining the effects of three contextual factors on the progressive use of IT. The secondary research question is therefore:

Is there a correlation between the type of funding formula used; the ownership mode (private or public); and size; and the progressive use of IT within Australian hospitals?

2.4 Investigative questions

Investigative questions are those that must be answered in order to satisfactorily answer the general research question (Emory & Cooper 1991, 78-79). For the purposes of this dissertation each of the factors examined in the hypotheses is given an operational definition. This allows the development of models that describe relationships between the dependent and independent variables. The definitions for this dissertation were adapted from those developed and used by Jarvenpaa and Ives (1991).

2.4.1 The dependent variable

The dependent variable in this dissertation is the progressive use of IT in Australian hospitals. Other references have been made to the concept of progressive use of IT. Boynton and Zmud (1987, 59-60), for example, referred to "information technology managerial efforts" and were said to involve:

> ... planning, organizing, controlling and directing the introduction of IT within an organization.

Organisations can therefore be progressive in use of IT in a number of ways:

1. Acquisition of IT hardware.
2. Acquisition of IT software.
3. Implementation of IT systems.
4. Undertaking strategic IT planning.

For analytical purposes, progressive use of IT in Australian hospitals was designated as "PROGIT" and defined as:

> The extent to which progress and continual improvement are made in the identification, development, implementation, management, evaluation of opportunities, and use of information systems and information technology in achieving the goals of Australian hospitals.

2.4.2 The independent variables

The key independent variables in this dissertation are executive participation and executive involvement. Using the definitions developed by Jarvenpaa and Ives (1991), the following operational definitions are presented in terms of the specific testing criteria.

Executive participation was designated as "EXECPART" and defined as:

> The CEO's activities or substantive personal interventions in the management of IT within an Australian hospital.

Executive involvement was designated as "EXECINVOLV" and defined as:

> The psychological state of the CEO, reflecting the degree to which the CEO views IT as being critical for the hospital's success.

The impact of other independent variables was considered in this dissertation as well. Operational definitions are now presented for each of these factors.

The type of funding formula used was designated as "HOSTFUND" and defined as:

> The extent to which a casemix formula is used to determine the funding allocation for the Australian hospital.

The type of ownership mode (private or public) was designated as "HOSTOWN" and defined as:

> The private (or public) ownership of the Australian hospital.

Size was designated as "HOSTSIZE" and defined as:

> The size of the Australian hospital.

2.4.3 Analytical models

Figure 2.3 shows the model describing the effects of EXECPART on PROGIT. It describes the effects of the IT-related management activities of the CEO, and shows that the more a CEO participates in these activities the more progressive the use of IT in that hospital. This leads to Hypothesis One that states:

There is a positive linear relationship between EXECPART and PROGIT

Figure 2.3 The effect of EXECPART on PROGIT

Figure 2.4 shows the model describing the effects of EXECINVOLV on PROGIT. It describes the effects of the psychological state of the CEO and shows that the more a CEO views IT as being critical for the hospital's success the more progressive the use of IT in that hospital. This leads to Hypothesis Two that states:

There is a positive linear relationship between EXECINVOLV and PROGIT.

Figure 2.4 The effect of EXECINVOLV on PROGIT

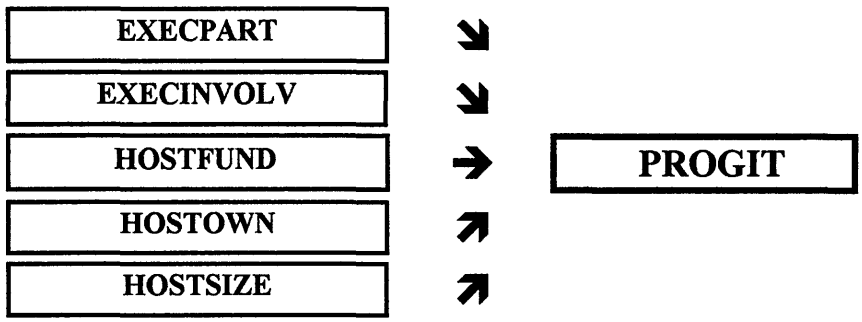
It was hypothesised that the executive involvement factor would influence PROGIT more strongly than the executive participation factor. This leads to Hypothesis Three that states:

There is a stronger correlation between EXECINVOLV and PROGIT, than between EXECPART and PROGIT.

Figure 2.5 shows the model representing the effects of all the independent variables considered in this dissertation on PROGIT. It describes the effects of

EXECPART, EXECINVOLV, HOSTFUND, HOSTOWN and HOSTSIZE on PROGIT.

Figure 2.5 The effects of EXECPART; EXECINVOLV; HOSTFUND; HOSTOWN and HOSTSIZE on PROGIT



The hypothesised impact of each of the contextual factors on PROGIT is now considered in turn.

The type of formula determining funding for an Australian hospital (HOSTFUND)

It was hypothesised that hospitals that use a casemix funding formula will be more progressive in their use of IT than hospitals that derive their funds from the more traditional, historically based budget allocation method. This is because casemix funding relies upon the operation of sophisticated information gathering, storage, and analysis techniques. This leads to Hypothesis Four that states:

> There is a positive linear relationship between HOSTFUND and PROGIT.

The ownership mode of the Australian hospital (HOSTOWN)

It was hypothesised that private hospitals, being more likely to be motivated by a profit motive (even if only to the extent of cost recovery), would be more conscious of costs than public hospitals. They would therefore be more conscious of the need to develop systems to collect and analyse cost data, and to develop systems that would make the hospital efficient. Thus it was hypothesised that private hospitals would be more likely to be progressive in the use of IT than public hospitals. This leads to Hypothesis Five that states:

> There is a positive linear relationship between HOSTOWN and PROGIT.

The size of the Australian hospital (HOSTSIZE)

It was hypothesised that larger hospitals would be more likely to be progressive in the use of IT than smaller hospitals. Smaller hospitals would be able to be administered much more easily than larger hospitals, and would not need a high degree of sophistication in IT. Larger hospitals, on the other hand, would be more likely to require sophisticated IT as this would assist the larger and more complex systems such as administration, communication, scheduling, human resource management and patient care. Merchant (1981, 815), in commenting on the effect of size observed:

> Larger organizations ... face an exponentially increasing number of channels requiring information flows for coordination purposes ....

This leads to Hypothesis Six that states:

> There is a positive linear relationship between HOSTSIZE and PROGIT.

2.4.4 Hypotheses

The hypotheses are summarised below. The first three hypotheses were developed to test the findings of Jarvenpaa and Ives (1991).

Hypothesis One

There is a positive linear relationship between EXECPART and PROGIT

Hypothesis Two

There is a positive linear relationship between EXECINVOLV and PROGIT.

Hypothesis Three

There is a stronger correlation between EXECINVOLV and PROGIT, than between EXECPART and PROGIT.

The next three hypotheses test the effect of the selected contextual factors.

Hypothesis Four

There is a positive linear relationship between HOSTFUND and PROGIT.

Hypothesis Five

There is a positive linear relationship between HOSTOWN and PROGIT.

Hypothesis Six

There is a positive linear relationship between HOSTSIZE and PROGIT.

2.5 Summary

This chapter begins with a presentation of the management question identifying the usefulness of the research to decision-makers or others who may benefit in practical terms. This is followed by an outline of the theoretical background to the dissertation. This outline includes the questions to be answered at the theoretical level. Such questions are subject to further analysis in later chapters. The questions to be addressed in answering the research questions are then presented in the form of theoretical models, along with the hypotheses for formal testing.

It was hypothesised that this research would support the findings of Jarvenpaa and Ives (1991), thereby providing theoretical support for the models they developed. More specifically, it was hypothesised that executive participation and executive involvement would be correlated with the progressive use of IT, and that the shape of each relationship would be linear with a positive slope. Further, it was hypothesised that the correlation between executive involvement and progressive use of IT would be stronger than that between executive participation and progressive use of IT.

The impact of each of three other factors on the progressive use of IT in Australian hospitals was also hypothesised. These were the funding formula, the ownership mode, and the size factors. It was hypothesised that each of these factors would be

correlated with the progressive use of IT, and that the shape of each relationship would be linear with a positive slope. The implication of this needs to be spelled out: hospitals using a casemix formula for funding will be more progressive in their use of IT than hospitals deriving their funds from a more traditional, historical basis; and private hospitals will be more progressive in their use of IT than public hospitals. Similarly larger hospitals will be more progressive in their use of IT than smaller hospitals.

Chapter Three

Research method

The survey method was used to identify the characteristics of the population. Marsh (1982, 7) states:

> ... in survey research the process of testing causal hypotheses, central to any theory-building endeavour, is a ... process of drawing inferences from already existing variance in populations by a rigorous process of comparison.

This chapter contains the methods used to collect, compile, and analyse the data. It begins with a discussion of sample selection procedures and then examines the existence of "demand syndrome", the phenomenon that exists when respondents answer in a way that they thought they were expected to answer. This is followed by the design of the survey form, measurement questions, scale development, treatment of missing data, and non-response bias. The final section contains a chapter summary, as well as summary statistics for the main variables.

3.1 Sample selection procedures

3.1.1 Unit of analysis

Data were collected using a survey of CEOs and senior information technology managers (SITMs) of Australian hospitals. The population is hospitals listed in Isaacson (1994). This is a year book that identifies the names of 1,099 Australian hospitals in 1992, providing addresses, telephone numbers, and the titles of the persons with the responsibility of running the hospital. The sample was chosen using selected random sampling techniques from both public and private Australian hospitals whose size was listed as greater than 100 maintained beds. Hospitals of this size were thought to be large enough to have considered the usefulness of information technology and information systems (IT), to have employed IT to some extent, and to have a SITM. Hospitals in the sample should be of a size comparable with the those of Jarvenpaa and Ives (1991, 212) who carried out their analysis on firms from *Fortune 500* listings.

3.1.2 Sample size

The sample must be large enough to draw conclusions about the characteristics of the population it represents, and it must reduce the probability of failing to reject the null hypothesis when it is false. Guidance on the process of determining sample size was drawn from Cohen and Cohen (1983, 59). They identified the size of the sample as one of the four parameters for determining the statistical power of the analysis. These four parameters, and their relationships with each other are:

1. The power of the test, defined as 1-β (the probability of rejecting the null hypothesis).

2. The region of rejection of the null hypothesis as determined by the α level and whether the test is one-tailed or two-tailed. As α increases, power increases.

3. The sample size *n*. As *n* increases, power increases.

4. The magnitude of the effect in the population, or the degree of departure from the null hypothesis. The larger this is, the greater the power.

These four parameters are so related that when any three of them are fixed, the fourth is completely determined (Cohen & Cohen 1983, 59).

The procedure used for determining the desired sample size (n^*) for the F test of the significance of R^2 is that set out in Cohen and Cohen (1983, 116-118). The significance criterion (α) was set at the 95% level (two-tailed test), and the desired power for the F-test set at .80. These are regarded as conventional measures for the purpose of analysis of this type (Cohen & Cohen 1983, 162). For the purposes of determining sample size there were 5 degrees of freedom, the number of independent variables. The resultant L-value (for α = .05) from Table E.2 was 12.83 (Cohen & Cohen 1983, 527).

The population effect size, f^2, was determined for this research from Equation 3.1, the formula provided by Cohen and Cohen (1983, 117):

$$f^2 = R^2 \div (1 - R^2) \qquad \textbf{Equation 3.1}$$

Jarvenpaa and Ives (1993) found that the predictor variable accounting for the smallest variance in the criterion variable was "executive participation". The R^2 for this variable was found to be 0.16, and this is the figure used to determine f^2. Substituting, f^2 was determined as follows:

$$f^2 = 0.16 \div (1 - 0.16)$$

$$= 0.19$$

The sample size was then determined from Equation 3.2, the formula suggested by Cohen and Cohen (1983, 117):

$$n^* = L \div f^2 + k + 1 \qquad \textbf{Equation 3.2}$$

$$= 12.83 \div 0.19 + 5 + 1$$

$$= 73.53$$

Thus, a sample of 74 useable responses was required. The Jarvenpaa and Ives (1991, 213) study produced response rates from CEOs of 45%. That is, 38 out of the 83 firms' CEOs surveyed provided data. Allowing for a response rate of around 40%, this means that at least 155 survey forms should be mailed. Survey forms were mailed to 236 Australian hospitals.

3.1.3 Survey logistics

Two survey forms were sent to the chief executive officer of each hospital in the sample using the title for that person as identified in Isaacson (1994). One was to be completed by the CEO, and the other (similar) survey form was to be completed by the SITM. Both were mailed to the CEO with a covering letter asking that the envelope containing the covering letter and survey form for the SITM be forwarded to the relevant person. Stamped addressed return envelopes were included for both the CEO and the SITM to preserve the confidentiality of each respondent. It was considered that attaching a stamp to the return envelopes rather than using a reply paid account would maximise the response rate.

Care was taken with the composition and appearance of the survey form and covering letters. The four-page, one-sided survey form for the CEO was photocopied onto sand-coloured paper with the Charles Sturt University crest as a mast head on the first page. The SITM survey form was similar in construction, but photocopied onto pale green copy paper. Each survey form was accompanied by a covering letter on the university letterhead requesting help with the project, indicating that it should take no more than ten minutes of the respondent's time. The strict confidentiality of responses was assured, and a statement was included explaining that the code number appearing on the survey form was for statistical matching purposes only. Respondents were each asked to write their name and address on the back of the stamped addressed return envelope if they wished to obtain a copy of the summary of findings of the study.

Two forms were sent to each hospital in order to control for demand syndrome.

3.2 Demand syndrome

This phenomenon was experienced by Jarvenpaa and Ives (1991, 213) who explained it as follows:

> The CEO responses may have been contaminated by the "demand syndrome"; the CEOs may have responded in the way they thought the researchers, their IT managers, or the press expected them to answer.

Their fear was realised upon scrutiny of the survey returns from the CEOs (Jarvenpaa & Ives 1991, 213):

> ... a close examination of the CEO responses indicated insignificant variation in data across respondents - particularly for items that assessed the CEOs' attitudes.

Consequently Jarvenpaa and Ives (1991) used the responses of the CEOs only for the item measuring the progressive use of IT. In order to control for demand syndrome survey forms were sent to SITMs as well as CEOs of Australian hospitals. Sending two forms to each hospital in the sample enabled measurement and evaluation of the effects of demand syndrome for the sample taken from Australian hospitals. It also facilitated a comparison with Jarvenpaa and Ives (1991).

The results provided by the two groups, CEOs and SITMs, were examined to determine whether any evidence could be found of demand syndrome. Data are provided in Table 3.1 that permit a comparison of the results of these two groups, showing scale summaries for EXECINVOLV and EXECPART.

Table 3.1 Scale summaries of EXECINVOLV and EXECPART

	EXECINVOLV		EXECPART	
	SITM Responses	CEO Responses	SITM Responses	CEO Responses
Number of items:	4	4	6	6
Number of cases:	97	118	97	113
Alpha:	0.6339	0.4467	0.6048	0.5632
Mean:	11.2062	12.2712	18.9381	20.3628
Variance:	4.9362	2.7634	11.3295	9.7154

The best evidence in support of the existence of demand syndrome can be identified by using an *F*-test. If there is no significant difference between the variances of the two scales, dividing the variance of the SITM scale by the variance of the CEO scale should give an answer of approximating 1. The confidence level is set at 95%.

H_0: There is no significant difference between the variances in the EXECPART and EXECINVOLV scales for CEOs and SITMs.

That is, the variance of the SITM scales divided by the variance of the CEO scales approximates 1.

Executive Participation:

SITM scale variance ÷ CEO scale variance

= 11.3295 ÷ 9.7154

= 1.1661

Executive Involvement:

SITM scale variance ÷ CEO scale variance

= 4.9362 ÷ 2.7634

= 1.7863

Since the *F*-statistic obtained at 120 degrees of freedom in the numerator and 100 degrees of freedom in the denominator is 1.37 (Cohen & Cohen 1983, Table D.1, 522-523), it is possible to reject the null hypothesis for the EXECINVOLV scale. As a result of this analysis, the responses of the CEOs were used only for the development of the PROGIT scale and the other contextual factors. They were not used for the development of the EXECINVOLV and EXECPART variables. This is the same approach as that taken by Jarvenpaa and Ives (1991).

There are other reasons for only using the responses of SITMs. Observation of Table 3.1 shows the mean of each scale is higher for the CEOs for both EXECPART and EXECINVOLV, showing that they have scored themselves higher than did the SITMs. In addition, on both scales the measures of Cronbach's alpha indicate that SITMs have provided a more consistent set of responses than CEOs.

3.3 Survey form design

Copies of both survey forms and accompanying cover letters are included in Appendix A of this dissertation. The survey forms were divided into three parts. Part I contained questions relating to the characteristics of the hospital. Part II of

each survey form asked about the respondent and the organisational status of the SITM within the hospital. Part III contained questions about the CEO, and the approach taken by the CEO to IT within the hospital.

The questions used in the survey relating to the key variables (PROGIT; EXECPART; and EXECINVOLV) were adapted from the study carried out by Jarvenpaa and Ives (1991, Appendix B pp. 225-227). The only changes to the survey questions were those necessitated by the descriptors for the differing units of analysis; that is, hospitals. Questions relating to each of the variables of the study were not grouped in any significant order or combination.

3.4 Measurement questions

The survey form used in this dissertation was based on that used by Jarvenpaa and Ives (1991). This was done to ensure that results were comparable. Questions relating to the three other contextual variables are included.

In the sections that follow, each of the variables is discussed in theoretical terms, followed by the measurement question and the range of possible responses where appropriate. Where responses were re-coded an explanation of the procedure is included.

3.4.1 Progressive use of IT in Australian hospitals (PROGIT)

A single question was used by Jarvenpaa and Ives (1991) to measure the progressive use of IT for a firm. Although it is subjective in nature it was determined to have convergent validity with at least one objective measure of this

variable. In an earlier study Jarvenpaa and Ives (1990, 351) found that the number of IT related phrases in the CEO's letter to the shareholders was positively correlated with the firm's yearly net profits as a percentage of sales. Jarvenpaa and Ives (1991, 214) refer to this in the following way:

> The combined IT and CEO responses on the progressive use of IT ... correlated .43 ($p > .002$) with the number of IT-related phrases in the 1988 chairman's letter.

Their conclusion was that the measure of the firm's progressive use of IT has some convergent validity with at least one objective measure. Dess and Robinson (1984) determined that firm's relative performance within an industry can be appropriate substitutes for objective performance measures. Jarvenpaa and Ives (1990) supported this idea.

Thus the single question used to measure this appears as follows:

> How would you describe your hospital's use of IT (information technology and information systems)?
>
> 1. laggard
> 2. somewhat behind
> 3. middle of the pack
> 4. close follower
> 5. a leading hospital

3.4.2 Executive participation in Australian hospitals (EXECPART)

Each of the items used to measure EXECPART was related to the activities of the CEO. Jarvenpaa and Ives (1991, 214) stated:

> Included within this factor were items concerning a CEO's role in corporate IT steering committees, the frequency of a CEO's personal participation in issues related to the firm's use of IT, and a CEO's familiarity with a firm's and its competitors' IT use.

All the questions presented are those taken from the survey form sent to SITMs. The items in the survey used to measure EXECPART are presented here followed by a description of the possible responses.

CEO's personal participation in hospital's use of IT

> How often does your CEO get personally involved in matters related to the use of IT within your hospital?

1. less than once a year
2. few times a year
3. monthly
4. weekly
5. daily

CEO's role in hospital IT steering committee

Which of the following best describes the CEO's role in the hospital IT steering committee?

1. no steering committee exists
2. IT committee exists, but with minimal input or awareness from the CEO
3. is a member of the IT steering committee
4. chairs an IT committee and actively participates in meetings
5. is the defacto steering committee

CEO's knowledge of other hospitals' use of IT

How knowledgeable is the CEO about IT innovations that have been developed by other hospitals?

1. weakly informed
2. somewhat informed
3. well informed
4. very informed
5. extremely knowledgeable

CEO's informal contacts with IT management

How frequent are informal contacts between the CEO and the hospital's senior IT management?

1. less than once a year
2. few times a year
3. monthly
4. weekly
5. daily

CEO's knowledge of IT opportunities in the hospital

How knowledgeable is the CEO about IT opportunities and possibilities for your hospital?

1. weakly informed
2. somewhat informed
3. well informed
4. very informed
5. extremely knowledgeable

Number of levels between IT head and CEO

How many levels in the organisation are you from the CEO?

This is an inverse scale in that choosing a low number indicates a high participation score for that hospital. It asks the head of IT within the hospital to indicate the number of levels within the administrative structure that the SITM position is from

the CEO. The results showed that there were no more than five such levels. The responses to this question were reverse coded.

3.4.3 Executive involvement in Australian hospitals (EXECINVOLV)

Each of the items used to measure EXECINVOLV was related to the CEOs' perceptions of IT. Jarvenpaa and Ives (1991, 214) stated that involvement includes:

> ... a CEO's prevailing thinking about IT spending, a CEO's perceived importance of IT for a firm, vision for IT, and endorsement of applications not meeting traditional criteria ....

The items in the survey form used to measure EXECINVOLV are presented here. They are followed by a description of the possible responses.

CEO's prevailing thinking about IT spending.

> Which of the following best describes the CEO's prevailing thinking about funds the hospital spends on IT?
>
> 1. Views IT as a strategic investment
> 2. Views IT as a resource to be allocated fairly across organisational units
> 3. Views IT as an expense to be controlled

The responses to this question were reverse coded.

CEO's perception of the importance of IT

Which of the following statements best describes the importance that your CEO perceives IT (information technology and information systems) to be for your hospital?

1. Has little concern for the potential utility of IT
2. Considers IT to be the concern of technologists, not managers, although is supportive of IT
3. Considers IT to be one of the many ways to cut costs in the hospital
4. Considers IT to be vital for smooth functioning of operations
5. Considers IT as one of the vital parts of the competitive strategy
6. Considers IT as the single most critical factor for the hospital

CEO's vision for IT

What is your CEO's vision for IT?

1. No vision for IT
2. A functional vision of how the hospital will use IT ("95% of patient information will be correctly coded")
3. A technical vision of how the hospital will use IT ("we will install a database that keeps track of all patients")
4. A strong, but generic vision ("we will be the leader in hospital use of advanced IT")

CEO's endorsement of applications not meeting traditional criteria.

How often does your CEO endorse major IT investments that have not been endorsed by traditional justification criteria and procedures?

1. Frequently
2. Occasionally
3. Rarely

The responses to this question were reverse coded.

3.4.4 Other contextual factors

The type of formula determining funding for an Australian hospital (HOSTFUND)

Two questions were used to measure the extent to which hospitals had adopted casemix funding. The first of these was constructed so that respondents would answer on a five-point scale.

What is the proportion of funds received by your hospital from a casemix formula?

1. very small
2. less than half
3. about half
4. more than half
5. Mostly all

The second allowed the respondent to provide an estimate of the percentage of funds derived from a casemix formula. It was constructed by allowing the respondent to write a percentage in a box.

> State the estimated proportion of funds received via casemix formula

The measurement of this variable was carried out in the following way:

1. The responses to each question from the CEO and the SITM for each hospital were averaged. This controlled for any variation in perception of casemix funding levels between the two respondents.

2. The first question was collapsed into a dichotomous variable so that those whose response was "about half" or above were given a score of 1. Those who answered 1 or 2 were given a score of 0.

3. The second question was collapsed into a dichotomous variable in such a way that those who responded with a 50% or more received a score of 1. All other respondents received a score of 0.

4. The final score was determined by coding responses with scores of 1 for both questions as 1. All other responses

received a score of 0.

Thus the final score for level of casemix funding was determined by only accepting a positive score if the proportion of casemix funding was greater than 50%.

The ownership mode of the Australian hospital (HOSTOWN)

Is your hospital a private hospital or a public hospital?

Respondents were asked to write their answer in a space provided on the survey form. Private hospitals were coded as 1; public hospitals were coded as 0. If a respondent indicated that the hospital had both public and private components, they were given a score of 1. This was thought to be appropriate because such hospitals would have enough of the characteristics of a private hospital.

The size of the Australian hospital (HOSTSIZE)

What is the size of your hospital?
(approximate number of maintained beds)

Respondents were to write the number of maintained beds in the space provided. The final scale was determined by averaging the responses of CEOs and SITMs. This was to account for any perceptual differences.

3.5 Scale development

De Vaus (1991, 249-250) states that building scales helps understand complex variables:

> It assists in developing more valid measures.... It helps increase reliability.... It enables more precision.... [and] ... by summarising the information conveyed by a number of questions into one variable the analysis is simplified considerably.

3.5.1 Interval scales

A possible criticism of the measurement questions in this dissertation is that the range of possible responses does constitute a truly interval scale. The range of possible answers to the questions measuring each of the key variables exist on an ordinal scale. Even though each alternative can be ranked above or below the others, the actual interval between each cannot be said to be identical. Cohen and Cohen (1983, 239) refer to this problem in the following way:

> The issue of the level of scaling and measurement precision required of quantitative variables in ... [multiple regression/correlation analysis] ... is complex and controversial.

Cohen and Cohen (1983, 239) agree that in its formal state multiple regression and correlation analysis is complex. It demands that quantitative independent variables

should be scaled at truly equal intervals and measured without error. They declare that:

> ... the general conviction among data analysts is that the assumption failure entailed by the use of fallible ... [independent variables] ... in the fixed-regression model ... does not materially affect any positive conclusions that are drawn.

A footnote in Cohen and Cohen (1983, 239) warns that this conviction is held only for simple regression. When multiple regression is used in this dissertation two variables, HOSTFUND and HOSTOWN were collapsed into dichotomies. The third, HOSTSIZE, is measured using the number of maintained beds, an interval scale. Thus, although the scales developed for EXECPART and EXECINVOLV are not perfect interval scales, they are suitable for use in statistical analysis in this dissertation.

Jarvenpaa and Ives (1991), developed scales using averaging. Therefore the scales for the two key variables, EXECPART and EXECINVOLV, were developed in the same way. It was felt that this method is more appropriate than summation because the scales of responses for the EXECPART and EXECINVOLV variables were not identical for all questions. The number of possible responses for measurement questions ranged from three to six.

3.5.2 Scale reliability and unidimensionality

Each item in a multi-item scale must be examined to see if it belongs to that scale (de Vaus 1991, 255-256). In order to do this, each of the scales was tested for both reliability and unidimensionality. Reliability is the extent to which the measurement instrument is internally consistent. Tests of unidimensionality investigate whether the questions in each scale measure the same underlying concept.

Jarvenpaa and Ives (1991) tested executive participation and executive involvement for reliability and unidimensionality. They used Cronbach's alpha and factor analysis.

3.5.3 Cronbach's alpha

The test for reliability is satisfied when alpha is, as a rule of thumb, around 0.7 (de Vaus 1991, 256). With these parameters in mind, consideration is now given to each of the two key variables in turn.

EXECPART

Results of the initial analysis for EXECPART, including all six items from the Jarvenpaa and Ives (1991) study, are presented in Table 3.2.1. It can be seen that the last two items are candidates for deletion because the alpha for the scales would be increased substantially if these items were deleted. Logical examination of these two questions supports their elimination.

Table 3.2.1 Reliability analysis for EXECPART (six items)

Item	Cases	Mean	Standard Deviation	Corrected item-total correlation	Alpha if item deleted
CEO's personal participation in firm's use of IT	97	3.1753	.9791	.5882	.4483
CEO's informal contacts with IT management	97	3.7423	.9819	.3558	.5529
CEO's knowledge of IT opportunities within the hospital	97	2.9278	.9270	.6528	.4258
CEO's knowledge of other hospitals' use of IT	97	2.6598	.8525	.5061	.4988
Number of levels between SITM and CEO	97	4.2577	.7810	.1044	.6361
CEO's role in hospital IT steering committee	97	2.1753	1.2248	.0082	.7228
Cronbach Alpha			**Standardised item alpha**		
0.6048			**0.6317**		

The question identifying the number of levels between the SITM and the CEO does not necessarily measure the IT-related management activities of the CEO. It is difficult to understand that where the number of levels between the CEO and the SITM is low, the IT-related management activities will necessarily be high. It is also difficult to understand that the converse would be true.

Problems can be also be found for the question relating to the CEO's role in the hospital steering committee. The low end of the scale required the respondent to indicate that no steering committee exists. The high end of the scale required the respondent to indicate that the CEO is the defacto steering committee. At both ends of the scale, therefore, no steering committee exists.

Table 3.2.2 shows the results of the reliability analysis after items 5 and 6 were deleted. The four-item scale produced an alpha of 0.7690. This satisfied the test of reliability.

Table 3.2.2 Reliability analysis for EXECPART (four items)

Item	Cases	Mean	Standard Deviation	Corrected item-total correlation	Alpha if item deleted
CEO's personal participation in firm's use of IT	98	3.1939	.9913	.6108	.6914
CEO's informal contacts with IT management	98	3.7551	.9851	.4524	.7777
CEO's knowledge of IT opportunities within the hospital	98	2.9286	.9222	.6710	.6597
CEO's knowledge of other hospitals' use of IT	98	2.6531	.8507	.5630	.7194
Cronbach Alpha			**Standardised item alpha**		
0.7690			**0.7719**		

EXECINVOLV

Table 3.3 provides the summary of results of reliability testing for the EXECINVOLV scale. The Cronbach (1951) alpha for "executive involvement" produced from the Jarvenpaa and Ives (1991, 214) data was 0.75. As can be observed, although the alpha value of 0.6339 is lower, it is still an acceptable level, and does not suggest that deletion of any of the items is appropriate.

Table 3.3 Reliability analysis for EXECINVOLV

Item	Cases	Mean	Standard Deviation	Corrected item-total correlation	Alpha if item deleted
CEO's prevailing thinking about IT spending	97	4.3608	.8189	.4976	.5012
CEO's perception of the importance of IT	97	2.2887	.7900	.3672	.5968
CEO's vision for IT	97	1.7010	.6482	.3041	.6328
CEO's endorsement of applications not meeting traditional criteria	97	2.8557	.9353	.5002	.4966
Cronbach Alpha				**Standardised item alpha**	
0.6339				**0.6281**	

3.5.4 Factor analysis

Scale unidimensionality was assessed using factor analysis. Factor analysis is a mathematically complex method of reducing a large set of variables to a smaller set of underlying variables referred to as factors (de Vaus 1991, 257). Factor analysis in this dissertation was carried out using the most widely used method of rotation; that is, varimax rotation (de Vaus 1991, 264).

The two decisions that can be made using factor analysis are how many factors to extract, and which factors to retain. Two statistics useful in making these decisions are eigenvalues and percent of variance explained by each factor. Eigenvalues are measures that attach to factors and indicate the amount of variance in the pool of original variables that the factor explains. To be retained, factors must have an eigenvalue greater than 1 (de Vaus 1991, 261). Data showing the cumulative percent of variance explained by each factor allows a decision to be made relating to the point at which no additional factors are to be included. The

decision to stop adding factors is reached when the next factor does not materially influence the amount of variance explained.

Another useful statistic produced by factor analysis is the Kaiser-Meyer-Olkin measure of sampling adequacy (KMO). This statistic is the equivalent of Cronbach alpha, and is a measure of whether a set of variables in a correlation matrix is suitable for factor analysis. It ranges from 0 to 1, and de Vaus (1991, 259) states:

> ... if the KMO yields values above 0.7 then the correlations, on the whole, are sufficiently high to make factor analysis suitable. More care should be taken if they lie between 0.5 and 0.69, and KMO values below 0.5 mean that factor analysis would be inappropriate for that set of variables.

Table 3.4 contains a summary of data generated from the initial factor extraction. Observation of this table reveals three factors with eigenvalues greater than 1, and the addition of a fourth variable accounting for only 9.1% of the variance. Only two factors are required, however, one for each of EXECPART and EXECINVOLV. The KMO was found to be 0.730. This makes factor analysis suitable.

Table 3.4 Summary of eigenvalues and percent of variance from ten questions measuring EXECPART and EXECINVOLV

Factor	Eigenvalue	Percent of variance	Cumulative percent
1	3.235	32.4	32.4
2	1.328	13.3	45.6
3	1.170	11.7	57.3
4	0.906	9.1	66.4
5	0.824	8.2	74.6
6	0.774	7.7	82.4
7	0.660	6.6	89.0
8	0.507	5.1	94.0
9	0.378	3.8	97.8
10	0.218	2.2	100.0

Table 3.5.1 contains a rotated factor matrix for the ten items included in the factor analysis. De Vaus (1991, 264) identifies this matrix as crucial to interpreting the results of factor analysis. He points out that high loading variables 'belong' to the factor on which they load. Observation of Table 3.5.2 reveals that the third factor contains the two variables eliminated using Cronbach's alpha (see paragraph 3.5.3 above).

Table 3.5.1 Rotated factor matrix for ten items measuring EXECPART and EXECINVOLV

Factor	Question	Factor 1	Factor 2	Factor 3
CEO's personal participation in firm's use of IT	**Part III, Question 2**	.7843	.0753	.1762
CEO's informal contacts with IT management	**Part III, Question 3**	.5581	.0753	.5604
CEO's knowledge of IT opportunities	**Part III, Question 4**	.8137	.3180	-.04469
CEO's knowledge of other hospitals' use of IT	**Part III, Question 5**	.7496	.2056	-.1220
Number of levels between SITM and CEO	**Part II, Question 2**	.1550	-.0195	.6675
CEO's role in corporate IT steering committee	**Part III, Question 8**	.2848	-.0559	-.6917
CEO's perception of the importance of IT	**Part III, Question 1**	.3932	.6347	.0122
CEO's prevailing thinking about IT spending	**Part III, Question 6**	.1602	.5962	.2705
CEO's endorsement of IT not meeting traditional criteria	**Part III, Question 7**	.0240	.6431	-.1040
CEO's vision for IT	**Part III, Question 9**	.1396	.7597	.0176
	Eigenvalue	3.235	1.238	1.170
	Variance explained	32.4%	13.3%	11.7%

The factors EXECPART and EXECINVOLV were identified when the factor analysis was run without these two variables. The resultant KMO was 0.751. The results of this analysis are presented in Table 3.5.2 along with the equivalent Jarvenpaa and Ives (1991) factor loadings (denoted as "J&I"). Inspection of Table 3.5.2 shows that the factor loadings identified by Jarvenpaa and Ives (1991, 215) are similar to those identified in the research undertaken in Australian hospitals, especially for executive participation.

Table 3.5.2 Rotated factor matrix for eight items measuring EXECPART and EXECINVOLV

Factor 1: Executive Participation	Communality	Factor 1	Factor 2	J&I
CEO's personal participation in firm's use of IT (Part III, Question 2)	.6657	.8117	.00824	.80
CEO's informal contacts with IT management (Part III, Question 3)	.5051	.7103	.0232	.69
CEO's knowledge of IT opportunities within the hospital (Part III, Question 4)	.7076	.7566	.3677	.67
CEO's knowledge of other hospitals' use of IT (Part III, Question 5)	.5460	.6957	.2490	.70
Eigenvalue:		3.195	n/a	not available
Variance explained:		39.9%	n/a	
Factor 2: Executive Involvement	**Communality**	**Factor 1**	**Factor 2**	**J&I**
CEO's perception of the importance of IT (Part III, Question 1)	.5537	.3760	.6422	.77
CEO's prevailing thinking about IT spending (Part III, Question 6)	.3762	.2117	.5760	.71
CEO's endorsement of IT not meeting traditional criteria (Part III, Question 7)	.4260	-.0169	.6525	.69
CEO's vision for IT (Part III, Question 9)	.5951	.1220	.7617	.74
Eigenvalue:		n/a	1.180	not available
Variance explained:		n/a	14.8%	

An additional statistic, communality, is included in Table 3-5. Communality scores identify questions for whose variance the factors do not account. They range from 0 to 1, and the higher the figure the better the set of selected factors explains the variance for that variable (de Vaus 1991, 262-263). Since the lowest communality identified in Table 3.6 is 0.3762 it can be said that the eight remaining questions satisfy this test.

Table 3.5.2 reveals the two key variables that contain four questions with high loadings. These are the four questions that were averaged to produce EXECPART and EXECINVOLV.

3.6 Missing data and non-response bias

3.6.1 Missing data

De Vaus (1991, 283) sets out the following observation relating to missing values:

> Missing values are a problem because they reduce the number of cases available for analysis.

Of the seven alternative ways of dealing with missing values identified by Hertel (1976), the pairwise solution was chosen even though it leads to a loss of data. De Vaus (1991, 284) states that the pairwise solution can be used when analysis is based on a zero-order correlation matrix; that is, for factor analysis, regression, and reliability. These are the methods of analysis used in this research. The pairwise solution does not lead to the loss of as many as would be lost with a listwise deletion method. De Vaus (1991, 286) makes the following statement:

> Of the approaches that involve losing data or cases, the pairwise solution is generally best ....

Pairwise deletion is therefore the method adopted in this research for the treatment of missing data.

3.6.2 Non-response bias

Two problems identified by de Vaus (1991, 73) with regard to non-response bias are unacceptable reduction of sample size and bias. The first of these was

overcome in this dissertation by drawing on an initial sample that was larger than needed. Calculation of the required sample size from Equation 3.2 revealed that it was necessary to obtain 74 useable responses. Survey forms were sent to 236 Australian hospitals in order to minimise the in order to minimise the need carry out follow-up procedures. This produced a total of 91 responses on a pairwise deletion of missing data.

The problem of bias is that which arises where the answers provided by respondents would be different from those who did not reply. De Vaus (1991, 74) offers three main ways of obtaining information to adjust for bias. Firstly, use what observable information can be picked up about non-respondents. Secondly, use the sampling frame to obtain information that might identify the characteristics of the non-respondents. Thirdly, compare the characteristics of the population from which the sample is drawn with those of the sample itself.

An examination of Isaacson (1994) reveals no discernible pattern amongst those Australian hospitals from which no response was forthcoming. For this dissertation it is assumed that the characteristics of non-respondents did not differ in any material way from those who responded.

3.7 Summary

In this chapter presented methods used to collect, compile, and analyse the data. Section 3.1 contained detail of sample selection procedures, outlining the unit of analysis, sample size and sample selection. Section 3.2 contained an explanation of

"demand syndrome" and tested for its presence in the sample data. Section 3.3 contained an explanation of the survey form design. Section 3.4 contained the measurement questions for each of the variables. Section 3.5 contained explanations of the way that scales were developed. Section 3.6 contained information relating to missing data and non-response bias.

Table 3.6 contains summary statistics for the variables that will be used in Chapter Four to test the propositions developed in Chapter Two.

Table 3.6 Summary statistics for main variables

Variable Name	Valid Cases (*N*)	Mean	Standard Deviation	Minimum Possible Actual	Maximum Possible Actual	Alpha
PROGIT	132	3.250	0.993	1 1	5 5	n/a
EXECPART	98	3.133	0.722	1 1	5 4.5	0.769
EXECINVOLV	98	2.814	0.566	1 1.25	5 4	0.634
HOSTFUND	97	0.278	0.451	0 0	1 1	n/a
HOSTSIZE	132	226.8	194.5	40 n/a	925 n/a	n/a
HOSTOWN	120	0.317	0.467	0 0	1 1	n/a

Figures 3.1 to 3.3 show the frequency histograms of the key variables with normal curves superimposed. Inspection of these reveals that all have approximately normal distributions, and no additional data transformations were necessary. Figures 3.4 and 3.5 show the bar charts of the two dichotomised variables, HOSTFUND and HOSTOWN. Figure 3.6 shows the histogram of HOSTSIZE, and reveals the distribution of hospitals in the sample by size measured by the

number of maintained beds. The distribution is positively skewed, and care must be taken with the interpretation of results involving this variable.

Figure 3.1 Histogram of PROGIT

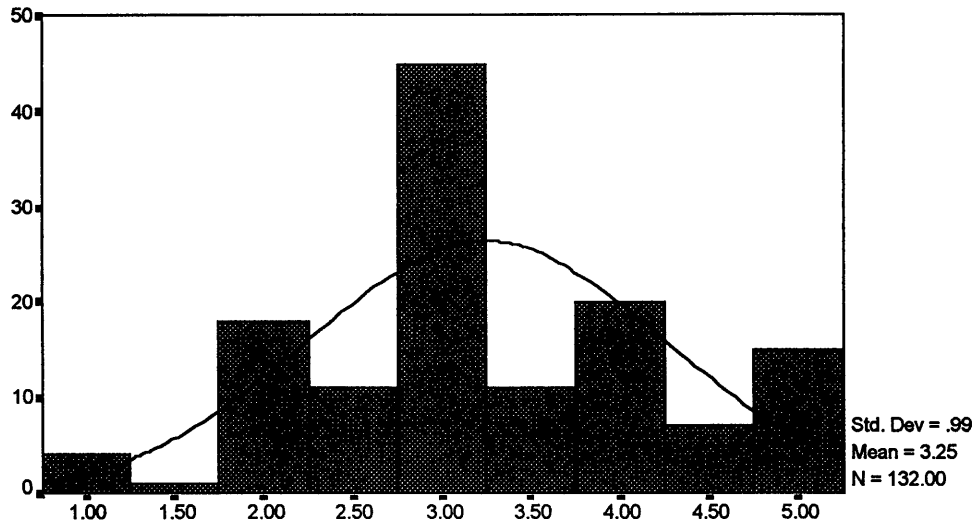


Figure 3.2 Histogram of EXECPART

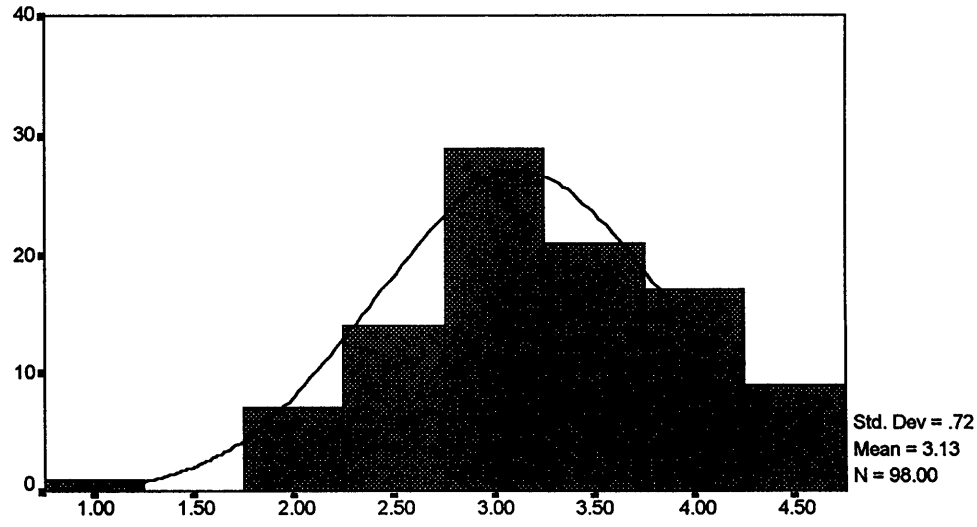


Figure 3.3 Histogram of EXECINVOLV

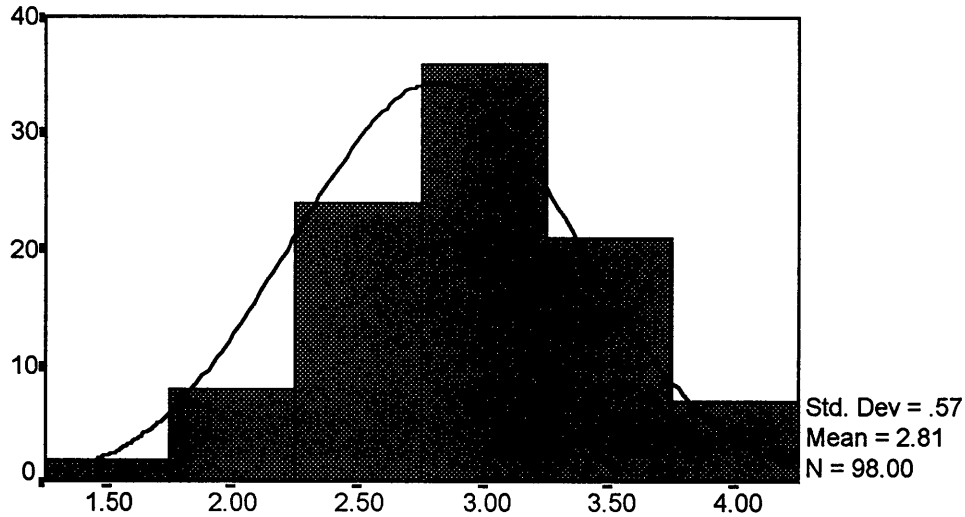


Table 3.4 Bar chart of HOSTFUND

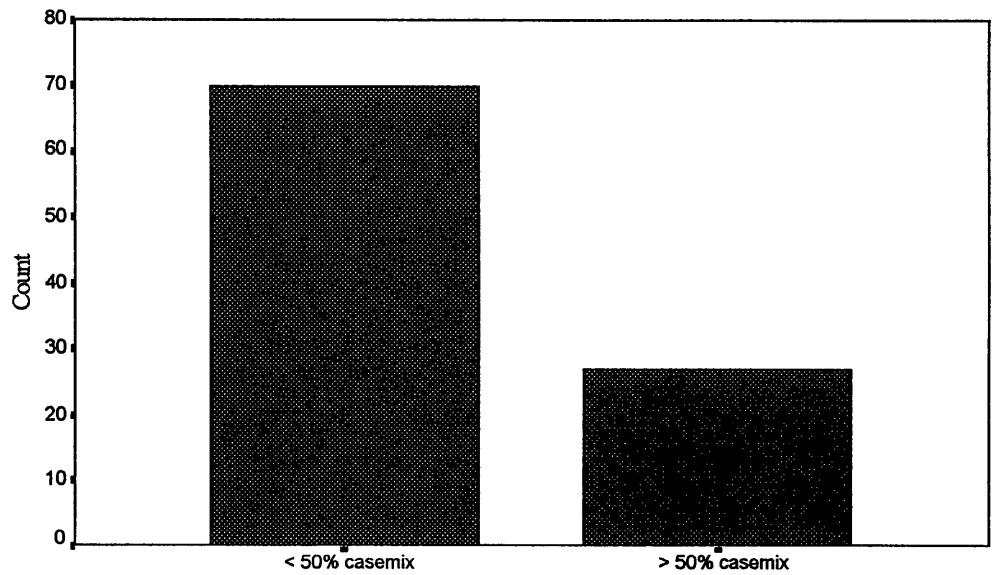


Table 3.5 Bar chart of HOSTOWN

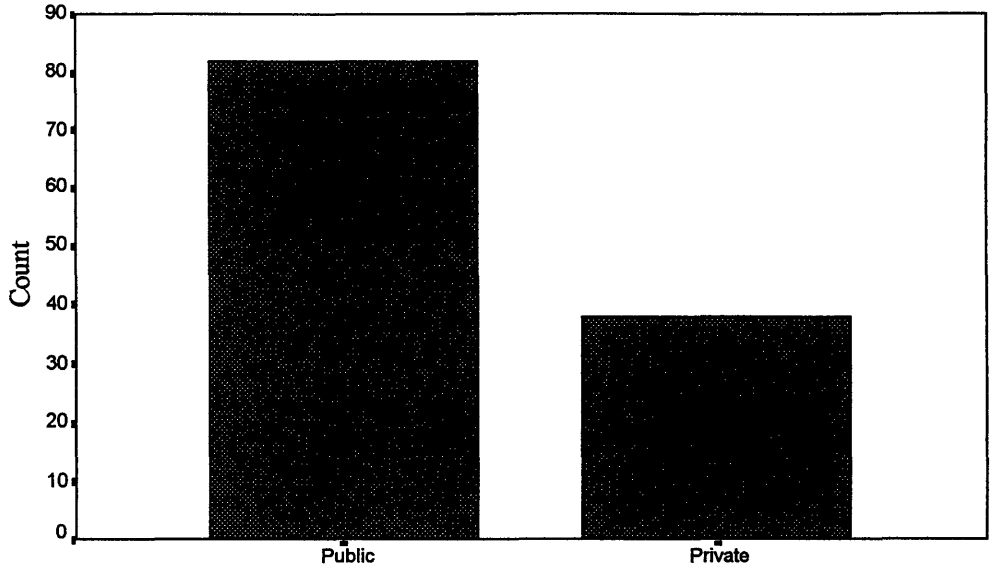
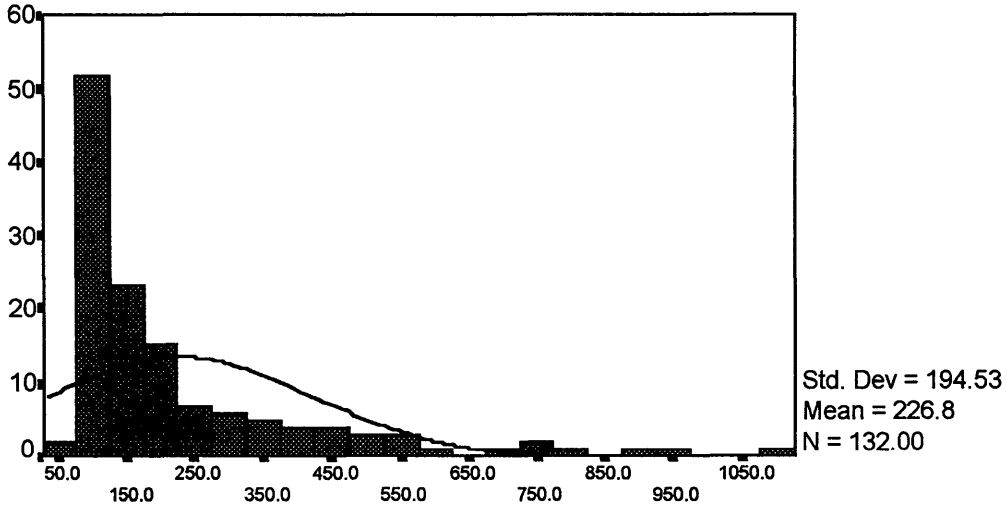


Figure 3.6 Histogram of HOSTSIZE



Hospital Size (Maintained Beds)

Table 3.7 shows frequency and percentage data for the number of years that a CEO has acted in the position of CEO, and the number of years that a person has acted as CEO in the hospital in which they are now employed. Table 3.8 shows similar data for SITMs.

Table 3.7 Summary statistics for CEOs

Number of years as:	CEO		CEO in this hospital	
	Frequency	%	Frequency	%
1 year	15	12.8	29	24.8
2 years	15	12.8	22	18.8
3 years	5	4.4	15	12.8
4 years	10	8.5	14	12.0
5 years	9	7.7	6	5.1
more than 5 years	63	53.8	31	26.5
TOTAL	117	100.0	117	100.0

Table 3.8 Summary statistics for SITMs

Number of years as:	SITM		SITM in this hospital	
	Frequency	%	Frequency	%
1 year	13	13.4	25	25.5
2 years	16	16.5	21	21.4
3 years	8	8.2	12	12.2
4 years	5	5.2	8	8.2
5 years	10	10.3	9	9.2
more than 5 years	45	46.4	23	23.5
TOTAL	97	100.0	98	100.0

Figure 3.7 shows a summary of responses by state.

Figure 3.7 Bar chart of respondents by Australian state