1-1-2000

An investigation of the relationship between organisational size and industry type with the development and use of executive information systems in the manufacturing sector

Nigel Warne
Edith Cowan University

Edith Cowan University

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AN INVESTIGATION OF THE RELATIONSHIP BETWEEN ORGANISATIONAL SIZE AND INDUSTRY TYPE WITH THE DEVELOPMENT AND USE OF EXECUTIVE INFORMATION SYSTEMS IN THE MANUFACTURING SECTOR

By

Nigel Warne B.Bus.

A Thesis Submitted in Partial Fulfillment of the Requirements for the

Award of

Master of Business (Information Systems)

At the School of Business, Edith Cowan University

Date of Submission: March 2000

USE OF THESIS

The Use of Thesis statement is not included in this version of the thesis.

Abstract

The purpose of this investigative research is to provide quantitative detail to better understand the development and use of Executive Information Systems (EIS) in the Australian Manufacturing sector. This investigation is an extension of previous research done on EIS in Australia (Pervan, 1992; Pervan and Phua, 1997) and looks more closely at the independent variables of organisation size and industry type in their relationship with the development and use of EIS.

A broad literature review provides a descriptive model that gives some insight into the development and use of EIS over more than fifteen years. Over eighty per cent of the reviewed literary work comes out of the United States of America, with very little research done in an Australian context.

A sample of 291 medium to large Manufacturing organisations around Australia was involved in a quantitative survey designed to measure the organisations' perceptions about the development and use of EIS. The survey comprised questions that were derived from a review of the literature, on the development and use of EIS in Australia and overseas.

The major finding of this investigation was evidence that the stage of EIS development is based on industry type and not size of organisation and that the majority of large organisations wanted to spend no more on EIS than medium sized organisations.

1. Differences

A finding of the investigation was evidence that some characteristics of the development and use of EIS are determined by organisation size and some by industry type within the Manufacturing sector.

The significant differences based on organisation size were:

- spending on ongoing annual maintenance of an existing EIS
- perceptions of benefits of EIS.

The significant differences based on industry type were:

- stage of EIS development
- areas of use of EIS
- perceptions of benefits of EIS

2. Similarities

The following characteristics of the development and use of EIS found to be similar between organisation size and industry type:

- types of users of EIS
- initial spending on the development of new EIS
- required functions and features of EIS
- problems of developing and introducing EIS

Information from this investigation about the required functions and features and users of EIS, as well as the specific areas of use of EIS by industry type will assist EIS vendors to focus on these areas in their products and development tools.

An understanding of common problems of developing and introducing EIS and users of EIS, as well as the relevant benefits of EIS and expected spending on EIS will assist organisations in their preparation, planning and successful implementation of EIS.

Declaration

I hereby certify that this thesis does not, to the best of my knowledge and belief:

(i) incorporate, without acknowledgement, any material previously submitted for a degree or diploma in any institution of higher education;

(ii) contain any material previously published or written by another person except where due reference is made in the text; or

(iii) contain any defamatory material.

Nigel Warne

Date: March 2000

Acknowledgments

My appreciation goes to Dr. Dieter Fink, Mr. Stuart Garner and Dr. Bill Hutchenson, my academic supervisors at Edith Cowan University, for guiding and assisting me through the process of turning thoughts and ideas into a Thesis. I have learnt much about Executive Information Systems and so very much about the process of business research.

Much thanks to Dr. Roger Sor from Edith Cowan University for valued input and guidance with the statistical method and presentation of this thesis.

To those that have reviewed my survey and associated draft work, I thank for spending the time and for giving valued critique and further ideas. Mr. Phil Watkins and Mr. Stewart Richmond provided such valued input as Information Systems professionals, helping so much with the survey and survey introduction letter.

My heartfelt thanks go to my loving wife and research assistant, Alison, who helped and supported me through the many highs and lows that come with business research. Our son James was born in the middle of writing-up of this thesis and provided a very welcome distraction.

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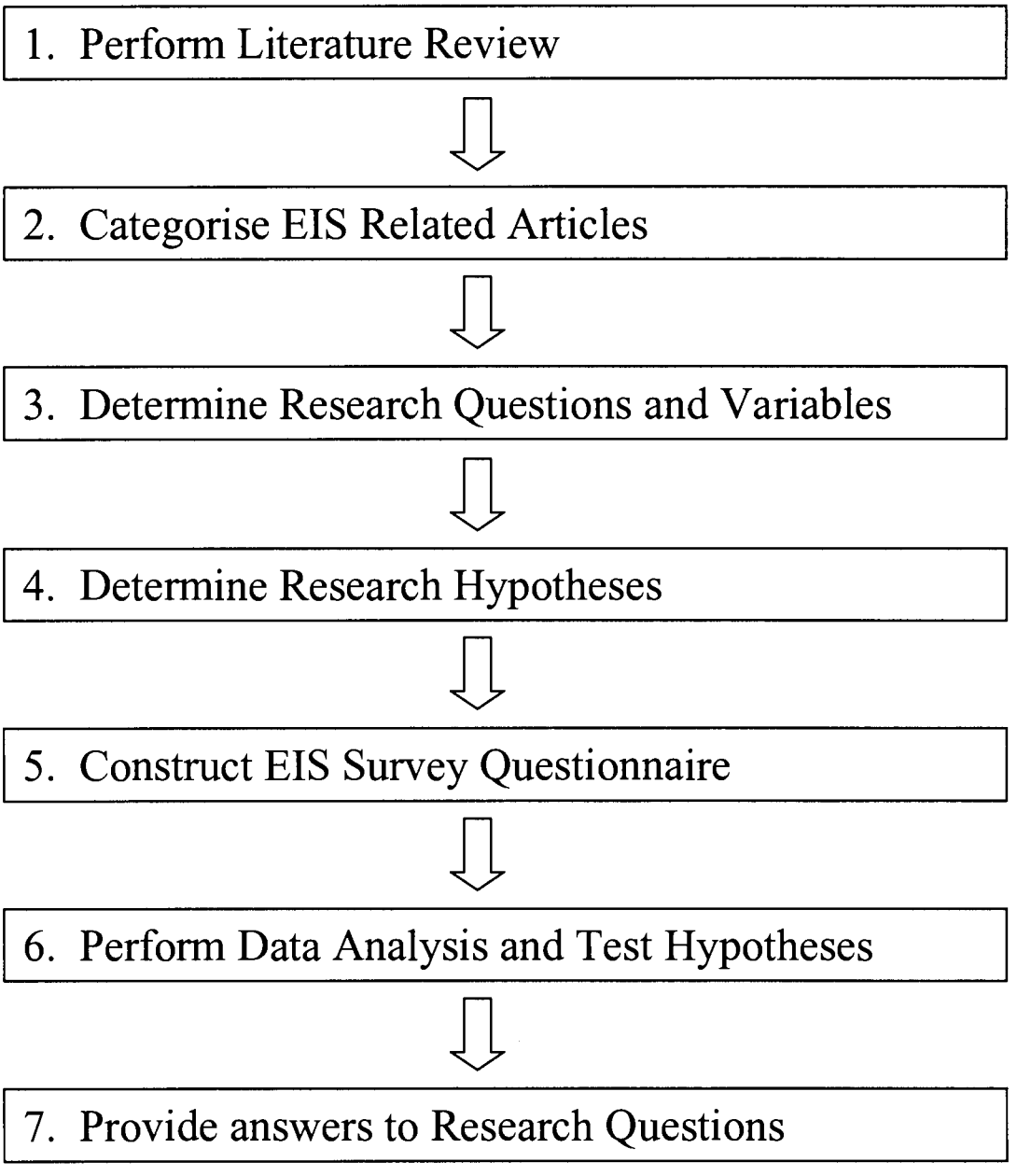
Chapter One – Introduction

Rockart and Treacy (1982) first described Executive Information Systems (EIS) more than fifteen years ago. This first description of an EIS created much excitement with talk about what an EIS could provide, with the vision of company executives using a computer to access internal and external information used to enhance their decision making in an increasingly competitive environment. Information previously summarised and presented to executives through middle management over an extended period of time could now be accessed in a timelier manner, allowing decisions to be made ahead of competitors in order to maximise productivity and increase profits.

A search of the literature relating to EIS was conducted to see how much of this vision had been realised since the defining study by Rockart and Treacy in 1982. A local Australian and international search for EIS related material found forty-one articles to 1997 (see Appendix A – EIS Related Articles).

The following diagram provides a conceptual model of the research approach for this investigation.

Diagram 1 – Research Approach



Each of the forty-one EIS related articles was categorised and further detail about these articles and their impact on this investigation is found in Chapter Two – Review of the Literature.

The excitement that came with that first description of an EIS (Rockart and Treacy, 1982) has been overshadowed by the expense of developing EIS that were not used effectively by the executive users (Watson, Rainer and Koh, 1991; Watson, 1993).

There were many case studies describing the factors that lead to EIS success and failure (Armstrong, 1990; Mohan, 1990; Whymark, 1991; Belcher and Watson, 1993). These experiences provided the lessons for those organisations that have not embarked on EIS development or use. A review of these experiences provides this investigation with information relating to the following distinct areas relating to the development and use of EIS:

1. Description of the framework for the development and use of EIS
2. Executive information requirements as they relate to EIS
3. Determination of costs and benefits of EIS
4. Emergence of EIS development packages and development tools

Further analysis of articles relating to these four areas provides the research questions and definition of research independent variables that were the basis of this investigation. The research questions are described further in this Chapter and the independent variables, industry type and organisational size, are defined in Chapter Three – Research Framework and Hypotheses.

Research hypotheses were derived from the literature review and presented in Chapter Three – Research Framework and Hypotheses. These hypotheses form the basis of the survey questions described in Chapter Four – Research Methodology. The responses from the survey questions were analysed and specific questions used to test the research hypotheses in Chapter Six – Hypotheses Testing. The findings from hypotheses testing

are presented in Chapter Seven – Discussion, Limitations and Future Research, to provide answers to the original research questions.

EIS Definition

Watson, Rainer and Koh (1991, p. 13) in their search for a variety of definitions of an Executive Information System, came up with the following definition:

> *"A computerised system that provides executives with easy access to internal and external information that is relevant to their critical success factors."*

The definition of an EIS by Watson, Rainer and Koh (1991) was the most concise of the forty-one articles relating to EIS (see Appendix A – EIS Related Articles). It was my opinion after reading the literature on EIS that while a definition is useful, a far richer understanding can be determined by describing the features and functions of EIS. It is these characteristics that easily identify an EIS to the reader, where the concise description was vague and non-specific about the nature of such systems.

Watson, Rainer and Koh (1991) concluded that characteristics of most EIS to be computer systems that include the following features:

- *tailored to individual executives users;*
- *extract, filter, compress and track critical data;*
- *provides online status access, trend analysis, exception reporting, and 'drill-down' (drill-down allows the user to access supporting detail or data that underlie summarised data);*
- *access and integrate a broad range of internal and external data;*

- *user-friendly and require minimal or no training to use;*
- *used directly by executives without intermediaries;*
- *present graphical, tabular, and/or textual information.*

Research Motivation

An Information System professional for more than a decade, I have followed the literature about EIS with a great deal of interest over this time. Like others in this industry, I have been waiting for the realisation of the promise of maximising productivity and increasing profits through the use of an EIS as described at Northwest Industries (Rockart and Treacy, 1982).

It has been many years since this promise by Rockart and Treacy (1982), with other case studies and investigations describing frameworks to successfully develop EIS (Belcher and Watson, 1993; Mohan, 1990; Whymark, 1991; Armstrong, 1990, Carroll and Larkin, 1992).

A study of the costs of developing and maintaining EIS within fifty-one United States organisations (Watson, 1993), showed an average initial cost of $US450,162 and annual ongoing costs of $US222,626. This high cost of development and ongoing support of EIS suggest that only the largest of organisations could afford to develop and use such systems.

Despite the large investment in the development of EIS by large organisations, a study of fifty such developments (Watson and Glover, 1991) found that 42% of large

organisations did not achieve their objectives and abandoned the EIS development and use.

The failure of many large organisations to develop and use EIS, together with my discussions with other industry professionals and EIS vendors leads me to suggest that EIS are largely an unrealised dream. Discussion about great improvements in the tools and technology used to develop EIS (Korzeniowski, 1993) and the use of such systems by a broader range of users than senior executives (McKendrick, 1993) gives hope for Information Systems professionals like myself to realise this dream of more than a decade. For a better understanding of the potential of EIS, investigation of organisations other than the largest needs to be conducted. More recent advances in EIS development tools and changes in scope of use within organisations also needs to be investigated.

Medium and Large Organisations

Much of the literature about EIS (32 of the 42 articles) was based on the experiences and learning from the largest of companies in the United States of America. A similar focus on the experiences and learning's from the largest companies was also evident in the six Australian articles listed in Appendix A – EIS Related Articles. An earlier study of the cost of EIS development and use (Watson and Glover, 1991) found that average cost of initial development to average $US450,162 and an annual ongoing support cost of $US222,626. This high cost of development and ongoing support suggests why only large organisations can afford to develop and use EIS and why it is only these organisations that are discussed in the literature available.

Four of the more recent articles relating to EIS (Karbowski, 1992; Frolick and Ramarapu, 1993; McKendrick, 1993; Korzeniowski, 1993) describe the maturation of EIS vendor solutions and development tools, with an associated reductions in the cost of introducing and maintaining such systems. McKendrick (1993) suggested that a dramatic fall in the cost of implementation of EIS allow for organisations other than the largest to take advantage of these systems. There is also a suggestion that the fall in costs also provides the opportunity to expand the use of EIS at all levels of management.

It is this suggestion of a maturation and improvement in affordability of EIS vendor solutions and development tools that has led to the use of organisational size as an independent variable. The relationship of organisational size was tested against the research questions and relating hypotheses by this investigation to see if organisations other than the largest are developing and using EIS.

Australian Manufacturing Sector

An investigation of the largest 200 organisations in Australia (Pervan, 1994) found a difference in priority for the development of EIS by Government, Service and Manufacturing sectors. This difference in priority between sectors led to this investigation of the Manufacturing sector in Australia. The Manufacturing sector ranked the priority for development of EIS higher than Government and Service sectors and this has been investigated further.

The relationship of industry type was tested against the research questions and relating hypotheses by this investigation to see if organisations within the Manufacturing sector have different priorities and ideas about the development and use of EIS.

Research Objective

The objective of this investigation was to determine the significance of variables, organisational size and industry type, and their effect on the following areas relating to EIS in Australian organisations that belong to the Manufacturing sector:

- stage of development of EIS
- areas of use of EIS
- users of EIS
- limit of expenditure on EIS
- perceptions of benefits of EIS
- perceptions of required features and functions of EIS
- perceptions of problems of developing and introducing EIS

These areas relating to EIS are further described in Chapter Two – Review of the Literature.

Understanding the effect of variables, organisational size and industry type, as they relate to the development and use of EIS in the Australian Manufacturing sector assists organisations in the following ways:

1. An understanding of where organisations stand in relation to their use of EIS and others of a similar size or industry type. This knowledge gives organisations an understanding of where they stand in their stage of development and use of EIS compared with their competitors.

2. The magnitude of EIS use within organisations of similar size or industry type. To what level are organisations targeting the use of EIS, by functional area and employee grouping? This determination of magnitude is important, so those organisations can plan for the most effective use of EIS.

3. The features and functions of EIS and their respective benefits as they are perceived by organisations of similar size or industry type. A large problem is the initial cost justification of EIS (Watson, Rainer and Koh, 1991; Belcher and Watson, 1993). More detailed information about perceived benefits of EIS by organisations of similar size or industry type will assist EIS vendors in providing the respective features and functions of EIS to the right market.

4. The lessons of developing and introducing an EIS into an organisation are more appropriate to the organisations of similar size and/or industry type.

Research Questions

Following on from the research objectives, the aim of this investigation was to answer the following research questions:

1. Are there differences in the stages of EIS development of organisations in the Manufacturing sector?

2. Are there differences in the areas of use of EIS within organisations in the Manufacturing sector?

3. Are there differences in the types of users of EIS within organisations in the Manufacturing sector?

4. Are there differences in the limits of expenditure on EIS by organisations in the Manufacturing sector?

5. Are there differences in perceptions of benefits of EIS by organisations in the Manufacturing sector?

6. Are there differences in perceptions of required functions and features of EIS by organisations in the Manufacturing sector?

7. Are there differences in perceptions of problems of developing and introducing EIS into organisations in the Manufacturing sector?

Organisation of Thesis

The first chapter introduces the topic and lays the foundation for the significance and purpose of this investigation. The second chapter comprises a general literature review, which forms the basis of the research framework described in Chapter Three – Research Framework and Hypotheses. The fourth chapter looks closely at the survey questionnaire as a tool for research, describing the many aspects that make it effective

in testing the hypotheses. The fifth chapter looks at the validity of the survey and its responses in this investigation. Chapter Six – Hypotheses Testing presents the hypothesis testing, using descriptive and statistical analysis. The discussion and conclusion that makes up Chapter Seven - Discussion, Limitations and Future Research presents the findings and recommendations about the relationship between organisational size and industry type with the development and use of EIS in Australian Manufacturing organisations.

Chapter Two – Review of the Literature

A broad literature search was conducted of material relating to EIS, providing a literary basis for this investigation. Multiple library searches of Information System journals, using library computer systems 'key-word' search systems were performed, together with global Internet searches of EIS related articles. An analysis of the material found using these searches is detailed in this chapter, to give a basis for the hypotheses used in this investigation.

General Literature Review

The literature search provided forty-one local Australian and international articles relating to EIS to 1997 (see Appendix A – EIS Related Articles). Each article was categorised into the following:

a) Article type

b) Country of origin

c) EIS related topic(s)

a) Article Types

Forty-one articles (Appendix A – EIS Related Articles) have been categorised into the following article types:

- case studies – 17 (41% of total number of articles)
- surveys – 10 (24% of total number of articles)
- combined case studies and surveys – 5 (12% of total number of articles)
- interviews – 5 (12% of total number of articles)
- literature reviews – 4 (10% of total number of articles)

The large number of pure case studies (41%) identifies important variables and their relationships with particular situations relating to EIS. The literature reviews (12%) bring the case studies and other associated articles together, to discuss these relationships between variables and situations relating to EIS further. The surveys (24%) allow further testing of these variables and help describe these against larger populations than can be provided by case studies. The interviews (10%) provided a further insight into changes relating to the development and use of EIS that could have an impact on the variables already described and tested in the case studies and surveys.

b) Country of Origin

Articles relating to Australian experiences with EIS were sought, providing as much of a local basis for this investigation as possible. Despite this focus, only six EIS related articles were found relating to Australian organisations. The United States provides much of the available literature on EIS and it is these overseas experiences that make up a large proportion of this literature review.

The forty-one EIS related articles originated from the following countries:

- United States – 32 (78% of the total number of articles)
- Australia – 6 (15% of the total number of articles)
- United Kingdom – 2 (5% of the total number of articles)
- New Zealand – 1 (2% of the total number of articles)

c) EIS Related Topic(s)

There are topic areas relating to the development and use of EIS that were discussed in articles. Further detail of these areas provides the variables and situations relating to EIS used in this investigation. The forty-one articles shown in Appendix A – EIS Related Articles were categorised into one or more of the following areas:

1. Description of the framework for the development and use of EIS – 20 (49%)
2. Executive information requirements as they relate to EIS – 11 (27%)
3. Determination of costs and benefits of EIS – 13 (31%)
4. EIS development packages and development tools – 15 (37%)

Each of these areas is further described, showing their importance to the Research Questions in Chapter One - Introduction. These articles provided the basis for these questions and the resulting hypotheses tested in this investigation.

1. Description of the Framework for the Development and Use of EIS

Analysis of the articles relating to the experience of developing and using EIS was provided in almost half of the articles (49%) from the literature search. These experiences were the foundation for the following research questions of this investigation:

- Are there differences in the perceptions of required functions and features of EIS by organisations in the Manufacturing sector?

EIS must provide information that is relevant to that organisation's strategic objectives and critical success factors (Rockart and Treacy, 1982). This was an important point that came out of this very early descriptive example of EIS and one that has shown to

be a very important element in recent developments. Fitzgerald (1990) found that 47% of respondents to a survey questionnaire had established critical success factors (CSF) at the outset of EIS projects. Watson and Frolick (1993) identified 39% of respondents to another survey as using CSF sessions when developing their systems. The definition of the information needs of executives had shown to be the biggest problem in the development of EIS (Fitzgerald, 1990). Without an understanding of the goals and direction of an organisation, the developers of EIS have less chance of providing systems and information that meet the needs of these executives.

EIS were only made possible with the availability of timely information from corporate databases and the technological improvements in the gathering of this and other "soft" information (i.e. gossip, ideas, opinions, reasoning and explanations). All of this is important for organisations in maintaining an understanding and control of their business and its environment (Watson and Frolick, 1993).

External information (i.e. stock market, journals, other industry players, customers, suppliers) is also used by many executives to gain a better understanding of the environment in which they operate and to learn about changes in the market that may affect their organisation. Most firms that have developed EIS have focussed their attention on providing information from their current information systems, despite the value executives place on this "soft" and external information (Watson, Rainer and Koh, 1991).

External data sources were investigated and noted in a survey of large U.S. organisations (Watson, Rainer and Koh, 1991) which showed the use of news services

(56%), stock markets (46%) and trade/industry data (34%) as the most common sources.

2. Executive Information Requirements

Analysis of the articles relating to the experience of developing an EIS for executives and the problems associated with their use was provided in over a quarter of the articles (27%) from the literature search. These experiences provided the foundation for the following research questions of this investigation:

- Are there differences in perceptions of benefits of EIS by organisations in the Manufacturing sector?
- Are there differences in the perceptions of required functions and features of EIS by organisations in the Manufacturing sector?
- Are there differences in perceptions of problems of developing and introducing EIS into organisations in the Manufacturing sector?

More than twenty-five percent of articles relating to EIS (see Appendix A – EIS Related Articles) discussed the nature of executives and how different their needs were in relation to EIS compared with other types of employees. With EIS developed for executives, it is important that these executive needs are well understood by all involved in the development and use of EIS.

Watson and Frolick (1993) observed that executives with access to more detailed information through EIS were more able to positively change the behavior of people at lower levels of the organisation. A better understanding of detailed data at the top of the organisation can facilitate the pushing down of decision making to operating levels.

It is important to get the lowest source of data to executives, instead of the more traditional access to highly aggregated and summarised data.

Features in EIS such as menus, graphics and colour allow the presentation of trends that avoids the data overload problem associated with examination of raw information. EIS should enable the user to extrapolate and explore trends to determine business problems as well as opportunities. The key to executives continuing to use EIS is a concise, straightforward system that invites inquiry and entices the user to explore further. EIS must be easy to navigate, as well as easy to operate and follow.

The graphical display of timely information to help executives make more informed decisions, requires a large investment in support and funds, with no guarantee of success. The nature of executive work meant that executives have neither the time nor the inclination to make full use of an EIS, preferring to use staff to provide much of their information (McKendrick, 1993). Creating such a sophisticated environment for such a small number of executive users meant that many of the benefits of EIS had not been realised.

3. EIS Costs and Benefits

Analysis of the articles relating to the costs and benefits of EIS was provided in over a quarter of the articles (31%) from the literature search. These experiences provided the foundation for the following research questions of this investigation:

- Are there differences in the limits of expenditure on EIS by organisations in the Manufacturing sector?

- Are there differences in perceptions of benefits of EIS by organisations in the Manufacturing sector?
- Are there differences in perceptions of problems of developing and introducing EIS into organisations in the Manufacturing sector?

It is difficult to justify the development and/or use of EIS using traditional cost/benefit analyses, as it is hard to quantify tangible benefits from their use. Some of those benefits that are hard to quantify (Watson, Rainer and Koh, 1991) include more focused organisational attention and improved internal and external communication. These benefits have been shown to result from the use of an EIS but are impossible to accurately identify in dollar terms as benefits.

The only information relating to the cost of development and use of EIS related to large organisations in the United States (Watson and Glover, 1991). Not only is the initial development of an EIS costly, with an average of $US450,162, but the annual ongoing support is as much as $US222,626 (Watson and Glover, 1991). These figures suggest that an EIS is expensive and, consequently, may be limited to larger firms with considerable financial resources.

4. EIS Development Packages and Development Tools

Analysis of the articles relating to the EIS development packages and development tools was provided in over a third of the articles (37%) from the literature search. These experiences provided the foundation for the following research question of this investigation:

- Are there differences in the limits of expenditure on EIS by organisations in the Manufacturing sector?

Korzeniowski (1993) in his interviews with leading EIS tool vendors found their marketing and development focus was expanding from the executives of an organisation to all levels of management. Korzeniowski suggests that the improvement of accessibility of information to all managers increases the appeal and acceptance of EIS into organisations. These EIS vendors were enhancing their products by making them available over many more operating system platforms and allowing them to move data more easily between EIS and other applications. The new focus allows all managers to get information, improving the communication between all levels of management.

International Data Corp (IDC), a large US marketing research firm, estimated in 1994 that the world market for EIS is growing at a rate of about 20% every year. This growth was attributed to the affordability of developing tools that improve the functionality of EIS that are developed and used.

Conyngham (1994) recommended, based on the evaluation of the use of an EIS at Kimberley-Clark Australia, that the EIS market and associated vendors were immature and had converging solutions. If other Australian Manufacturing organisations were of this same view, then many organisations could be holding back from the development and use of EIS. This is a situation needing to be tested, given there could have been a maturation of vendors and tools since that evaluation.

An Australian EIS Perspective

Conyngham (1994) makes the comment that the material available on EIS relating to Australian organisations comprises largely qualitative studies of large organisations that share their experiences about developing EIS. A small number of quantitative studies have emerged since this observation (Pervan, 1992; Pervan, 1994; Pervan and Phua, 1997) and many of the findings provided similar findings to those in the U.S. literature.

Pervan (1992) provides the earliest quantitative survey results on the penetration of EIS in the largest 200 Australian organisations. This research is investigative in nature, examining expected and actual benefits of EIS and the usage of these systems and by whom. This survey of large Australian organisations was the first published quantitative research to be done in Australia, a decade after EIS were described (Rockart and Treacy, 1982). These research shows Australian executives, like their U.S. counterparts, were interested in the benefits of EIS. These executives also rely on their support staff to use such systems. There is interest shown by large organisations in the development and use of EIS, with many of them in an "evaluation mode". Australian organisation development and use of EIS were at an early stage, compared with their counterparts in the U.S., with EIS usage patterns very similar.

Executive Information Systems (EIS) were ranked as a top ten information systems issue by the largest Australian Manufacturing organisations in the Manufacturing sector (Pervan, 1994). This result was in contrast to the two other industry sectors, which ranked it as a 14th (Service sector) and 18th (Government sector) Information Systems management issue. This difference in ranking shows there to be a difference in the

attitude towards the development and use of EIS between these three industries sectors. This investigation looks specifically at the Manufacturing sector and whether organisations of different industry types have different perceptions about the development and use of EIS within this sector.

It is known, based on studies of the largest 200-300 Australian organisations (Pervan, 1992; Pervan, 1994; Pervan and Phua, 1997), that the larger amount of research based on the U.S. on the development and penetration of EIS is relevant to large Australia organisations. Pervan (1994) and Pervan and Phua (1997) showed a delay in the adoption of EIS in Australia compared with similar sized organisations in the U.S., with longer development times of these systems. There is a move towards using Personal Computer (PC) based EIS tools (Pervan and Phua, 1997) and the improved functionality and price effectiveness of these EIS development tools (Korzeniowski, 1993) can only increase the use of penetration of these systems through organisations of all sizes.

There is a lack of information about EIS in Australian organisations between 1994 and 1997. This led to Pervan and Phua (1997) conducting an investigation that was designed to complete a picture of the current state of EIS in Australia, based on previous Australian and recent US surveys. This investigation provides the most detailed account of the penetration of, and issues relating to the use of EIS in large Australian organisations.

Pervan and Phua (1997) surveyed the top 300 organisations in Australia on the state of EIS in these organisations. Of the response from 72 of the 300 organisations, only

seven percent had no EIS, existing or planned. Seventy five percent of these organisations were currently developing an EIS or in the process of evaluating the tools required for the development and use of these systems.

The suggestion for future research from Pervan and Phua (1997), based on their survey of the largest Australian organisations, is for future research of organisations smaller than the largest 300 organisations. There is also suggestion for more detailed case studies to give more background to the issues and problems associated with the development and use of EIS in Australian organisations.

Relevance of Literature to Investigation

The forty-one reviewed articles relating to EIS (see Appendix A – EIS Related Articles) provided the rationale for the use of the two independent variables and seven research questions that were tested by this investigation. Survey questions were derived from the EIS related articles in the literature review and used to test the hypotheses defined in Chapter Three – Research Framework and Hypotheses. The results of the hypotheses testing in Chapter Six – Hypotheses Testing, provides the basis for answers to these seven research questions that make up this investigation.

The seven research questions relate to the following areas that have been discussed in the literature review:

1. Stage of development of EIS
2. Areas of use of EIS
3. Types of users of EIS
4. Limit of expenditure on EIS

5. Perceptions of benefits of EIS
6. Perceptions of required features and functions of EIS
7. Perceptions of problems of developing and introducing EIS

These areas are further described, as they provided the basis of the survey questions used to test the hypotheses defined in Chapter Three – Research Framework and Hypotheses.

1. Stage of Development of EIS

Pervan and Phua (1997) determined the stage of development of EIS in organisations as one of the following phases:

1. No EIS exists or is under consideration.
2. EIS had been proposed and its introduction is under evaluation.
3. The EIS had been accepted and is under development and implementation.
4. The EIS is operational and in use.
5. EIS failure (where the EIS had gone into decline and been phased out).

These five stages as described by Pervan and Phua (1997) are progressive and give some indication as to the progress of organisations towards the development and use of an EIS. Only 7% of the large Australian organisations in a recent study were found to have no EIS existing or planned (Pervan and Phua, 1997). This finding shows that EIS was relatively recent in large Australian organisations, with 44% in the process of EIS evaluation.

Watson and Glover (1991) provided figures on the average cost of the development of an EIS at $US450,162 and an ongoing maintenance support of $222,626. Watson and Glover (1991) suggest that EIS may only be limited to larger firms with considerable financial resources. This high cost of entry to the EIS market suggests it is more likely that larger organisations have embarked on the development and use of EIS, compared with smaller organisations that were less likely to have done so.

A reduction in the implementation costs of EIS of up to a factor of ten (McKendrick, 1993) suggests that the cost of entry to the EIS market is falling. Korzeniowski (1993) in his interviews with leading EIS tool vendors, found that the tools used to develop and use EIS were also improving and substantially cheaper than those earlier figures of Watson and Glover (1991).

Determining the stage of EIS development and use of Australian organisations in the Manufacturing sector checks if there is interest in EIS with all sizes of organisation, or only the largest. If the cost of development and use of EIS is too much for many organisations, then I anticipate many organisations at the first stage of 'No EIS exists or is under consideration' as described by Pervan and Phua (1997) in determining the stage of development of EIS in organisations.

2. Areas of use of EIS

McKendrick (1993) talks about the spread of EIS over all levels of management in organisations. Middle managers and professionals having detailed access to department information through an EIS, with executives using more summarised information at a corporate level.

There is little information in the literature about the areas of use of EIS in organisations. This investigation looks at the most common areas of organisations in the Manufacturing sector that would be included in an EIS. The areas of use of EIS were identified by my discussion with the two Information Systems Managers from organisations in the Manufacturing sector that reviewed the survey questionnaire. The areas of use were defined as:

- Financial Monitoring
- Sales/Market Analysis
- Competitive Analysis
- Forecasting/Demand Analysis
- Non-Financial Monitoring (ie. Human Resources)
- Production Monitoring

3. Types of Users of EIS

McKendrick (1993) makes the comment that EIS have traditionally been created for a small number of executive users that have neither the time nor the inclination to make full use of such a system.

The development focus of leading EIS tool vendors is to expand the focus from the executives of an organisations to all levels of management (Korzeniowski, 1993). It is this accessibility of information that is expected to increase the appeal and acceptance of EIS into organisations of all size.

This investigation looked at the different management levels and types in the Australian Manufacturing sector to determine if there was expansion outside the executive level for EIS development and use. The distinction is made between the different levels of management that exist in organisations that belong to the Manufacturing sector, to investigate the most likely users of EIS. The types of users of EIS were determined by the researcher and checked by the two Information Systems Managers that reviewed the survey questionnaire. The types of users were:

- Chief Executive Officer
- Secretary to Chief Executive Officer
- Executives
- Executive Secretaries
- Management Staff
- Support Staff (ie. Analysts and Clerks)
- Sales Representatives
- Engineers
- Factory/Warehouse Employees

It was understood that this was not a comprehensive list of types of users in all organisations in the Manufacturing sector.

4. Limit of expenditure on EIS

The Australian Bureau of Statistics (1994) provided the expenditure of Information Technology as a percentage of revenue of Australian Manufacturing organisations, indicating a correlation between the size of an organisation and the amount of money it spends on Information Technology. An extension to this correlation is that larger

organisations have a higher limit of expenditure on EIS through a larger expenditure of Information Technology. Large organisations were more likely to have a higher limit on the expenditure for the development of EIS than smaller organisations, as well as a higher amount for annual EIS maintenance.

5. Perceptions of benefits of EIS

An understanding of the benefits that organisations were delivered from the development and use of EIS gives an insight into why organisations invest in this technology. Belcher and Watson (1993) discussed the problem of clearly identifying the return from many Information Technology (IT) investments, making systems such as EIS more difficult to evaluate and justify. In order to evaluate such IT investments, traditional financial measures were often required, together with strategic and intangible benefits that support the decision to invest in EIS.

The following reasons have been identified from the literature as to what benefits organisations have achieved from the use of EIS:

- reduction in paperwork
- time savings in reporting data to executives
- reduction in request for changes to reports
- savings in finding problems more quickly
- savings in finding opportunities more quickly

Appendix B – Survey Question References provides the source of these defined benefits in the justification of an EIS.

6. Perceptions of required features and functions of EIS

Mohan (1990) described the features and functions of an EIS in a discussion of the need for EIS in the public sector. It is the benefit to the business in using EIS with these features and functions that needs to be understood by top management in their support of what Mohan (1990) calls 'risky projects like the development of EIS'.

Watson, Rainer and Koh (1991) studied 50 firms that had an existing or were developing an EIS. This investigation provided a framework that could be compared or used as a basis for future EIS developments. The most common features of EIS from these fifty (50) firms involved in the investigation were provided.

The following features and functions of EIS were identified from the literature:

- 'Drill down' between layers of information
- trend analysis
- ease of use
- visual gauges of performance
- modeling and 'what-if' scenarios
- access to external data

Appendix B – Survey Question References provides the source of these defined functions and features in an EIS.

7. Perceptions of problems of developing and introducing EIS

There were many case studies describing EIS success and failure (Armstrong, 1990; Mohan, 1990; Whymark, 1991; Belcher and Watson, 1993). The experiences from the development and use of EIS provided lessons for those considering the development

and/or use of an EIS. More than twenty-one (42%) of a study of 50 EIS developments (Watson, Rainer and Koh, 1991) experienced failure, highlighting the importance of learning from others experiences and not making the same mistakes.

The following problems in creating and introducing an EIS were identified from the literature:

- justification to develop or use an EIS
- importance of development of EIS against other projects
- availability of tools to develop an EIS
- cost of developing an EIS
- ongoing cost of maintaining an EIS
- availability of executives
- executive lack of computer experience
- lack of support by executives
- determining executives EIS needs
- availability of company data
- timeliness of company data

Appendix B – Survey Question References provides the source of these defined problems in creating and introducing an EIS.

Chapter Three – Research Framework and Hypotheses

This chapter describes the use of independent variables, industry type and organisational size and their use in a number of hypotheses derived from the literature review. These hypotheses are presented and described, forming the basis for the survey that is further described in Chapter Four – Research Methodology.

Industry Type and Organisational Size

The studies on EIS in Australia (Pervan, 1992; Pervan, 1994, Pervan and Phua, 1997) found surveys of the top 200 to 300 organisations by gross revenue as the measure of the development and use of EIS in Australia. Inclusion of only the largest Australian organisations in these surveys meant that no effective analysis had been done using size as an independent variable against the development and use of EIS in Australia. The size of organisations can be measured by number of employees and gross sales revenue, both of which have been used by the Australian Bureau of Statistics (1994) in their presentation of statistics about surveys of Manufacturing establishments in Australia. Gross sales revenue was used to determine the largest 200 and 300 Australian organisations to be used in similar EIS related investigations (Pervan, 1992; Pervan, 1994, Pervan and Phua, 1997).

Both numbers of employees and gross revenues were requested from the survey respondents for this investigation. A correlation of the two independent variables of number of employees and gross sales revenue showed a positive correlation of 0.75, with a significance of $p<0.001$. The assumption about the testing hypotheses relating to size is that the number of employees is used as the independent variable, instead of using both measures to test all hypotheses.

Industry sector was requested of the survey respondents by all of these Australian quantitative investigations (Pervan, 1992; Pervan, 1994, Pervan and Phua, 1997). While comment was made about response by industry sector, there was no further investigation of industry type within these industry sectors. This investigation tests the effect of industry type as an independent variable against the hypotheses, in determining if there are differences in perceptions about the development and use of EIS by industry type.

Industry type of organisations within the Manufacturing sector was determined at the sampling phase, using the information on the KOMPASS CD-ROM to give the standard ANZIC code as used by the Australian Bureau of Statistics (1994). The ANZIC selection of industry type was requested from organisations asked to participate in the survey, to determine the industry type of each respondent for further analysis as an independent variable.

Research Hypotheses

Hypotheses were based on the Research Questions described in Chapter One - Introduction and the following section details each hypothesis tested by this investigation.

Stage of EIS Development of Organisations in the Manufacturing Sector

The following hypotheses are based on the first research question – 'Are there differences in the stages of EIS development of organisations in the Manufacturing sector?'.

The null hypothesis reflects this view of Watson and Glover (1991) that the initial development and ongoing cost of EIS were substantial and therefore, larger organisations were are more likely to have progressed to a further stage of EIS development.

H0 1: There is significant difference between medium and large sized organisations in the Manufacturing sector in the stage of EIS development.

HA 1: There is no significant difference between medium and large sized organisations in the Manufacturing sector in the stage of EIS development.

There is no empirical evidence to suggest different EIS development between organisations in the Manufacturing sector. A null hypothesis will not reflect any significant difference between industry type in the Manufacturing sector and stage of EIS development.

H0 2: There is no significant difference between the industry type of organisation in the Manufacturing sector in the stage of EIS development.

HA 2: There is significant difference between the industry type of organisation in the Manufacturing sector in the stage of EIS development.

Areas of Use of EIS within Organisations in the Manufacturing Sector

The following hypotheses are based on the second research question – 'Are there differences in the areas of use of EIS within organisations in the Manufacturing sector?'

There is no empirical evidence of the relationships between organisation size and industry type with these categories of different areas of use of EIS. The null hypotheses will reflect there not being a significant difference between these variables.

H0 3: There is no significant difference between medium and large sized organisations in the Manufacturing sector in the EIS areas of use.

HA 3: There is significant difference between medium and large sized organisations in the Manufacturing sector in the EIS areas of use.

H0 4: There is no significant difference between the industry type of an organisation in the Manufacturing sector in the EIS areas of use.

HA 4: There is significant difference between the industry type of an organisation in the Manufacturing sector in the EIS areas of use.

Types of Users of EIS within Organisations in the Manufacturing Sector

The following hypotheses are based on the third research question – 'Are there differences in the types of users of EIS within organisations in the Manufacturing sector?'

There is no empirical evidence on these expectations of the types of users of EIS with size or industry type of organisation. The null hypotheses will reflect there not being a significant difference between these variables.

H0 5: There is no significant difference between medium and large sized organisations in the Manufacturing sector in the types of EIS users.

HA 5: There is significant difference between medium and large sized organisations in the Manufacturing sector in the types of EIS users.

H0 6: There is no significant difference between the industry type of an organisation in the Manufacturing sector in the types of EIS users.

HA 6: There is significant difference between the industry type of an organisation in the Manufacturing sector in the types of EIS users.

Limit of Expenditure on EIS by Organisations in the Manufacturing Sector

The following hypotheses are based on the fourth research question – 'Are there differences in the limits of expenditure on EIS within organisations in the Manufacturing sector?'

To properly compare the amount organisations would spend in total on the development of EIS, the survey question used to test this hypothesis specifies the development of a new EIS. This ensures that organisations at different stages of EIS development ignore amounts already spent on development and didn't specify only the remaining EIS development amount.

There is literary evidence to suggest that large organisations have spent large amounts of money on the development of EIS and on ongoing annual maintenance (Watson and Glover, 1991). There is also suggestion that larger organisations have larger capital and operating budgets than smaller organisations. An extension to this is that larger organisations were able and more willing to spend more on the development and use of EIS. The following hypotheses will be used to test this assumption.

H0 7: There is significant difference between medium and large sized organisations in the Manufacturing sector in the amount considered for spending on the development of a new EIS.

HA 7: There is no significant difference between medium and large sized organisations in the Manufacturing sector in the amount considered for spending on the development of a new EIS.

No literature was found to suggest there is any difference in the spending on EIS by organisations of different industry types, so the null hypothesis will reflect there to be no significant difference between variables.

H0 8: There is no significant difference between the industry type of an organisations in the Manufacturing sector in the amount considered for spending on the development of a new EIS.

HA 8: There is significant difference between the industry type of an organisation in the Manufacturing sector in the amount considered for spending on the development of a new EIS.

The following hypotheses determine if there is a difference between medium and large sized organisations and the amount they would consider spending on ongoing annual maintenance of an existing EIS. It is anticipated that larger organisations were able, through larger capital and operating budgets, to spend more on the annual maintenance of an existing EIS.

H0 9: There is significant difference between medium and large sized organisations in the Manufacturing sector in the amount considered spending on ongoing annual maintenance of an existing EIS.

HA 9: There is no significant difference between medium and large sized organisations in the Manufacturing sector in the amount considered for spending on ongoing annual maintenance of an existing EIS.

No literature was found to suggest there is any difference in the ongoing annual maintenance spending on EIS by organisations of different industry types, so the null hypothesis reflects there to be no significant difference between variables.

H0 10: There is no significant difference between the industry type of organisation in the Manufacturing sector in the amount considered for spending on ongoing annual maintenance of an existing EIS.

HA 10: There is significant difference between the industry type of an organisation in the Manufacturing sector in the amount considered for spending on ongoing annual maintenance of an existing EIS.

Perceptions of Benefits of EIS by Organisations in the Manufacturing Sector

The following hypotheses are based on the fifth research question – 'Are there differences in perceptions of benefits of EIS by organisations in the Manufacturing sector?'

There is no empirical evidence to verify that the rating of importance of these benefits of using EIS, by organisational size or industry type of organisation. The null hypotheses will reflect there to be no significant difference between these variables.

H0 11: There is no significant difference between medium and large sized organisations in the Manufacturing sector in the perception of benefits from the use of EIS.

HA 11: There is significant difference between medium and large sized organisations in the Manufacturing sector in the perception of benefits from the use of EIS.

H0 12: There is no significant difference between the industry type of organisation in the Manufacturing sector in the perception of benefits from the use of EIS.

HA 12: There is significant difference between the industry type of organisation in the Manufacturing sector in the perception of benefits from the use of EIS.

Perceptions of Required Functions and Features of EIS by Organisations in the Manufacturing Sector

The following hypotheses are based on the sixth research question – 'Are there differences in perceptions of required functions and features of EIS by organisations in the Manufacturing sector?'

There is no empirical evidence to verify that the rating of importance of these functions and features of EIS by size or industry type of organisation. The null hypotheses will reflect there to be no significant difference between these variables.

H0 13: There is no significant difference between medium and large sized organisations in the Manufacturing sector in the perception of required functions and features of EIS.

HA 13: There is significant difference between medium and large sized organisations in the Manufacturing sector in the perception of required functions and features of EIS.

H0 14: There is no significant difference between the industry type of organisation in the Manufacturing sector in the perception of required functions and features of EIS.

HA 14: There is significant difference between the industry type of organisation in the Manufacturing sector in the perception of required functions and features of EIS.

Perceptions of Problems of Developing and Introducing EIS into Organisations in the Manufacturing Sector

The following hypotheses are based on the seventh research question – 'Are there differences in perceptions of problems of developing and introducing EIS into organisations in the Manufacturing sector?'

There is no empirical evidence to verify that the rating of importance of these expected problems of developing and introducing EIS into an organisation. The null hypotheses will reflect there not being a significant difference between these variables.

H0 15: There is no significant difference between medium and large sized organisations in the Manufacturing sector in the perception of problems associated with developing and introducing an EIS.

HA 15: There is significant difference between medium and large sized organisations in the Manufacturing sector in the perception of problems associated with developing and introducing an EIS.

H0 16: There is no significant difference between the industry type of organisation in the Manufacturing sector in the perception of problems associated with developing and introducing an EIS.

HA 16: There is a significant difference between the industry type of organisation in the Manufacturing sector in the perception of problems associated with developing and introducing an EIS.

Chapter Four – Research Methodology

This chapter describes the research approach and strategy used in this investigation. The use of a survey instrument as the method to test the research hypotheses described in Chapter Three – Research Framework and Hypotheses is presented. Discussion on the process involved in the design and testing of the survey questionnaire and the selection of a representative sample to be used in the investigation follows.

Research Approach

Saunders, Lewis and Thornhill (1997) describe two main approaches to research: deductive and inductive approaches. Underlying these approaches is the research philosophy, or the way knowledge is developed. There are two main views about the research process that dominate the literature: positivism and phenomenology.

Positivism is the traditional approach to research where the researcher is independent of the subject of the research, objective and works with quantifiable observations using statistical analysis. Results should be able to be replicated, so findings can be checked and further extended in future research.

Phenomenology is a completely different view about the way in which knowledge is developed and argues against the view of positivism in that the circumstances of today can not always be applied in the future. Phenomenologists argue that the ever-changing world of business organisations and the unique nature of business situations put in question the issue of generalisability of the findings of positivism.

This investigation used a deductive approach that owes more to positivism, verses an inductive approach that is more aligned with phenomenology. Saunders, Lewis and Thornhill (1997) make the distinction between these two approaches that form the basis for the design of any research project. A deductive approach is where you develop a theory and hypotheses and design a research strategy to test the hypothesis, or the inductive approach, where you would collect data and develop theory as a result of your data analysis.

Research Strategy

Saunders, Lewis and Thornhill (1997) describe research strategy as the way in which you answer the research question(s) that has been defined as the basis of the research project. The most common research approaches are:

- experiment
- survey
- case study
- grounded theory
- action research
- longitudinal studies
- exploratory and explanatory studies

Thirty-two (78%) of the forty-one Australian and international articles relating to EIS to 1997 (see Appendix A – EIS Related Articles) that provided a literary basis for this investigation were based on surveys and/or case studies.

A survey questionnaire was chosen as a quantitative method to investigate a relatively large population in a short time, at a relatively low cost (Davis and Cosenza, 1985). The survey method is more commonly associated with the deductive research approach and has been used in fifteen (37%) of the forty-one Australian and international articles relating to EIS to 1997.

The attitudes and perceptions of medium to large manufacturing organisations about the development and use of EIS have not previously been tested, so a survey was chosen as the most appropriate research method.

Davis and Cosenza (1985) make the point that researchers must possess a rudimentary understanding of the problem being investigated, on which a survey can be based. The research questions as described in Chapter Two – Review of the Literature were the basis of the hypotheses tested by an analysis of the survey responses. The research questions were derived from a broad literature review of some forty-one articles that include case studies, surveys, interviews and literature reviews.

The objective of this quantitative research is to understand relationships between variables, organisation size and industry type, against research questions that have been derived from a literature review about the development and use of EIS. Survey questionnaires have been used previously to investigate the variable of organisation size against perceptions relating to EIS in Australia (Pervan, 1992; Pervan and Phua, 1997).

Use of Survey Instrument

A mail survey was sent to 291 organisations that were selected as a representative sample of the population of Australian manufacturing organisations (see Sample Selection). This technique had been used in studies relating to EIS in Australia and overseas (Watson, Rainer and Koh, 1991; Watson, 1993; Leidner and Elam, 1994; Miller, 1994; Daneshgar, 1993; Rainer, Snyder and Watson, 1992; Pervan, 1992; Vandenbosch and Higgins, 1995; Pervan and Phua, 1997).

The survey used a standard questionnaire made up largely of closed questions, where the number of responses to a specific question were limited to a selection provided by the researcher. Open-ended questions are the alternative to closed-ended questions, where the respondents can answer these questions as they please. The advantage of using closed-ended questions is that the answers can be more easily handled in data collection, needing less interpretation of answers by the researcher in data analysis (Davis and Cosenza, 1985).

Instructions on how to complete the survey questionnaire were provided in an introduction letter (see Appendix C – Survey Introduction Letter), together with examples of how to read and interpret the survey questions. The intention was to give instruction that would help limit the number of responses that would have to be rejected because of question or instruction misinterpretation.

Survey Design

The survey questions were derived from the forty-one articles relating to EIS as described in Chapter Two – Review of the Literature. These questions were designed

to determine respondents perceptions about the development and use of EIS, based on literature from Australia and overseas.

The survey questionnaire had six main components, relating to the research questions:

1. Determination of the independent variables of size and industry type of organisation.
2. Determination of the stage of development of EIS in that organisation.
3. Areas of EIS use within the organisation.
4. Types of users of EIS within the organisation.
5. The limit of expenditure on EIS by that organisation.
6. Organisation perceptions about the development and use of EIS.

The only open-ended independent variable measure was that of respondent job title, as it was expected that there would be more variations of job title than was possible to list for selection.

There were three groupings of perceptions that measured the experiences of those that have developed and/or using or have used an EIS, or the expectations of those organisations that have not developed or used and EIS. These groupings were:

1. Perceptions about the benefits of EIS to that organisation.
2. Perceptions of required features and functions of EIS for that organisation.
3. Perceptions of problems of developing and introducing EIS into that organisation.

The closed-ended questions used to measure these perceptions about EIS utilised two scaling techniques, itemised rating scales and Likert scales. Itemised rating scales

provide only a limited number of categories that one or more answers can be selected from. Likert scales provide a method for a respondent to agree or disagree with a variety of statements about their perceptions on a subject. A five-point scale was used to provide sensitivity in measuring differences in perception about the development and use of EIS (Davis and Cosenza, 1985). The five-point Likert scale is a method used in other surveys about EIS in Australian organisations (Pervan, 1992; Pervan and Phua, 1997). Both itemised rating scales and Likert scales allow for effective data coding, which can be further analysed to show relationships and trends.

Each of the questions that related to measurement of perception were derived from the literature review.

Ethical Considerations

The respondents to the survey had the right to expect complete anonymity, especially where questions were being asked which in some way could be used in a way that they did not wish or intend (Davis and Cosenza, 1985). The independent variables being requested in the survey to measure the size of the organisation, turnover and employee numbers is sensitive in nature and respondent anonymity must be clearly stated and adhered. The guarantee of company and respondent anonymity was made clear in the introduction letter (see Appendix C – Survey Introduction Letter), as was the use of only aggregate data. It was necessary to obtain the respondent's position within their organisation, to determine the perspective from which answers to the survey were given, although this alone was not sufficient for any identification of company or respondent.

An offer of the summary of this study's findings was given to each of the study participants, together with a tear-off slip that gave further contact details. These were to be sent back in another envelope, to ensure total anonymity. In some instances, these were forwarded together with the completed surveys, although this contact detail did not ask for company names, just E-mail or mailing details.

At no time are any individual responses identified, nor published as such, as promised in the survey introduction letter.

Data Collection

A package was sent to the selected sample of 291 organisations on the 4th December 1996. This package included an introduction letter (see Appendix C – Survey Introduction Letter) as well as a blank survey (see Appendix D – Survey Questionnaire) to be filled out and a reply paid envelope in which to return the completed survey questionnaire.

Within three weeks of mailing the survey to 291 manufacturing organisations around Australia, 71 responses had been received. In the first week, ten surveys were returned with incorrect addresses. For each of the incorrect addresses, a search for the correct address was made using the Telecom Web Page, giving the latest address and contact details. The returned surveys were sent to the newfound addresses for these ten organisations. Within one week, three were again returned with these organisations not able to be contacted.

Two companies stated that they did not have adequate resources to properly complete the survey and returned all of the correspondence and documentation. Eleven companies also declined to participate in the survey, stating that they had recently stopped manufacturing or were only involved in importing/exporting or distribution of already manufactured goods.

Three respondents completed surveys that could not be included in the investigation, based on information they provided on the surveys. Two respondents stating that they did not consider themselves to be manufacturing organisations and one respondent stated that they answered the survey in terms of their perception of a manufacturing computer system, not an EIS.

Thirty-seven companies provided contact details in response to the offer of sending a summary of the results to them. This showed 15% of companies sent the survey were interested in the outcome and findings of this investigation.

Table 1 - Data Collection Summary

	Number of Surveys
Sample Population	
Surveys sent	291
Returned surveys with no contact address	3
Companies unable to participate (resources)	2
Companies no longer or never in manufacturing	11
Total Sample Population	275
Responses	
Number of initial responses	71
Returned uncompleted or unable to participate	16
Unusable responses	3
Total Useable Responses	52
Response rate	18.9%

Chapter Five – Research Validity and Reliability

The validity and reliability of a survey needs to be determined before one can rely on the results of an investigation based on a survey. Davis and Cosenza (1985) describe the need for both internal and external validity testing in order to measure the degree to which the results of the investigation can be relied upon as being correct.

This chapter looks at the validity of the survey and its responses, by examining the internal validity and reliability as well as the external validity of this investigation.

Internal Validity

Davis and Costenza (1985, p.114) provided the following definition of internal validity:

> *"Internal validity can be defined as the degree to which the results of the study can be relied upon as being correct. Without it one cannot be confident that the relationships identified in the investigation are either well grounded or justifiable given the conditions of the study."*

This section discusses the internal validity checks that were done prior to the survey questionnaire being sent to organisations as part of this investigation. The factors that determine the internal validity of this survey, as defined by Davis and Costenza (1985), are:

- content validity of survey
- survey construction validation
- sample selection

Content Validity of Survey

The forty-one reviewed articles relating to EIS (see Appendix A – EIS Related Articles) provided the basis for the use of the two independent variables (see Chapter Three – Research Framework and Hypotheses) and seven research questions (see Chapter One – Introduction) that were tested by this investigation. Survey questions and possible responses were also derived from these EIS related articles and are fully described in Chapter Two – Review of the Literature.

Survey Construction Validation

There was a two-phase approach to the testing of the survey instrument: feedback by academic supervisors and a review of the survey questionnaire by two independent Information Systems Managers. The feedback involved two academic supervisors of this investigation reviewing the questions and their basis and use in hypotheses testing. Three versions of the survey instrument ensued, each reviewed and improved according to responses by the academic supervisors.

Following the academic review, two Information Systems (IS) Managers from manufacturing organisations of different size and industry types were asked to review the latest version of the survey questionnaire. These two IS managers were chosen as typical of whom the final survey would finally be sent and it was felt they could provide valuable feedback from the perspective of the survey respondent. These managers were asked to take particular note of the wording and appropriateness of questions and responses.

These IS manager reviews led to changes in the wording of questions, providing more detail to ensure clarity of question meaning, changing the order of questions to give better flow of answers and overall presentation and appearance of the survey questionnaire. Feedback was also given as to the time to complete the survey as well as to whom the survey should be addressed. A debriefing interview was done with both IS managers to let them explain their recommendations and give further feedback.

An improved survey questionnaire, with the two IS Manager's original ideas and suggestions included, was presented to them both for further review and again there were slight changes before they agreed to the format and content of the final survey. The final version of the survey instrument is included in Appendix D – Survey Questionnaire.

The academic supervisors suggested and it was agreed by the two IS managers that the survey should include a tear-off slip for respondents to be given the opportunity to receive a summary of the investigation's finding. This was seen as the best incentive to encourage people to complete and return the survey, giving the opportunity for them to receive the results and findings. Appealing to their altruistic sense was seen as the best method of improving the response rate. The tear-off slip asked for the basic contact details, which were to be returned separately to the survey questionnaire, ensuring complete anonymity.

The other suggestion from this survey instrument testing was to whom the survey should be sent. It was thought by both IS Managers that the survey should be addressed to the Information Systems/Computing Manager and that the covering letter

ask that the survey be filled out by that person in the organisation that was most closely involved in this area. It was agreed that not all manufacturing organisations to be sent this survey would have an Information Systems/Computing Department, though it was suggested that this address would get the survey to the most appropriate person.

The placement of questions is critical in the design and layout of the questionnaire. Questions should be laid out in a way that is easy to read and follows the flow of the questioning process (Davis and Cosenza, 1985). A well-laid out survey questionnaire helps ensure that the respondent correctly and completely fills out the questions. Advice was given by academic supervisors and IS managers to improve the layout of the survey questions to help maximise the response rate. This advice included:

1. wording of questions and answers
2. sequence of questions
3. length of questions
4. general page layout

Sample Selection

The 1992/93 Census (Australian Bureau of Statistics, 1994) showed 38,285 organisations in the Australian Manufacturing sector. It was decided to concentrate on what was termed as 'medium and large establishments' by the Australian Bureau of Statistics (1994): those employing 100 or more persons. This subset of 1654 medium and large manufacturing organisations was 4.3% of the 38,285 manufacturing organisations in Australia, providing 59.7% of the employment, 63.5% of the turnover and 78.4% of the net capital expenditure.

Based on the lack of capital expenditure of manufacturing organisations smaller than 100 employees, it was my assumption that these small organisations were very unlikely to even consider the development and use of EIS. This investigation was only involved with 'medium and large' manufacturing organisations, with 100 or more employees. Any findings would reflect this.

The identification of the population of this subset was required in order to properly gather a sample, to which the survey could be sent. The most up-to-date and accurate information on this population is gained through publishing organisations that specialise in gathering company details for mailing lists and direct access. These publishing organisations sell this detail on compact disk (CD) as well as offering a service that includes selecting samples from these lists using supplied selection criteria.

The investigation found that two publishing organisations provided a list of Australian manufacturing organisations; Kompass and Dun and Bradstreet. Kompass had details on over 30,000 Australian organisations, with Dun and Bradstreet having less than 16,000. Kompass had been gathering Australian Company information since 1968, whereas Dun and Bradstreet started in 1978.

A CD-ROM was purchased (Kompass, 1996) with details on 1748 organisations in the Australian Manufacturing sector with one hundred or more employees, compared with very similar number to that of the 1992/93 figure of 1654 Census (Australian Bureau of Statistics, 1994). The difference can be attributed to changes in organisational circumstances over four years as well as any small difference in the accurate determination of employee numbers by Kompass in their gathering of information. The

problem of having companies included as subsidiaries or included as part of the Group Company is another possible reason for the difference in numbers.

The selection of the population from the Kompass CD-ROM was made with the criteria that the company had to have one hundred or more employees in order to include only medium and large Australian organisations in the Manufacturing sector. It was also decided to include only the head office of that organisation, to save having many state branches being included in the sample population. The resulting companies were imported to a Microsoft Excel spreadsheet from the CD-ROM, for the final sample selection. The spreadsheet was used to order the population by organisation name. This allowed for duplicates to be removed from the population, as there were slight differences in the name for the same two organisations. This duplication was a problem with Kompass (1996) in their collection of company information.

Similar studies have taken a sample of 200 or 300 organisations from a population that included all industry sectors (Pervan, 1992). There was a population of 1748 Australian manufacturing organisations with one hundred or more employees available from the Kompass (1996) selection. Funding for this investigation did not allow for a survey questionnaire to be sent to all 1748 organisations, so it was decided that a method was required to include a representative sample of the entire population for this investigation.

There is a multitude of sampling methods that provide a method of selecting a sample from the entire population (Davis and Cosenza, 1985). The Systematic Sampling method was selected, giving the best representation by independent variable (see

Chapter One – Introduction) of manufacturing type and organisation size. Kompass (1996) identified the manufacturing type and organisation size of organisations which allowed for a representative number of organisations to be selected by these independent variables. Other sampling methods (Davis and Cosenza, 1985) were used where the independent variables were not able to be determined for selection of a sample from the entire population, making them less representative of the independent variables used in an investigation.

The Systematic Sampling method provided a sample of 291, after selecting every sixth organisation from the population of 1748 from the Kompass (1996) selection. The population was ordered by organisation size and industry type before this selection, ensuring representative sampling for these two independent variables. The number five was randomly selected by asking a child to choose a number between one and six, to start the Systematic Sampling selection (Davis and Cosenza, 1985). Every sixth company from the fifth company in this ordered list was selected to make up the sample for this investigation, giving the names and details of 291 organisations. This sample of 291 organisations made up 16.6% of the entire population of 1748 from the Kompass (1996) selection.

The survey was addressed to the Information Systems/Computing Manager of each organisation. The introduction letter asked for this survey to be completed by that person with the most knowledge about the subject of Executive Information Systems.

External Validity

External validity relates to the degree to which the findings from the hypotheses testing, which is done against the responses to the survey from a sample population, is representative of the entire population (Davis and Costenza, 1985). External validity can be measured and compared against the results of similar studies. The factors that need to be tested to provide external validity are:

- survey response
- representativeness of sample – independent variables

Survey Response

The useable response rate of 19% (see Table 1 - Data Collection Summary) is lower than the 25-30% that is expected from general mailing surveys (Davis and Cosenza, 1985). The following response rates were achieved by previous studies for large Australian organisations, across all industry sectors:

- (Pervan and Phua, 1997) – 24%
- (Pervan, 1994) – 29%
- (Pervan, 1992) – 22%

The target population of this investigation was not previously surveyed for a response on an EIS related topic. Pervan and Phua (1997) stated that the larger Australian organisations were only now getting involved in the development and use of EIS, after much more of a delay than their U.S. counterparts. It is possible that a low response was caused by organisations having an interest in EIS as yet, something discussed further in Chapter Seven – Discussion, Limitations and Future Research.

Representativeness of Sample

The two independent variables being used in the testing of the hypotheses in this investigation are organisational size and industry type. The responses to this survey for these variables are as follows.

Organisational Size

The number of employees in each Australian manufacturing organisation measured organisational size, as used by the Australian Bureau of Statistics (1994). Organisational size for this investigation's population, survey sample selection and survey responses are shown in Table 2 – Survey Response by Number of Employees.

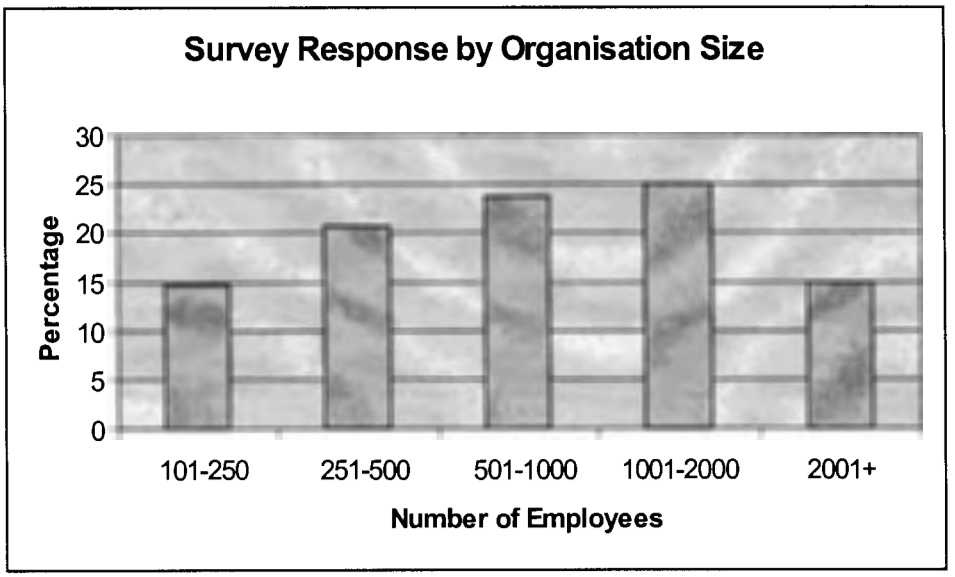
Table 2 – Survey Response by Number of Employees

Number of Employees	Population	Sample Selection @ 16.6%	Survey Response	Survey Response Vs. Sample
101-250 employees	907	151	22	14.6%
251-500 employees	349	58	12	20.7%
501-1000 employees	252	42	10	23.8%
1001-2000 employees	120	20	5	25%
2001+ employees	120	20	3	15%
Totals	1748	291	52	17.8%

A Chi-squared "Goodness of Fit" test was done to show the sample is representative in terms of number of employees. A Chi-squared value of 29.15 ($p < 0.001$) was calculated using the expected and actual response numbers for each category of number

of employees. This result ($\alpha = 0.10$) shows the response was not representative of the sample.

Graph 1 – Survey Response by Organisation Size



Pervan and Phua (1997) made the distinction between small (less than 100 employees), medium (less than 1,000 employees) and large sized organisations (1,000 or more employees). The Australian Bureau of Statistics (1994) in their collection and presentation of census data used this categorisation to describe organisation size. Organisational size based on this categorisation for the population of this investigation, sample selection and responses are shown in Table 3 – Survey Response by Organisation Size.

Using this categorisation method of medium and large sized organisations, there is a response rate of 17.5% for medium sized and 20% for large organisations.

Table 3 – Survey Response by Organisation Size

Organisation Size	Population	Sample Selection @ 16.6%	Survey Response	Survey Response Vs. Sample Sel.
Medium	1508	251	44	17.5%
Large	240	40	8	20%
Totals	1748	291	52	17.8

A Chi-squared value of 0.12 ($p < 0.73$) was calculated using the expected and actual response numbers for these two categories of organisation size. This result ($\propto = 0.10$) shows the response was representative of the sample.

Industry Type

The categories of industry type within the Manufacturing Sector were determined from the Australian Bureau of Statistics (1994). Information about the particular industry types of each of the Australian manufacturing organisation was available on the population and sample selection. Industry type based on this categorisation for the population of this investigation, sample selection and responses are shown in Table 4 – Survey Response by Industry Type.

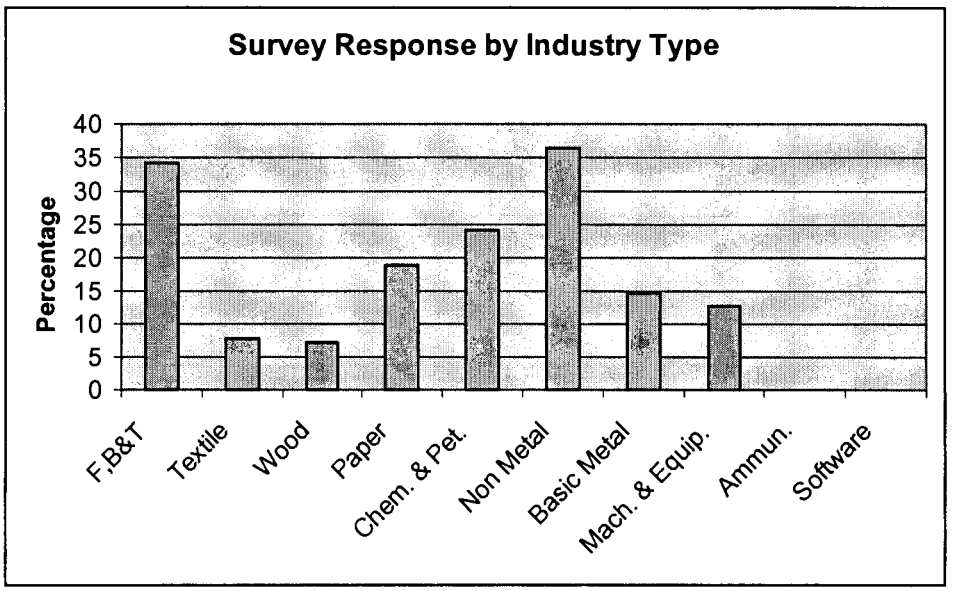
A Chi-squared value of 15.11 ($p < 0.08$) was calculated using the expected and actual response numbers for these categories of industry type. This result ($\propto = 0.10$) shows the response was not representative of the sample. The degree of variance of response rate (from 0% for Software to 34% for Food, Beverage and Tobacco) was too large and conclusions from hypotheses testing were not possible for the Manufacturing Sector as

a whole. The implications of further analysis of this large variance are discussed in Chapter Seven – Discussion, Limitations and Future Research.

Table 4 – Survey Response by Industry Type

Industry Type	Population	Sample Selection @ 16.6%	Survey Response	Survey Response Vs. Sample
Food, Beverage and Tobacco	265	44	15	34.1%
Textile, Clothing and Footwear	157	26	2	7.7%
Wood Products	84	14	1	7.1%
Paper Products	126	21	4	19%
Chemical, Petroleum Products	222	37	9	24.3%
Non Metal	66	11	4	36.4%
Basic Metal	162	27	4	14.8%
Machinery and Equipment	612	102	13	12.7%
Ammunition	12	2	0	0%
Software	42	7	0	0%
Totals	1748	291	52	17.8%

Graph 2 – Survey Response by Industry Type



The survey response rate by industry type (Table 4 – Survey Response by Industry Type) shows two industry types, 'Food, Beverage and Tobacco' and 'Chemical and Petroleum Products', which can be used in this investigation. These two industry types have survey response rates higher than the average (17.8%) of all industry types in the Manufacturing Sector and have enough survey responses to be able to perform statistical relevant tests of hypotheses.

Testing of hypotheses relating to industry type is limited to the comparisons between 'Food, Beverage and Tobacco' and 'Chemical and Petroleum Products' industries which were respectively the second and third largest industry types by number of organisations and revenue in the Australian Manufacturing Sector (Australian Bureau of Statistics, 1994). The largest industry type, 'Machinery and Equipment', had less than a 13% response rate and this was considered too low as a representative response to be considered by this investigation.

Table 5 – Survey Response by Two Industry Types

Industry Type	Population	Sample Selection @ 16.6%	Survey Response	Survey Response Vs. Sample Sel.
Food, Beverage and Tobacco	265	44	15	34.1%
Chemical, Petroleum Products	222	37	9	24.3%
Totals	487	81	24	29.6%

A Chi-squared value of 0.63 ($p < 0.43$) was calculated using the expected and actual response numbers for these two industry types. This result ($\propto = 0.10$) shows the response was representative of the sample.

Data Analysis

There were a number of factors that led to hypothesis testing in this investigation based on nonparametric methods and not to assume or test for a normal distribution of responses. Davis and Cosenza (1985) suggest that nonparametric methods are most appropriate when the sample size is small. When the sample data set is large (e.g., greater than 100) it makes little sense to use nonparametric statistics at all. Given the number of responses (52) is less than 100, the probability of normally distributed responses is reduced.

Nonparametric tests are typically less powerful and less flexible in terms of conclusions that they can provide (Davis and Cosenza, 1985). However, parametric tests based on

the normality assumptions can more easily be limited by a lack of precise measurement, compared with nonparametric tests used in this investigation that rely on a ranked order of responses.

The following nonparametric tests were identified using the data analysis tool (SYSTAT) as the most appropriate to test the hypotheses in this investigation:

1. Mann-Whitney U Test – the interpretation of this test is identical to that of a t-test for independent samples. The difference in testing is that this test is computed based on rank sums rather than means. This is the most sensitive nonparametric alternative to the t-test.
2. Wald-Wolfowitz Runs Test – this compares two groups on a single variable. This test assesses the hypothesis that two independent samples were drawn from two groups that differ in respect to mean and the general shape of distribution.
3. Spearman R Correlation – is a nonparametric correlation that determines the extent to which values of the two variables are "proportional" to each other. The Spearman R assumes that the variables under consideration were measured on at least an ordinal (rank order) scale, that is, that the individual observations can be ranked into two ordered series.

Chapter Six - Hypotheses Testing

This chapter presents the descriptive and statistical testing and results for each of the sixteen hypotheses. A summary of the results of hypotheses testing is presented at the end of this chapter.

The Stage of EIS Development of Organisations in the Manufacturing Sector

H0 1: There is significant difference between medium and large sized organisations in the Manufacturing sector in the stage of EIS development.

HA 1: There is no significant difference between medium and large sized organisations in the Manufacturing sector in the stage of EIS development.

Question three of the survey determined the state of EIS in each organisation. This question provided an ordinal rating of the progressive stages of the development and use of EIS:

1 – EIS are not required

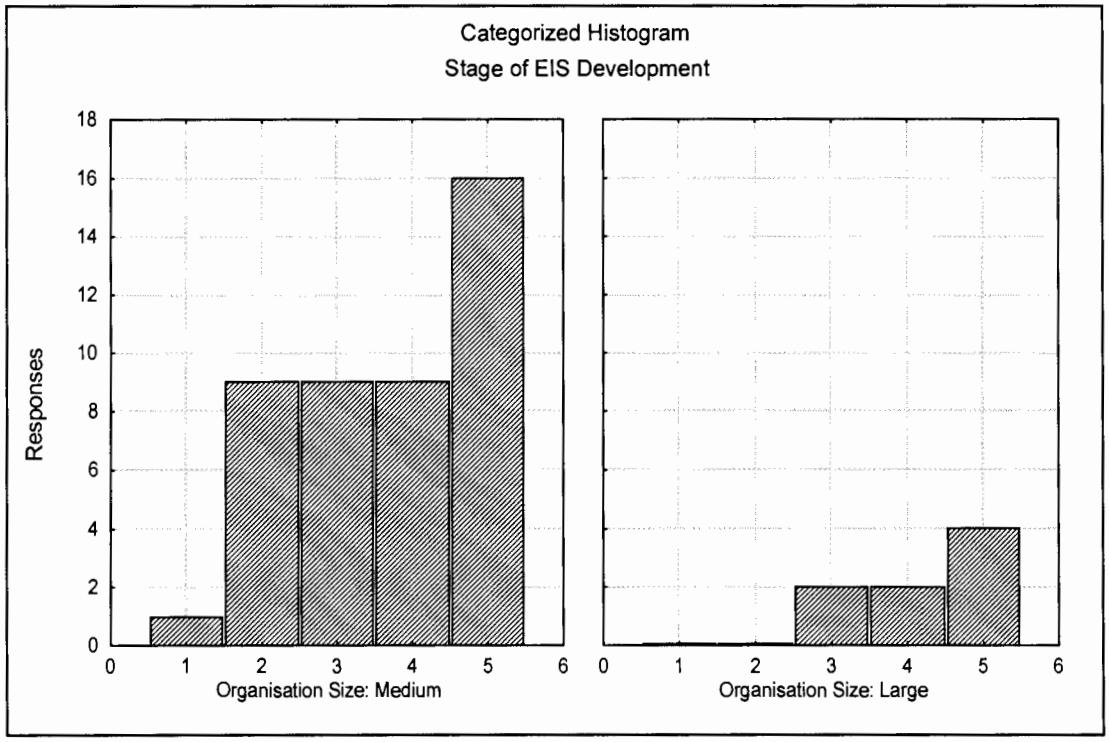
2 – EIS have not yet been considered

3 – Currently evaluating EIS hardware and software components

4 – Currently developing EIS

5 – EIS already developed and are being used

Graph 3 – Survey Response by Stage of EIS Development and Organisation Size



The independent variable that was used in this hypothesis, organisational size, was determined by categories of the number of employees in these organisations. The use of this independent variable is discussed further in Chapter Five – Research Validity.

Table 6 – Survey Response by Stage of EIS Development and Organisation Size

Size of Organisation	Stage of Development (Mean)	Number
Medium	3.7	44
Large	4.2	8
Totals	3.8	52

A descriptive analysis of these responses between medium and large sized organisations (see Table 6 – Survey Response by Stage of EIS Development and

Organisation Size) shows large organisations at a further stage of EIS development and use than medium sized organisations. On average, medium sized organisations are between the stages – 'Evaluation of hardware/software' and 'Being developed'. Larger organisations are at a higher stage of EIS development - between 'Being developed' and 'Developed and effective'.

A Wald-Walfowitz Runs Test was used to test this hypothesis and determine if there were significant differences between these two groups of organisation size and their stage of EIS development. This provided the following result:

$\alpha = 0.10$

$Z = -0.843$

$p = 0.3990$

The result of this Wald-Walfowitz Runs Test shows no statistical difference between medium and large sized organisations in the Manufacturing sector and stage of EIS development, so **reject H0 1, therefore accept HA 1.**

H0 2: There is no significant difference between the industry type of organisation in the Manufacturing sector in the stage of EIS development.

HA 2: There is significant difference between the industry type of organisation in the Manufacturing sector in the stage of EIS development.

Question three of the survey determined the state of EIS in each organisation. This question was used to test the current hypothesis in the same way as the previous hypothesis.

Graph 4 – Survey Response by Stage of EIS Development and Industry Type

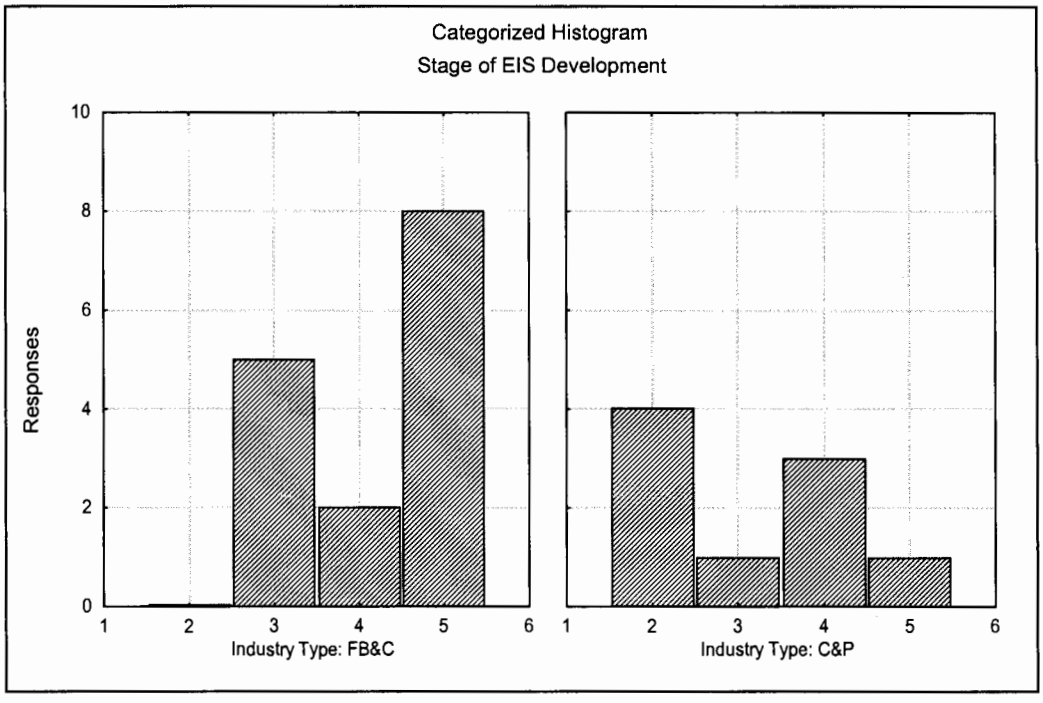


Table 7 – Survey Response by Stage of EIS Development and Industry Type

Industry Type	Stage of Development (Mean)	Number
Food, Beverage and Tobacco	4.2	15
Chemical and Petroleum Products	3.1	9
Totals	3.8	24

There is a greater number of more advanced EIS development responses for 'Food, Beverage and Tobacco' than 'Chemical and Petroleum Products' as shown in Graph 4 - Survey Response by Stage of EIS Development and Industry Type. A descriptive

analysis of these responses by industry sector (see Table 7 – Survey Response by Stage of EIS Development and Industry Type) shows 'Food, Beverage and Tobacco' organisations were at a further stage of EIS development than 'Chemical and Petroleum Products'. On average, Chemical and Petroleum Products' organisations are between the stages – 'Evaluation of hardware/software' and 'Being developed'. 'Food, Beverage and Tobacco' organisations are a higher stage of EIS development – between 'Being developed' and 'Developed and effective'.

A Wald-Wolfowitz Runs Test was used to test this hypothesis and to determine if there was a significant difference between these two groups of industry type and their stage of EIS development. This provided the following result:

$\alpha = 0.10$

$Z = -1.898$

$p = 0.057$

The result of this Wald-Walfowitz Runs Test shows a statistical difference between the industry type for 'Food, Beverage and Tobacco' and 'Chemical and Petroleum Products' and their stage of EIS development, so - **reject H0 2, therefore accept HA2**.

The Areas of Use of EIS within Organisations in the Manufacturing Sector

H0 3: There is no significant difference between medium and large sized organisations in the Manufacturing sector in the EIS areas of use.

HA 3: There is significant difference between medium and large sized organisations in the Manufacturing sector in the EIS areas of use.

Question six of the survey determined the importance of including areas of operation within an organisation in new or existing EIS. This question used a likert scaling method to provide a measurement of the degree of importance of each of the areas of use within Australian manufacturing organisations:

1 – Financial Monitoring

2 – Sales/Market Analysis

3 – Competitive Analysis

4 – Forecasting/Demand Analysis

5 – Non-Financial Monitoring (ie. Human Resources)

6 – Production Monitoring

Space was left at the bottom of the question for respondents to include any areas of use that may not have been included in the list above. There were no additional areas of use provided by any of the respondents.

A descriptive analysis of these responses by organisational size (see Table 8 – Survey Response by EIS Areas of Use and Organisation Size) shows a very similar ranking of the areas of use within organisations of EIS between medium and large organisations.

A Wald-Wolfowitz Runs Test was done against each of the EIS areas of use (see Table 9 - Variance Analysis by EIS Areas of Use and Organisation Size) to determine if there

was a significant difference between the two groups of medium and large organisations in the Manufacturing sector.

Table 8 – Survey Response by EIS Areas of Use and Organisation Size

Areas of Use	Medium		Large	
	(Mean)	(No.)	(Mean)	(No.)
Financial Monitoring	4.26(2)	43	4.38(2)	8
Sales/Market Analysis	4.36(1)	42	4.75(1)	8
Competitive Analysis	3.76(4)	34	4.29(4)	7
Forecasting/Demand	3.90(3)	42	4.33(3)	6
Non-Financial Monitoring	2.64(5)	36	3.50(5)	6
Production Monitoring	4.26(2)	43	4.33(3)	6

Table 9 – Variance Analysis by EIS Areas of Use and Organisation Size

Areas of Use	Z	P
Financial Monitoring	-0.81	0.417
Sales/Market Analysis	-0.78	0.436
Competitive Analysis	-0.92	0.358
Forecasting/Demand	-1.72	0.086*
Non-Financial Monitoring	-0.19	0.852
Production Monitoring	-0.37	0.714

$\alpha = 0.10$ * = significant result

The result of these Wald-Wolfowitz Runs Tests (see Table 9 – Variance Analysis by EIS Areas of Use and Organisation Size) shows a statistical difference for one of the six EIS areas of use - 'Forecasting/Demand'.

A Spearman Rank Correlation test was done to see if there was a significant correlation in ranking of EIS areas of use between the two groups of medium and large organisations in the Manufacturing sector. There was a correlation of 0.965, which is significant at $p < 0.003$. The statistical difference of a single EIS area of use, 'Forecasting/Demand', is not enough to affect the Spearman Rank Correlation test. This showed there was a significant correlation of ranking between these two groups, so - **do not reject H0 3, therefore reject HA 3**.

H0 4: There is no significant difference between the industry type of an Organisation in the Manufacturing sector in the EIS areas of use.

HA 4: There is significant difference between the industry type of an Organisation in the Manufacturing sector in the EIS areas of use.

Question six of the survey determined the importance of including areas of operation within an organisation in new or existing EIS. This question was used to test the current hypothesis in the same way as the previous hypothesis.

A descriptive analysis of these responses by industry type (see Table 10 – Survey Response by EIS Areas of use and Industry Type) shows a difference in ranking with 'Finance Monitoring' and 'Production Monitoring'. The 'Food, Beverage and

Tobacco' organisations place a greater importance on 'Finance Monitoring', ranking this as a second (2) priority, compared with 'Chemical and Petroleum Products' organisations which ranked it as a fifth (5) priority. The 'Chemical and Petroleum Products' organisations ranked 'Production Monitoring' as a second (2) priority, compared with 'Food, Beverage and Tobacco' organisations which ranked it as a fourth (4) priority.

Table 10 – Survey Response by EIS Areas of Use and Industry Type

Areas of Use	**Food,Bev. and Tobacco**		**Chemical and Petroleum**	
	(Mean)	(No.)	(Mean)	(No.)
Financial Monitoring	4.46(2)	15	3.88(5)	8
Sales/Market Analysis	4.64(1)	14	4.62(1)	8
Competitive Analysis	3.92(5)	12	3.83(4)	6
Forecasting/Demand	4.33(3)	12	4.00(3)	8
Non-Financial Monitoring	2.91(6)	11	2.43(6)	7
Production Monitoring	4.29(4)	14	4.38(2)	8

A Wald-Wolfowitz Runs Test was done against each of the EIS areas of use (see Table 11 – Variance Analysis by EIS Areas of Use and Industry Type) to determine if there was a significant difference between these two industry types in the Manufacturing sector.

The result of these Wald-Wolfowitz Runs Tests (see Table 11 – Variance Analysis by EIS Areas of Use and Industry Type) shows a statistical difference for one of the six EIS areas of use - 'Forecasting/Demand'.

A Spearman Rank Correlation test was done to see if there was a significant correlation in ranking of EIS areas of use between the two industry sectors of 'Food, Beverage and Tobacco' and 'Chemical and Petroleum Products'. There was a correlation of 0.600, which is not significant at p = 0.208. This showed there to be no significant similarity in ranking between these two industry sectors, so **reject H0 4, therefore accept HA 4**.

Table 11 – Variance Analysis by EIS Areas of Use and Industry Type

Areas of Use	Z	P
Financial Monitoring	-0.68	0.498
Sales/Market Analysis	0.39	0.698
Competitive Analysis	0.55	0.582
Forecasting/Demand	-1.73	0.084*
Non-Financial Monitoring	1.25	0.210
Production Monitoring	-0.09	0.931

$\propto = 0.10$ * = significant result

The Types of Users of EIS within Organisations in the Manufacturing Sector

H0 5: There is no significant difference between medium and large sized organisations in the Manufacturing sector in the types of EIS users.

HA 5: There is significant difference between medium and large sized organisations in the Manufacturing sector in the types of EIS users.

Question seven of the survey determined the importance of users within an organisation having access to new or existing EIS. This question used a likert scaling method to provide a measurement of the degree of importance of each of these users within Australian manufacturing organisations:

1 – Chief Executive Officer

2 – Secretary to Chief Executive Officer

3 – Executives

4 – Executive Secretaries

5 – Management Staff

6 – Support Staff

7 – Sales Representatives

8 – Engineers

9 – Factory/Warehouse Workers

Space was left at the bottom of the question for respondents to include any other users of a new or existing EIS that they considered may not have been included in the list above. There were no additional users provided by any of the respondents.

A descriptive analysis of these responses by organisational size (see Table 12 – Survey Response by EIS Users and Organisation Size) shows a difference in ranking between a number of different EIS users between medium and large organisations in the Manufacturing sector. Large organisations place a greater importance on the use of

EIS by 'Chief Executive Officer' than 'Management Staff'. 'Sales Representatives' are ranked higher in their use of EIS than 'Support Staff' for large organisations and 'Engineers' are ranked two higher in their use of EIS by medium sized organisations.

Table 12 – Survey Response by EIS Users and Organisation Size

Users of EIS	Medium		Large	
	(Mean)	(No.)	(Mean)	(No.)
Chief Executive Officer	4.18(3)	40	4.38(2)	8
Secretary to CEO	3.21(7)	33	3.50(6)	6
Executives	4.48(1)	42	4.50(1)	8
Executive Secretaries	2.77(8)	30	3.40(7)	5
Management Staff	4.40(2)	43	4.25(3)	8
Support Staff	3.42(5)	38	4.00(4)	7
Sales Representatives	3.69(4)	39	3.88(5)	8
Engineers	3.40(6)	30	3.14(8)	7
Factory/Warehouse	2.69(9)	32	2.83(9)	6

A Wald-Wolfowitz Runs Test was done against each of the users of EIS (see Table 13 – Variance Analysis by EIS Users and Organisation Size) to determine if there was a significant difference between medium and large sized organisations in the Manufacturing sector.

The result of these Wald-Wolfowitz Runs Tests (see Table 13 – Variance Analysis by EIS Users and Organisation Size) shows no statistical difference between Medium and Large sized organisations and the users they would consider for a new EIS.

A Spearman Rank Correlation test was done to see if there was a significant correlation in ranking of EIS user between the medium and large organisations in the Manufacturing sector. There was a correlation of 0.881, which is significant at $p < 0.003$. This showed there was a significant correlation of ranking between these two groups, so **do not reject H0 5, therefore reject HA 5**.

Table 13 – Variance Analysis by EIS Users and Organisation Size

Users of EIS	Z	p
Chief Executive Officer	-0.18	0.859
Secretary to CEO	-1.38	0.168
Executives	-1.32	0.187
Executive Secretaries	-1.14	0.255
Management Staff	-1.36	0.175
Support Staff	-1.07	0.285
Sales Representatives	-0.68	0.498
Engineers	0.36	0.720
Factory/Warehouse	1.20	0.230

$\alpha = 0.10$ * = significant result

H0 6: There is no significant difference between the industry type of organisation in the Manufacturing sector in the types EIS users.

HA 6: There is significant difference between the industry type of organisation in the Manufacturing sector in the types of EIS users.

Question seven of the survey determined the importance of users within an organisation having access to new or existing EIS. This question was used to test the current hypothesis in the same way as the previous hypothesis.

Table 14 – Survey Response by EIS Users and Industry Type

Users of EIS	**Food,Bev. and Tobacco** (Mean)	(No.)	**Chemical and Petroleum** (Mean)	(No.)
Chief Executive Officer	4.00(3)	15	4.12(3)	8
Secretary to CEO	2.58(8)	12	3.14(7)	7
Executives	4.47(1)	15	4.38(1)	8
Executive Secretaries	2.30(9)	10	3.14(7)	7
Management Staff	4.40(2)	15	4.38(1)	8
Support Staff	3.62(4)	13	3.57(6)	7
Sales Representatives	3.53(5)	15	3.86(4)	7
Engineers	2.67(7)	12	3.86(4)	7
Factory/Warehouse	2.91(6)	11	2.00(9)	6

A descriptive analysis of these responses by industry type (see Table 14 – Survey Response by EIS Users and Industry Type) shows a difference in ranking between a number of EIS users between 'Food, Beverage and Tobacco' and 'Chemical and Petroleum' organisations. The rankings for the top three positions are very similar – 'Executives', 'Management Staff' and 'Chief Executive Officer'. 'Chemical and

Petroleum' place a greater importance on 'Engineers' and then 'Sales Representatives' having access to EIS. 'Food, Beverage and Tobacco' rank 'Support Staff' and 'Factory/Warehouse' users ahead of 'Chemical and Petroleum' organisations.

A Wald-Wolfowitz Runs Test was done against each of the users of EIS (see Table 15 – Variance Analysis by EIS Users and Industry Type) to determine if there was a significant difference between these two industry types in the Manufacturing sector.

Table 15 – Variance Analysis by EIS Users and Industry Type

Users of EIS	Z	p
Chief Executive Officer	0.27	0.789
Secretary to CEO	1.10	0.272
Executives	0.74	0.460
Executive Secretaries	-0.12	0.903
Management Staff	0.74	0.459
Support Staff	0.96	0.335
Sales Representatives	-0.78	0.433
Engineers	-1.96	0.050*
Factory/Warehouse	0.97	0.330

$\alpha = 0.10$ * = significant result

The result of these Wald-Wolfowitz Runs Tests (see Table 15 – Variance Analysis by EIS Users and Industry Type) shows a statistical difference for one of the six EIS users - 'Engineers'.

A Spearman Rank Correlation test on the two industry sectors of 'Food, Beverage and Tobacco' and 'Chemical and Petroleum Products' showed a correlation of 0.810, which is significant at p = 0.008. The statistical difference of a single type of EIS user, 'Engineers', is not enough to affect the Spearman Rank Correlation test. This showed there was no difference in the ranking between industry sectors, so **do not reject H0 6, therefore reject HA 6**.

The Limit of Expenditure on EIS by Organisation in the Manufacturing Sector

H0 7: There is significant difference between medium and large sized organisations in the Manufacturing sector in the amount considered for spending on the development of a new EIS.

HA 7: There is no significant difference between medium and large sized organisations in the Manufacturing sector in the amount considered for spending on the development of a new EIS.

Question seventeen of the survey determined an absolute value that the respondent estimated that would be considered as an upper limit to spend on purchasing/developing a new EIS, including additional computer equipment, software/development tools, wages, training etc.

Graph 5 – Survey Response by Initial Spending Limit and Organisation Size

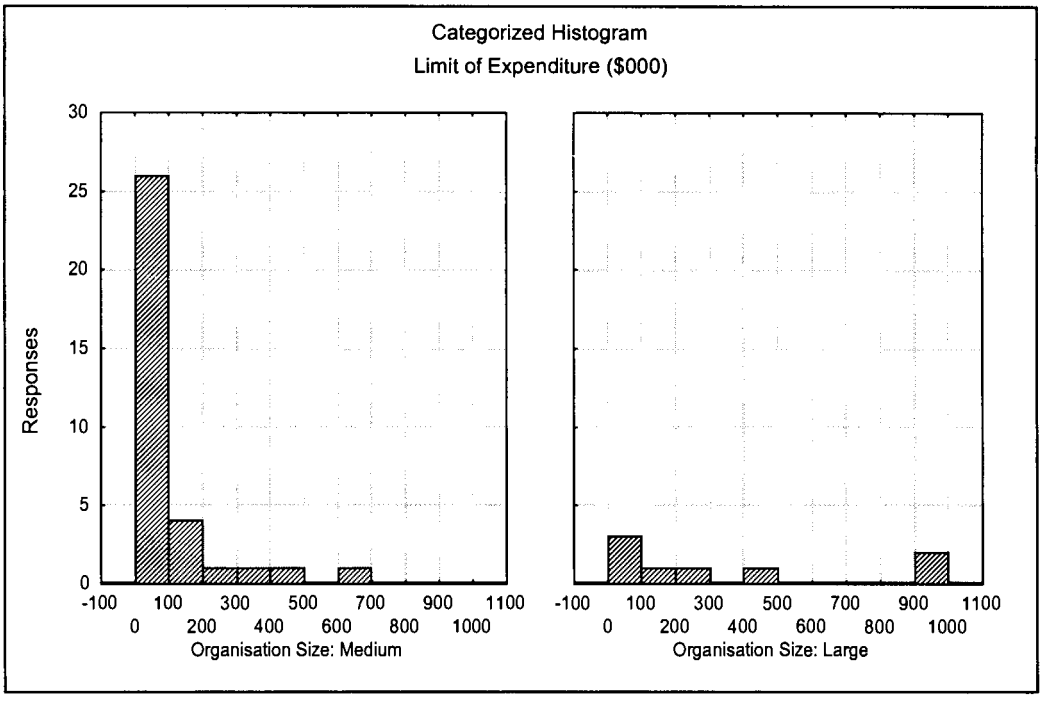


Table 16 – Survey Response by Initial Spending Limit and Organisation Size

Size of Organisation	Initial Spending Limit (Mean)	Number
Medium	128,670	34
Large	406,250	8
Totals	181,547	42

A descriptive analysis of these responses by organisational size (see Table 16 – Survey Response by Initial Spending Limit and Organisation Size) shows a larger initial spending limit on purchasing/developing a new EIS by large organisations compared with medium sized organisations. The individual responses (see Graph 5 – Survey Response by Initial Spending Limit and Organisation Size) shows two responses by large sized organisations which has increased the average for this grouping of

organisation by size. Most other responses are similar between both medium and large sized organisations.

A Wald-Wolfowitz Runs Test was used to test this hypothesis and determine if there were significant differences between these two industry types and the amounts they would consider spending on the purchase/development of a new EIS. This provided the following result:

$\propto = 0.10$

$Z = 0.2450$

$p = 0.98$

The result of this Wald-Wolfowitz Runs Test shows no statistical difference between medium and large sized organisations in the Manufacturing Sector and the amounts they would consider spending on the purchase and/or development of a new EIS, so **reject H0 7, therefore accept HA 7**.

H0 8: There is no significant difference between the industry type of an organisation in the Manufacturing sector in the amount considered for spending on the development of a new EIS.

HA 8: There is significant difference between the industry type of an organisation in the Manufacturing sector in the amount considered for spending on the development of a new EIS.

Question seventeen of the survey determined an absolute value that the respondent estimated that would be considered as an upper limit to spend on purchasing/developing a new EIS, including additional computer equipment, software/development tools, wages, training etc. This question was used to test the current hypothesis in the same way as the previous hypothesis.

Graph 6 – Survey Response by Initial Spending Limit and Industry Type

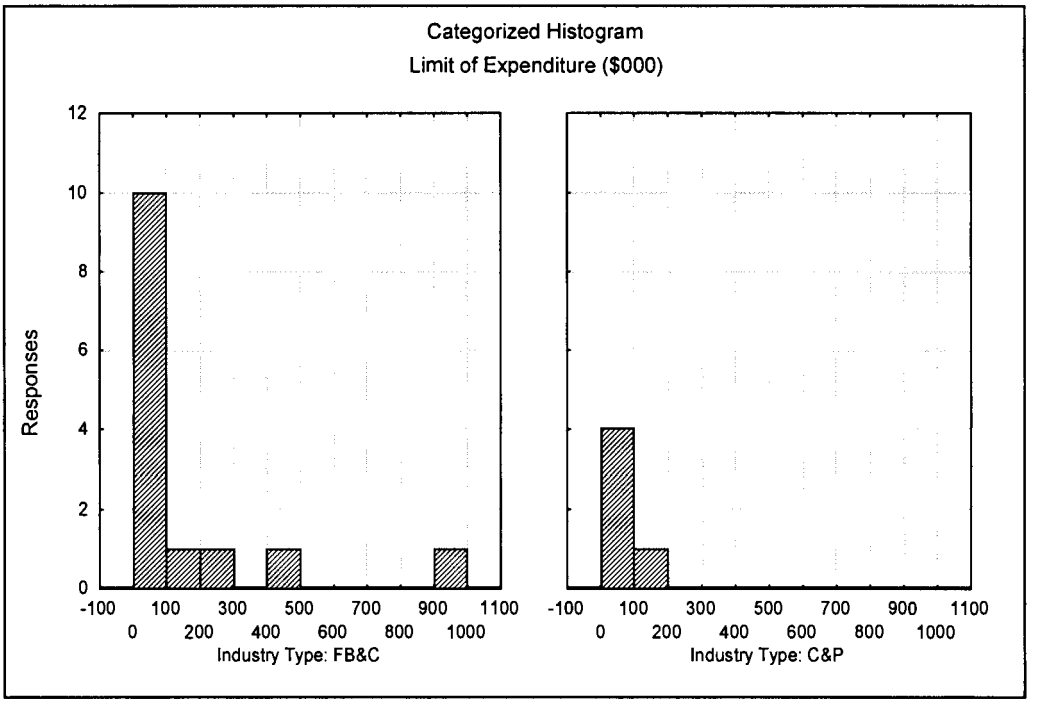


Table 17 – Survey Response by Initial Spending Limit and Industry Type

Industry Type	Initial Spending Limit (Mean)	Number
Food, Beverage and Tobacco	194,000	14
Chemical and Petroleum Products	94,000	5
Totals	168,000	19

A descriptive analysis of these responses by industry sector shows a difference in the means that represent the amount that organisations are willing to spend on the purchase/development of a new EIS between the two industry types (see Table 17 – Survey Response by Initial Spending Limit and Industry Type). There were two responses (see Graph 6 - Survey Response by Initial Spending Limit and Industry Type) for 'Food, Beverage and Tobacco', which greatly distorts this mean and creates much of this difference in mean between industry type.

A Wald-Wolfowitz Runs Test was used to test this hypothesis and determine if there were significant differences between these two industry types and the amounts they would consider spending on the purchase/development of a new EIS. This provided the following result:

$\propto = 0.10$

$Z = .3911$

$p = 0.39$

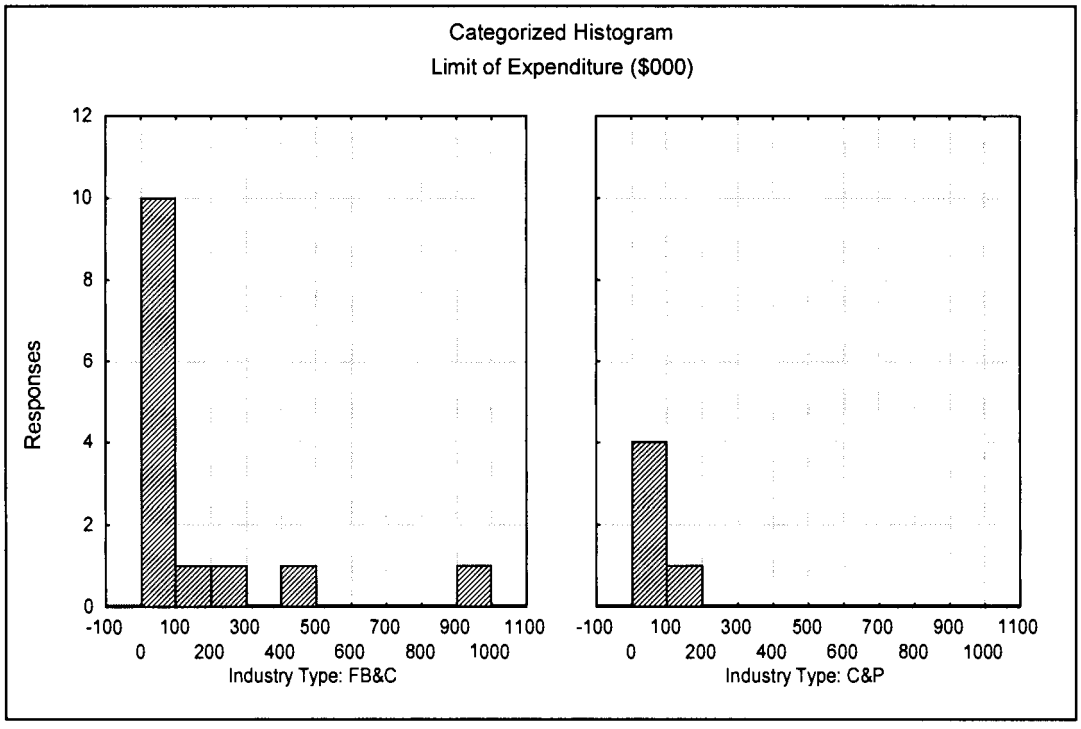
The result of this Wald-Wolfowitz Runs Test shows no statistical difference between the industry type for 'Food, Beverage and Tobacco' and 'Chemical and Petroleum Products' in the amounts they would consider spending on the purchase and/or development of a new EIS, so **do not reject H0 8, therefore reject HA 8.**

H0 9: There is significant difference between the medium and large sized organisations in the Manufacturing sector in the amount considered for spending on ongoing annual maintenance of an existing EIS.

HA 9: There is no significant difference between medium and large sized organisations in the Manufacturing sector in the amount considered for spending on ongoing annual maintenance of an existing EIS.

Question eighteen of the survey determined an absolute value that the respondent estimated would be considered as an upper limit to spend on maintaining an EIS per annum, including wages, data gathering, training etc.

Graph 7 – Survey Response by Annual Maintenance Limit and Organisation Size



A descriptive analysis of these responses by organisational size (see Table 18 – Survey Response by Annual Maintenance Limit and Number of Employees) shows an increase in the amount that organisations would consider spending on ongoing annual maintenance on an existing EIS as these organisations get larger in size.

Table 18 – Survey Response by Annual Maintenance Limit and Organisation Size

Size of Organisation	Annual Maintenance (Mean)	Number
Medium	25,029	34
Large	100,000	8
Totals	39,310	42

A Wald-Wolfowitz Runs Test was used to test this hypothesis and determine if there were significant differences between these two industry types and the amounts they would consider spending on the purchase/development of a new EIS. This provided the following result:

$\propto = 0.10$

$Z = -3.005$

$p = 0.0026$*

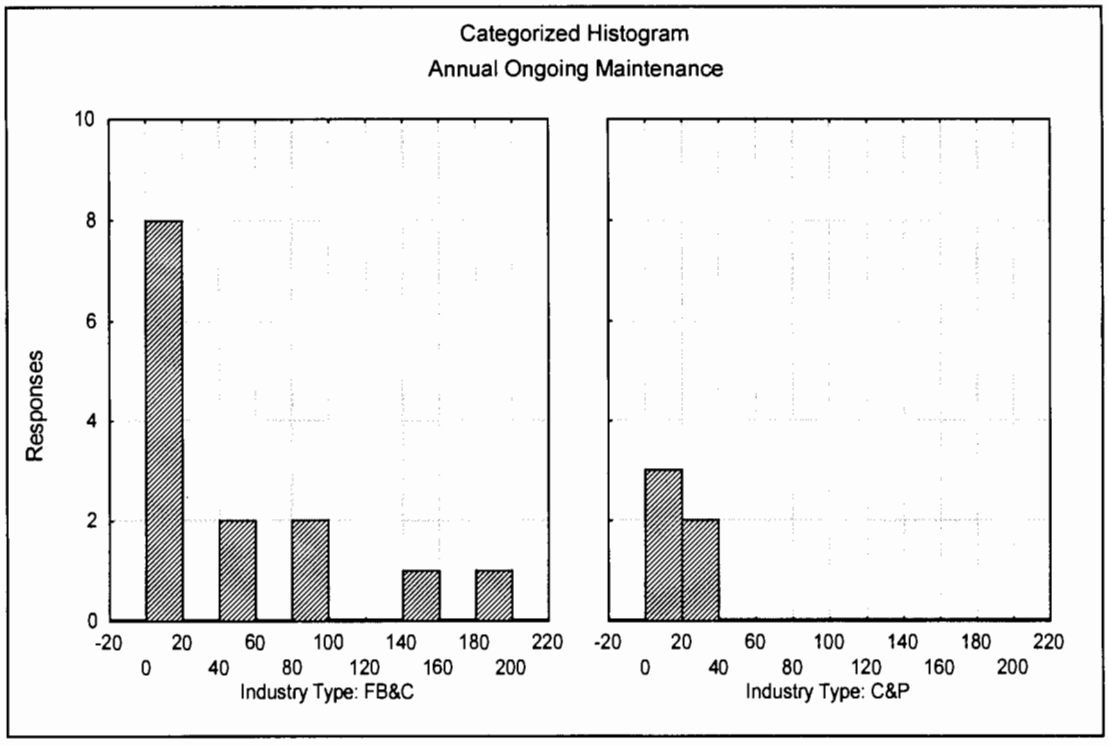
The result of this Wald-Wolfowitz Runs Test shows statistical difference between medium and large sized organisations in the Manufacturing Sector and the amount considered for spending on ongoing annual maintenance of an existing EIS, so **do not Reject H0 9, therefore reject HA 9**.

H0 10: There is no significant difference between the industry type of an organisation in the Manufacturing sector in the amount considered for spending on ongoing annual maintenance of an existing EIS.

HA 10:There is significant difference between the industry type of an organisation in the Manufacturing sector in the amount considered for spending on ongoing annual maintenance of an existing EIS.

Question eighteen of the survey determined an absolute value that the respondent estimated would be considered as an upper limit to spend on maintaining an EIS per annum, including wages, data gathering, training etc. This question was used to test the current hypothesis in the same way as the previous hypothesis.

Graph 8 – Survey Response by Annual Maintenance Limit and Industry Type



A descriptive analysis of these responses by industry sector (see Table 19 – Survey Response by Annual Maintenance Limit and Industry Type) shows a difference in the means that represent the amount that these organisations would consider spending on the ongoing annual maintenance of an existing EIS between the two industry types.

Further investigation (see Graph 8 – Survey Response by Annual Maintenance Limit and Industry Type) shows a large variance in the amounts that organisations in the 'Food, Beverage and Tobacco' industry sector were willing to spend on the ongoing annual maintenance of an EIS and that an average spending amount is affected by this variation.

Table 19 – Survey Response by Annual Maintenance Limit and Industry Type

Industry Type	Annual Maintenance (Mean)	Number
Food, Beverage and Tobacco	54,000	14
Chemical and Petroleum Products	20,000	5
Totals	45,000	19

A Wald-Wolfowitz Runs Test was used to test this hypothesis and determine if there were significant differences between these two industry types and the amounts they would consider spending on the purchase/development of a new EIS. This provided the following result:

$\alpha = 0.10$

$Z = .3911$

$p = 0.695$

The result of this Wald-Wolfowitz Runs Test shows no statistical difference between the industry type for 'Food, Beverage and Tobacco' and 'Chemical and Petroleum

Products' and the amounts they would consider spending on ongoing annual maintenance of an existing EIS, so **do not reject H0 10, therefore reject HA 10**.

The Perceptions of Benefits of EIS by Organisations in the Manufacturing Sector

H0 11: There is no significant difference between medium and large sized organisations in the Manufacturing sector in the perception of benefits from the use of EIS.

HA 11: There is significant difference between medium and large sized organisations in the Manufacturing sector in the perception of benefits from the use of EIS.

Question eleven of the survey determined the importance of the benefits expected from the use of new or existing EIS. This question used a likert scaling method to provide a measurement of the degree of importance of each of these benefits to organisations in the Manufacturing sector. The benefits were defined as:

1 – Reduction in paperwork

2 – Reporting time savings

3 – Reduced requests for report changes

4 – Finding business problems more quickly

5 – Finding business opportunities more quickly

Space was left at the bottom of the question for respondents to include any other benefits expected from new or existing EIS that they considered may not have been

included in the list above. There were no additional benefits provided by any of the respondents.

Table 20 – Survey Response by EIS Benefits and Organisation Size

Benefits of EIS	Medium		Large	
	(Mean)	(No.)	(Mean)	(No.)
Paperwork Reduction	3.70(4)	44	3.12(4)	8
Quicker Reporting	4.45(1)	44	3.75(3)	8
Less Changes to Reports	3.40(5)	43	3.12(4)	8
Finding Problems	4.18(2)	44	4.62(1)	8
Finding Opportunities	3.93(3)	44	4.38(2)	8

A descriptive analysis of these responses by organisation size shows much difference in the ranking of EIS benefits between medium and large sized organisations. There is one EIS benefit with more than one ranking different, that of 'Quicker Reporting'. There was a high rating (4.45) by medium-sized organisations of new or existing EIS being able to reduce the time to report information to executives, compared with a lower rating (3.75) by larger organisations.

A Wald-Wolfowitz Runs Test was done against each of the EIS benefits (see Table 21 – Variance Analysis by EIS Benefits and Organisation Size) to determine if there was a significant difference between medium and large sized organisations in the Manufacturing sector.

Table 21 – Variance Analysis by EIS Benefits and Organisation Size

Benefits of EIS	Z	P
Paperwork Reduction	-2.49	0.013*
Quicker Reporting	-2.49	0.013*
Less Changes to Reports	-1.90	0.057*
Finding Problems	-0.84	0.399
Finding Opportunities	-0.84	0.399

$\propto = 0.10$ * = significant

The result of these Wald-Wolfowitz Runs Tests (see Table 21 – Variance Analysis by EIS Benefits and Organisation Size) shows three significant difference in rating between medium and large organisations and the benefits expected from the use of new or existing EIS - 'Paperwork Reduction', 'Quicker Reporting' and 'Less Changes to Reports'. The ranking of 'Paperwork Reduction' was the fourth important for both groups of organisation size, showing there is a similar ranking, but common difference in importance in that ranking. The ranking of 'Quicker Reporting' was ranked first important for medium sized organisations and third important for large organisations, and there is a significant difference in rating between these groups. The ranking of 'Less Changes to Reports' was ranked fifth for medium sized organisations and fourth important for large organisations.

A Spearman Rank Correlation test was done to see if there was a significant correlation in ranking of EIS benefits between the two groups of medium and large organisations in the Manufacturing sector and their perception of benefits from the use of EIS. There

was a correlation of 0.666, which is not significant at p = 0.219, so **reject H0 11, therefore accept HA 11**.

H0 12: There is no significant difference between the industry type of organisation in the Manufacturing sector in the perception of benefits from the use of EIS.

HA 12: There is significant difference between the industry type of organisation in the Manufacturing sector in the perception of benefits from the use of EIS.

Question eleven of the survey determined the importance of the benefits expected from the use of new or existing EIS. This question was used to test the current hypothesis in the same way as the previous hypothesis.

Table 22 – Survey Response by EIS Benefits and Industry Type

Benefits of EIS	**Food,Bev. and Tobacco** (Mean)	(No.)	**Chemical and Petroleum** (Mean)	(No.)
Paperwork Reduction	3.67(4)	15	3.56(5)	9
Quicker Reporting	4.13(2)	15	4.44(1)	9
Less Changes to Reports	3.33(5)	15	3.62(4)	8
Finding Problems	4.40(1)	15	3.89(3)	9
Finding Opportunities	4.07(3)	15	4.11(2)	9

A descriptive analysis of these responses by industry type shows only one EIS benefit more than one ranking different, that of 'Finding Problems'. There was a high rating (4.40) by 'Food, Beverage and Tobacco' organisations of new or existing EIS being

able to improve the time it took executives to locate business problems, compared with a lower rating (3.89) by 'Chemical and Petroleum' organisations.

A Wald-Wolfowitz Runs Test was done against each of the EIS benefits (see Table 23 – Variance Analysis by EIS Benefits and Industry Type) to determine if there was a significant difference between these two industry types in the Manufacturing sector.

Table 23 – Variance Analysis by EIS Benefits and Industry Type

Benefits of EIS	Z	P
Paperwork Reduction	-0.56	0.577
Quicker Reporting	0.78	0.434
Less Changes to Reports	0.27	0.789
Finding Problems	-1.90	0.058*
Finding Opportunities	0.33	0.738

$\propto = 0.10$ * = significant

The result of these Wald-Wolfowitz Runs Tests (see Table 23 – Variance Analysis by EIS Benefits and Industry Type) shows one statistical difference between 'Food, Beverage and Tobacco' and 'Chemical and Petroleum Products' organisations in the Manufacturing Sector and EIS benefit – 'Finding Problems'.

A Spearman Rank Correlation test on the two industry sectors of 'Food, Beverage and Tobacco' and 'Chemical and Petroleum Products' showed a correlation of 0.600, which is not significant at $p = 0.208$. This showed there was significant similarity in the

ranking between these two industry sectors and their perception of benefits from the use of EIS, so **reject H0 12, therefore accept HA 12**.

The Perceptions of Required Functions and Features of EIS by Organisations in the Manufacturing Sector

H0 13: There is no significant difference between medium and large sized organisations in the Manufacturing sector in the perception of required functions and features of EIS.

HA 13: There is significant difference between medium and large sized organisations in the Manufacturing sector in the perception of required functions and features of EIS.

Question twelve of the survey determined the importance of the functions and features of new or existing EIS. This question used a likert scaling method to provide a measurement of the degree of importance of each of these functions and features to organisations in the Manufacturing sector. The functions and features were defined as:

1 – 'Drill down' through information

2 – Trend analysis

3 – Ease of use

4 – Response times

5 – Visual gauges of performance/non-performance

6 – Modeling and 'what-if' scenarios

7 – Access to external data

Space was left at the bottom of the question for respondents to include any other features and functions they expected from new or existing EIS, that they considered might not have been included in this list. There were no additional features or functions provided by any of the respondents.

Table 24 – Survey Response by EIS Feature and Function and Organisation Size

Features and Functions of EIS	Medium		Large	
	(Mean)	(No.)	(Mean)	(No.)
'Drill down'	4.36(2)	44	4.88(1)	8
Trend analysis	4.16(4)	44	4.50(3)	8
Ease of use	4.61(1)	44	4.62(2)	8
Response times	4.27(3)	44	4.25(4)	8
Gauges of performance	4.09(5)	43	4.38(5)	8
Modeling and 'what if'	3.72(6)	44	4.12(6)	8
External data	2.59(7)	44	3.50(7)	8

A descriptive analysis of these responses by organisation size (see Table 24 – Survey Response by EIS Feature and Function and Organisation Size) shows a very similar ranking of the features and functions of new or existing EIS within these organisations, with no feature more than one rating different. 'Ease of Use' shows as the highest rated (4.61) feature and function of EIS and medium sized organisations rate the ability to 'drill down' between layers of information as their highest rated (4.88) feature and function.

A Wald-Wolfowitz Runs Test was done against each of the EIS features and functions (see Table 25 – Variance Analysis by EIS Feature and Function and Organisation Size) to determine if there was a significant difference between medium and large sized organisations in the Manufacturing sector.

Table 25 – Variance Analysis by EIS Feature and Function and Organisation Size

Features and Functions of EIS	Z	P
'Drill down'	-0.84	0.399
Trend analysis	-1.94	0.052*
Ease of use	0.25	0.800
Response times	0.25	0.800
Gauges of performance	-0.81	0.417
Modeling and 'what if'	-0.84	0.399
External data	-0.84	0.399

$\alpha = 0.10$ * = significant

The result of these Wald-Wolfowitz Runs Tests (see Table 25 – Variance Analysis by EIS Feature and Function and Organisation Size) shows one statistical variance of the seven EIS features and functions between medium and large sized organisations – 'Trend Analysis'.

A Spearman Rank Correlation test was done to see if there was a significant correlation in ranking of EIS features and functions between the two groups of medium and large organisations in the Manufacturing sector. The statistical difference of a single EIS

Feature and Function, 'Trend Analysis' is not enough to affect the Spearman Rank Correlation test. There was a correlation of 0.929, which is significant at $p < 0.003$, therefore **do not reject H0 13, therefore reject HA 13**.

H0 14: There is no significant difference between the industry type of organisation in the Manufacturing sector in the perception of required functions and features of EIS.

HA 14: There is significant difference between the industry type of organisation in the Manufacturing sector in the perception of required functions and features of EIS.

Question twelve of the survey determined the importance of the functions and features of new or existing EIS. This question was used to test the current hypothesis in the same way as the previous hypothesis.

A descriptive analysis of these responses by industry type (see Table 25 – Survey Response by EIS Features and Functions and Industry Type) shows a high rating (4.80) by 'Food, Beverage and Tobacco' organisations of new or existing EIS being able to 'drill down' between layers of information, compared with a lower rating (4.11) by 'Chemical and Petroleum Production' organisations. 'Ease of Use' was the most important feature for 'Chemical and Petroleum Production' as against the ability to 'drill down' between layers of information as defined to be the most important function or feature by 'Food, Beverage and Tobacco' organisations.

Table 26 – Survey Response by EIS Features and Functions and Industry Type

Features and Functions of EIS	Food,Bev. and Tobacco (Mean)	(No.)	Chemical and Petroleum (Mean)	(No.)
'Drill down'	4.80(1)	15	4.11(3)	9
Trend analysis	4.27(4)	15	4.44(2)	9
Ease of use	4.53(2)	15	4.67(1)	9
Response times	4.33(3)	15	4.11(3)	9
Gauges of performance	4.00(5)	15	3.62(5)	8
Modeling and 'what if'	3.93(6)	15	3.56(6)	9
External data	3.00(7)	15	2.56(7)	9

A Wald-Wolfowitz Runs Test was done against each of the EIS features and functions (see Table 27 – Variance Analysis by EIS Features and Functions and Industry Type) to determine if there was a significant difference between these two industry types in the Manufacturing sector.

The result of these Wald-Wolfowitz Runs Tests (see Table 27 – Variance Analysis by EIS Features and Functions and Industry Type) shows one significant variance between 'Food, Beverage and Tobacco' and 'Chemical and Petroleum Products' and EIS features and functions– 'Drill Down'.

The ranking of these features and functions was not greatly changed as a result of this difference, with this function or feature a high priority for both 'Food, Beverage and Tobacco' and 'Chemical and Petroleum Products' organisations. This suggests that the

feature of 'drill down' between layers of information is significantly more important to 'Food, Beverage and Tobacco' organisations than 'Chemical and Petroleum Products' organisations.

Table 27 – Variance Analysis by EIS Features and Functions and Industry Type

Features and Functions of EIS	Z	P
'Drill down'	-2.34	0.019*
Trend analysis	0.78	0.434
Ease of use	-0.11	0.911
Response times	-0.11	0.911
Gauges of performance	-0.21	0.837
Modeling and 'what if'	0.33	0.738
External data	-0.11	0.911

$\alpha = 0.10$ * = significant

A Spearman Rank Correlation test was done to see if there was a significant correlation in ranking of EIS features and functions between the two industry sectors of 'Food, Beverage and Tobacco' and 'Chemical and Petroleum Products'. The statistical difference of a single EIS Feature and Function, 'Trend Analysis' is not enough to affect the Spearman Rank Correlation test. There was a correlation of 0.793, which is significant at $p = 0.032$, so **do not reject H0 14, therefore reject HA 14**.

The Problems of Developing and Introducing EIS into Organisations in the Manufacturing Sector

H0 15: There is no significant difference between medium and large sized organisations in the Manufacturing sector in the perception of problems associated with developing and introducing an EIS.

HA 15: There is significant difference between medium and large sized organisations in the Manufacturing sector in the perception of problems associated with developing and introducing an EIS.

Question thirteen of the survey determined the magnitude of problems associated with creating and/or introducing a new EIS into that organisation. This question used a likert scaling method to provide a measurement of the magnitude of problem of each of these associated issues:

1 – Justification to develop

2 – Importance against other projects

3 – Availability of products and tools

4 – Initial cost of development

5 – Ongoing maintenance costs

6 – Executive availability

7 – Executive lack of computer experience

8 – Lack of project support

9 – Determining executive needs

10 – Availability of company data

11 – Timeliness of company data

12 – Availability of external data

Space was left at the bottom of the question for respondents to include any other problems associated with creating and/or introducing a new EIS into that organisation that they considered may not have been included in the list above. There were no additional problems provided by any of the respondents.

Table 28 – Survey Response by EIS Problems and Organisation Size

Problems of Creating an EIS	Medium		Large	
	(Mean)	(No.)	(Mean)	(No.)
Justification to develop	3.09(9)	44	3.75(2)	8
Importance other projects	3.30(5)	44	3.38(7)	8
Availability products/tools	3.12(8)	43	2.50(12)	8
Initial costs	3.86(1)	44	3.75(2)	8
Ongoing costs	3.30(5)	44	2.75(10)	8
Executive availability	3.40(4)	43	3.62(6)	8
Exec. Lack of comp. exp.	3.64(2)	44	3.75(2)	8
Lack of project support	3.20(7)	44	3.88(1)	8
Determine exec. Needs	3.43(3)	44	3.75(2)	8
Company data available	2.86(11)	44	3.38(7)	8
Company data timely	2.88(10)	43	2.88(9)	8
External data available	2.41(12)	41	2.75(10)	8

A descriptive analysis of these responses by organisation size (see Table 28 – Survey Response by EIS Problems and Organisation Size) shows little difference between the highest and lowest ranked problem in both categories of organisation size is less than one and a half (1.5) scales. This indicates no great magnitude of difference between the problems associated with creating and/or introducing a new EIS into these organisations. Despite these small differences in scaling, there were significant differences between medium and large organisations in their ranking.

Large organisations were more concerned with the lack of executive support (rate of 3.88 and ranking of 1), compared with medium-sized organisations (rate of 3.20 and ranking of 7). Large organisations were also concerned with being able to justify the development of an EIS (rate of 3.75 and ranking of 2), as against medium-sized organisations (rate of 3.09 and ranking of 9).

Smaller organisations were more concerned with the ongoing costs of an existing EIS (rate of 3.30 and ranking of 5), compared with large organisations (rate of 2.75 and ranking of 10).

A Wald-Wolfowitz Runs Test was done against each of the EIS problems (see Table 29 – Variance Analysis by EIS Problems and Organisation Size) to determine if there was a significant difference between medium and large sized organisations in the Manufacturing sector.

Table 29– Variance Analysis by EIS Problems and Organisation Size

Problems of Creating an EIS	Z	p
Justification to develop	-0.84	0.399
Importance other projects	1.35	0.177
Availability products/tools	-0.81	0.417
Initial costs	-1.39	0.164
Ongoing costs	-0.84	0.399
Executive availability	-1.90	0.057*
Exec. Lack of comp. exp.	0.25	0.800
Lack of project support	0.25	0.800
Determine exec. needs	0.25	0.800
Company data available	1.35	0.177
Company data timely	0.28	0.781
External data available	-0.21	0.835

$\propto = 0.10$ * = significant

The result of these Wald-Wolfowitz Runs Tests (see Table 29 – Variance Analysis by EIS Problems and Organisation Size) shows one significant variance between medium and large sized organisations – 'Executive Availability'.

A Spearman Rank Correlation test was done to see if there was a significant correlation in ranking of EIS Problems between the two groups of medium and large organisations in the Manufacturing sector. The statistical difference of a single EIS Problem, 'Executive Availability' is not enough to affect the Spearman Rank Correlation test.

There was a correlation of 0.501, which is significant at p = 0.097, so **do not reject H0 15, therefore reject HA 15.**

H0 16: There is no significant difference between the industry type of organisation in the Manufacturing sector in the perception of problems associated with developing and introducing an EIS.

HA 16: There is significant difference between the industry type of organisation in the Manufacturing sector in the perception of problems associated with developing and introducing an EIS.

Question thirteen of the survey determined the magnitude of problems associated with creating and/or introducing a new EIS into that organisation. This question was used to test the current hypothesis in the same way as the previous hypothesis.

A descriptive analysis of these responses by industry type (see Table 30 – Survey Response by EIS Problems and Industry Type) shows a very similar ranking of the problems of creating a new EIS within these organisations. 'Lack of Project Support' was the one EIS problem determined by 'Chemical and Petroleum' organisations (2), compared with 'Food, Beverage and Tobacco' organisations (7).

A Wald-Wolfowitz Runs Test was done against each of the EIS problems (see Table 31 – Variance Analysis by EIS Problems and Industry Type) to determine if there was a significant difference between these two industry types in the Manufacturing sector.

Table 30 – Survey Response by EIS Problems and Industry Type

Problems of Creating an EIS	Food,Bev. and Tobacco (Mean)	(No.)	Chemical and Petrol. (Mean)	(No.)
Justification to develop	3.27(5)	15	3.44(7)	9
Importance other projects	3.53(2)	15	3.88(2)	9
Availability products/tools	2.53(12)	15	3.11(9)	9
Initial costs	3.53(2)	15	3.88(2)	9
Ongoing costs	2.80(8)	15	3.44(7)	9
Executive availability	3.87(1)	15	4.00(1)	8
Exec. Lack of comp. Exp.	3.40(4)	15	3.88(2)	9
Lack of project support	3.00(7)	15	3.88(2)	9
Determine exec. Needs	3.27(5)	15	3.66(6)	9
Company data available	2.73(9)	15	3.00(10)	9
Company data timely	2.73(9)	15	2.78(11)	9
External data available	2.60(11)	15	2.56(12)	9

The result of these Wald-Wolfowitz Runs (see Table 31 – Variance Analysis by EIS Problems and Industry Type) shows two significant variance between 'Food, Beverage and Tobacco' and 'Chemical and Petroleum Products' and EIS problems – 'Determine executive needs' and 'External data available'.

A Spearman Rank Correlation test was done to see if there was a significant correlation in ranking of EIS problems between the two industry sectors of 'Food, Beverage and Tobacco' and 'Chemical and Petroleum Products'. The statistical difference of the two

EIS problems, 'Determine executive needs' and 'External data available', are not enough to affect the Spearman Rank Correlation test. There was a correlation of 0.887, which is significant at $p < 0.001$, so **do not reject H0 16, therefore reject HA 16**.

Table 31 – Variance Analysis by EIS Problems and Industry Type

Problems of Creating an EIS	Z	p
Justification to develop	1.228	0.219
Importance other projects	-0.558	0.576
Availability products/tools	0.782	0.434
Initial costs	0.335	0.738
Ongoing costs	1.228	0.219
Executive availability	0.267	0.789
Exec. Lack of comp. exp.	-0.558	0.577
Lack of project support	0.782	0.434
Determine exec. Needs	2.121	0.034*
Company data available	0.782	0.434
Company data timely	-0.111	0.911
External data available	1.675	0.094*

$\alpha = 0.10$ * = significant

Summary of Findings

The findings from the sixteen research hypotheses are:

H0 1: There is a significant difference between medium and large sized organisations in the Manufacturing sector in the stage of EIS development – **Reject H0 1, therefore accept HA 1.**

H0 2: There is no significant difference between the industry type of organisation in the Manufacturing sector in the stage of EIS development – **Reject H0 2, therefore accept HA 2.**

H0 3: There is no significant difference between medium and large sized organisations in the Manufacturing sector in the EIS areas of use – **Do not reject H0 3, therefore reject HA 3.**

H0 4: There is no significant difference between the industry type of an organisation in the Manufacturing sector in the EIS areas of use – **Reject H0 4, therefore accept HA 4.**

H0 5: There is no significant difference between medium and large sized organisations in the Manufacturing sector in the types of EIS users – **Do not reject H0 5, therefore reject HA 5.**

H0 6: There is no significant difference between the industry type of an organisation in the Manufacturing sector in the types of EIS users – **Do not reject H0 6, therefore reject HA 6.**

H0 7: There is significant difference between medium and large sized organisations in the Manufacturing sector in the amount considered for spending on the development of a new EIS – **Reject H0 7, therefore accept HA 7.**

H0 8: There is no significant difference between the industry type of an organisation in the Manufacturing sector in the amount considered for spending on the development of a new EIS – **Do not reject H0 8, therefore reject HA 8.**

H0 9: There is significant difference between medium and large sized organisations in the Manufacturing sector in the amount considered for spending on ongoing annual maintenance of an existing EIS – **Do not reject H0 9, therefore reject HA 9.**

H0 10: There is no significant difference between the industry type of organisation in the Manufacturing sector in the amount considered for spending on ongoing annual maintenance of an existing EIS – **Do not reject H0 10, therefore reject HA 10.**

H0 11: There is no significant difference between medium and large sized organisations in the Manufacturing sector in the perception of benefits from the use of EIS – **Reject H0 11, therefore accept HA 11.**

H0 12: There is no significant difference between the industry type of organisation in the Manufacturing sector in the perception of benefits from the use of EIS – **Reject H0 12, therefore accept HA 12.**

H0 13: There is no significant difference between medium and large sized organisations in the Manufacturing sector in the perception of required functions and features of EIS – **Do not reject H0 13, therefore reject HA 13.**

H0 14: There is no significant difference between the industry type of organisation in the Manufacturing sector in the perception of required functions and features of EIS – **Do not reject H0 14, therefore reject HA 14.**

H0 15: There is no significant difference between medium and large sized organisations in the Manufacturing sector in the perception of problems associated with developing and introducing an EIS – **Do not reject H0 15, therefore reject HA 15.**

H0 16: There is no significant difference between the industry type of organisation in the Manufacturing sector in the perception of problems associated with developing and introducing an EIS – **Do not reject H0 16, therefore reject HA 16.**

Chapter Seven - Discussion, Limitations and Future Research

This chapter looks more closely at the results of the of the hypotheses testing in the previous chapter and the implications of findings against the research questions detailed and described in Chapter One – Introduction. Discussions of the findings are further presented, together with discussion on the limitations of this investigation and recommendations for ongoing and future research.

Discussion of Findings

A summary of the relationships between the variables of organisation size and industry type with the development and use of EIS in Australian manufacturing organisations are presented in Table 32 – Variable Relationship with Research Questions.

Organisation size has statistical significance with two Research Questions:

4b. Are there differences in the amount considered for spending on ongoing annual maintenance of an existing EIS within organisations in the Manufacturing Sector?

5. Are there differences in perceptions of benefits of EIS by organisations in the Manufacturing Sector?

The two industry types of 'Food, Beverage and Tobacco' and 'Chemical and Petroleum' were found to be statistically significant for three research questions:

1. Are there differences in the stages of EIS development of organisations in the Manufacturing sector?
2. Are there differences in the areas of use of EIS within organisations in the Manufacturing sector?

5. Are there differences in perceptions of benefits of EIS by organisations in the Manufacturing sector?

Table 32 – Variable Relationship with Research Questions

Research Questions	Org. Size	Industry Type
1. Are there differences in the stages of EIS development of organisations in the Manufacturing sector?	n	**Y**
2. Are there differences in the areas of use of EIS within organisations in the Manufacturing sector?	n	**Y**
3. Are there differences in the types of users of EIS within organisations in the Manufacturing sector?	n	n
4a. Are there differences in the amount considered for spending on the development of new EIS within organisations in the Manufacturing sector?	n	n
4b. Are there differences in the amount considered for spending on ongoing annual maintenance of an existing EIS within organisations in the Manufacturing sector?	**Y**	n
5. Are there differences in perceptions of benefits of EIS by organisations in the Manufacturing sector?	**Y**	**Y**
6. Are there differences in perceptions of required functions and features of EIS by organisations in the Manufacturing sector?	n	n
7. Are there differences in perceptions of problems of developing and introducing EIS into organisations in the Manufacturing sector?	n	n

The implications of these findings are discussed for each of the research questions detailed in Chapter One - Introduction.

1. Are there differences in the stages of EIS development of organisations in the Manufacturing sector?

There was no statistical significance in the difference of groupings by organisation size. This result goes against the earlier finding of Watson and Glover (1991) that the cost of developing and using EIS are prohibitive for smaller organisations and that they are less likely to be able to afford such systems. McKendrick (1993) suggested that the cost of entry to the EIS market is falling and this could lead to smaller organisations being involved in the development and use of EIS. The emergence of smaller organisations than the largest 200-300 developing and using EIS adds weight to this suggestion.

There was a statistical significance in the difference of groupings by industry type in the Australian Manufacturing sector and the stage of EIS development. The difference between 'Food, Beverage and Tobacco' and 'Chemical and Petroleum Products' organisations and their stage of EIS development shows that the importance to develop and use EIS is based on type of industry and not size of organisation.

Pervan and Phua (1997) determined that seventy five percent of organisations were currently developing an EIS or in the process of evaluating the tools required for the development and use of these systems, in a survey of the top 300 organisations in

Australia. This investigation has found two-thirds of the 'Food, Beverage and Tobacco' organisations were beyond the evaluation of tools required for EIS development and were developing or using completed EIS. In contrast, almost half of the 'Chemical and Petroleum' organisations had not even considered EIS.

2. Are there differences in the areas of use of EIS within organisations in the Manufacturing sector?

There is a significant correlation in ranking of EIS areas of use, between the two groups of medium and large organisations in the Manufacturing sector:

1. Sales/Market Analysis
2. Financial Monitoring
3. Production Monitoring
4. Forecasting/Demand
5. Competitive Analysis
6. Non-Financial Monitoring

Large organisations gave an average score of importance higher for all six EIS areas of use. There was a significant difference in the score of importance for only one of the EIS area of use – 'Forecasting and Demand', meaning there is no statistical significance in larger organisations having a higher average score of importance than medium sized organisations. 'Forecasting and Demand' is ranked a fourth important EIS area of use, so the difference in score of importance is not significant.

There was a statistical significant difference between the rankings of EIS areas of use by industry type in the Australian Manufacturing sector. The 'Food, Beverage and Tobacco' organisations ranked 'Financial Monitoring' as a secondary important EIS area of use, with 'Chemical and Petroleum Products' placing a greater importance on 'Production Monitoring'. Both industry types scored 'Sales/Market Analysis' as the most important EIS area of use.

3. Are there differences in the types of users of EIS within organisations in the Manufacturing sector?

There was a very similar ranking of the users of EIS between medium and large organisations, with no statistical difference in ranking between these two groups of organisation size. Executives were the highest ranked users of EIS, which is consistent with the literature describing the different information needs of executives and their use of EIS (Watson and Frolick, 1993; Watson, Rainer and Doh, 1991; Lester, 1989).

There was a very similar ranking of the users of EIS and the two industry types of 'Food, Beverage and Tobacco' and 'Chemical and Petroleum' in the Australian Manufacturing sector. The only statistically significantly difference in ranking of user of EIS was 'Engineer' with 'Chemical and Petroleum' organisations giving a statistically higher rating for this type of user compared with 'Food, Beverage and Tobacco' organisations.

The top five users of EIS ranked in the following order of importance by organisation size and industry type are:

1. Executives
2. Management Staff
3. Chief Executive Officer
4. Sales Representatives
5. Support Staff

The suggestion by Korzeniowski (1993) that there is some focus on users of EIS outside executives is supported by the high ranking of Management Staff and Sales Representatives as users of EIS. McKendrick (1993) makes the comment that EIS have traditionally been created for executive use only and these users have little time or inclination to properly use such systems. While executives are still the primary users of EIS, the high ranking of Management Staff suggests there is growing use of EIS at lower levels of management.

4. Are there differences in the limits of expenditure on EIS by organisations in the Manufacturing sector?

The limits of expenditure on EIS were broken down into an initial amount for the development of EIS and the annual ongoing maintenance of an EIS. Both types of expenditure on EIS were statistically tested against the independent variables, organisation size and industry type, in providing an answer to this research question.

4a. Initial Amount Considered for Spending on Development of a New EIS

There was no statistical difference between medium and large sized organisations and the amount considered for spending on the development of a new EIS. Some large organisations were willing to spend greater amounts on EIS and that increased the average amount large organisations were willing to spend on a new EIS. In fact, the majority of large organisations wanted to spend no more on EIS than medium sized organisations and this was evident in there being no statistical difference between these two groups of organisation size.

Medium sized organisations were willing to spend an average of $128,670 on the development of a new EIS. Over a third (36%) of medium sized organisations (see Table 4 – Survey Response by Stage of EIS Development and Organisation Size) have already developed and are using EIS. Korzeniowski (1993) found the tools used to develop EIS were improving and substantially cheaper than the average cost of development of EIS at $US450,162 (Watson and Glover, 1991). This large reduction in cost of initial development and advance in stage of EIS development within medium sized organisations shows EIS are now more affordable and being used by organisations outside the largest 200 to 300.

There was no statistical difference between the two industry types of 'Food, Beverage and Tobacco' and 'Chemical and Petroleum' in the Australian Manufacturing sector and the amount considered for spending on the development of a new EIS. There were inconsistent amounts considered for spending on EIS by 'Food, Beverage and Tobacco' organisations and further investigation found size of organisation within this industry

type to be the reason. There were two large 'Food, Beverage and Tobacco' organisations willing to spend more on the initial development of EIS than others.

4b. Amount Considered for Spending on Ongoing Annual Maintenance of an Existing EIS

There was statistical difference between medium and large organisations and the amount considered for spending on ongoing annual maintenance of an existing EIS. Large organisations are more willing to spend greater amounts on ongoing maintenance of EIS than medium sized organisations. There was a much wider range of amounts considered for this annual ongoing maintenance by larger organisations, with medium sized organisations more consistent in the amount they would spend.

Large organisations were willing to spend an average of $100,000 on the ongoing annual maintenance of an existing EIS with medium sized organisations with a much lower figure of $25,029. Both figures are much lower than the $US222,626 that was found to be the annual ongoing support for the largest organisations in the U.S. (Watson and Glover, 1991).

There was no statistical difference between the two industry types of 'Food, Beverage and Tobacco' and 'Chemical and Petroleum' in the Australian Manufacturing sector and the amounts considered for spending on ongoing annual maintenance of an existing EIS. There were inconsistent amounts of ongoing maintenance of EIS by 'Food, Beverage and Tobacco' organisations and further investigation suggests size of organisation within this industry type is the reason for this variation. There was a

greater spread of organisation size within the 'Food, Beverage and Tobacco' industry type and this is reflected in a greater variation in spending on ongoing annual maintenance of EIS than 'Chemical and Petroleum' organisations.

5. Are there differences in perceptions of benefits of EIS by organisations in the Manufacturing sector?

There was significant difference in ranking between the perceptions of benefits of EIS and medium and large sized organisations. Medium sized organisations ranked 'Quicker Reporting' and large organisations ranked 'Finding Problems' as the most important benefit of EIS.

In support of this difference in ranking of perceptions of benefits of EIS between medium and large sized organisations, there was a statistical difference in rating of three of the five benefits of EIS, 'Paperwork Reduction', Quicker Reporting' and 'Less Changes to Reports'. Each of these benefits was rated statistically different between medium and large sized organisations in the Manufacturing sector.

There was significant difference in ranking between the perceptions of benefits of EIS and the two industry types of 'Food, Beverage and Tobacco' and 'Chemical and Petroleum'. 'Food, Beverage and Tobacco' organisations ranked 'Finding Problems' and 'Chemical and Petroleum' organisations ranked 'Quicker Reporting' as the most important benefit of EIS. There were more large organisations in the 'Food, Beverage and Tobacco' survey responses and more medium sized organisations in the 'Chemical and Petroleum' survey responses. This could explain the similar finding of most

important benefit of EIS by organisation size between large sized organisations and 'Food, Beverage and Tobacco' organisations and medium sized organisations and 'Chemical and Petroleum' organisations.

6. Are there differences in perceptions of required functions and features of EIS by organisations in the Manufacturing sector?

There was no statistical significance in ranking between the perceptions of required functions and features of EIS and medium and large sized organisations. There was also no statistical significance in ranking between the perceptions of required functions and features of EIS between the two industry types of 'Food, Beverage and Tobacco' and 'Chemical and Petroleum'. This showed a similar requirement of the required features and functions of EIS across organisation size and two industry types in the Manufacturing sector in Australia.

There were four features and functions of EIS ranked highest in importance by organisation size and industry type:

- 'Drill down' through information
- Ease of use
- Response times
- Trend analysis

The remaining features and functions of EIS were consistently ranked by organisation size and industry type as follows:

5 – Visual gauges of performance/non-performance

6 – Modeling and 'what-if' scenarios

7 – Access to external data

The suggestion that the executives place a high importance on external information (Watson, Rainer and Koh, 1991) is not reflected, as there was little requirement for this type of information in EIS. Access to external data was consistently ranked the lowest required feature and function of EIS across organisation size and industry type in the Australian Manufacturing sector.

7. Are there differences in perceptions of problems of developing and introducing EIS into organisations in the Manufacturing sector?

There was no statistical significance in ranking between the perceptions of problems of developing and introducing EIS and medium and large sized organisations. There was also no statistical significance in ranking between the perceptions of problems of developing and introducing EIS between the two industry types of 'Food, Beverage and Tobacco' and 'Chemical and Petroleum'. This showed a similar expectation of the problems associated with developing and introducing EIS across organisation size and two industry types in the Manufacturing sector in Australia.

There were four problems associated with developing and introducing EIS ranked highest in importance across organisation size and industry type:

- Initial Cost
- Executive lack of computer experience
- Determining executives needs

- Executive availability

There were exceptions to this top ranking, with large organisations including the problem of 'Justification to develop' a second highest ranking issue. This was not a problem in medium sized organisations where it was a ninth ranked issue. Large organisations would seem to need greater justification for the development of EIS than medium sized organisations. 'Food, Beverage and Tobacco' organisations ranked this a fifth highest issue and 'Chemical and Petroleum' organisations had this as a seventh ranked issue, showing it not as greater problem for medium as large sized organisations indicated.

'Lack of project support' was the other problem associated with the development and introduction of EIS that showed great variation across organisation size and industry type. Large organisations ranked this the single highest problem, with medium sized indicating it a much lesser problem where it was a seventh ranked issue. 'Food, Beverage and Tobacco' organisations ranked 'Lack of project support' as a seventh ranked issue and 'Chemical and Petroleum' organisations ranked this problem an equal second issue. This difference between industry type is interesting in that the responses from 'Food, Beverage and Tobacco' organisations contain more large organisations than the responses from 'Chemical and Petroleum' organisations. This would suggest EIS project support is an issue with large organisations, but this support does vary between industry types in the Australian Manufacturing sector.

Limitations of Investigation

It may be argued that the size of the sample population of 291 could be larger, although a sample of 200-300 was common for surveys about EIS in Australia (Watson, 1989; Pervan, 1992 and Pervan, 1994). The only population used by previous surveys on EIS in Australia (Watson, 1989; Pervan, 1992 and Pervan, 1994) was the top 200-300 Australian organisations. This investigation looked at organisations outside this group, including much smaller organisations in a specific sector - Manufacturing. This investigation had no direct comparisons about response rate of this industry sector or results of hypothesis testing to make comparisons against.

The response rate to the survey by industry type in the Australian Manufacturing sector varied from 0% (Ammunition and Software) to 36.4% (Non Metal Industry). This varied response in these industry sectors meant that only two of the ten industry types in the Australian Manufacturing sector were included in the testing of hypothesis relating to industry type. The comparison of the 'Food, Beverage and Tobacco' and 'Chemical, Petroleum products' industries is only an indication of the difference between industry type and can not be generalised further across all industry types in the Australian Manufacturing sector.

The survey response rate of 18.9% is lower than previous Australian surveys (Watson, 1989; Pervan, 1992 and Pervan, 1994), with this being investigative research on EIS in medium to large Australian manufacturing organisations. Based on the large variance in response rate by industry type, it may be that some organisations that are not at all interested in the development and use of EIS and have therefore not responded to the survey. This lack of response needs to be investigated further.

There were more large sized organisations in the 'Food, Beverage and Tobacco' survey responses and more medium sized organisations in the 'Chemical and Petroleum' survey responses. The results of industry type and organisation size against each research question as presented in Table 32 – Variable Relationship with Research Question show only one relationship – differences in perceptions of benefits of EIS by organisations in the Manufacturing sector which was shown to be significant by industry type and organisation size. This finding needs further investigation, to determine if the smaller sample of industry type was affected by the variable of organisation size.

There were three survey responses found to be less than the Cronbach's Alpha 0.7 level of reliability (see Table 2 – Survey Reliability with Scale Questions). Sample size and number of scale categories are believed to affect the size of Cronbach's Alpha (Davis and Costenza, 1985). Sample size has already been identified as a limitation of this investigation and the number of scale categories could have been increased for these survey questions.

Future Research

This investigation is still only one of a very few number of studies into the development and use of EIS in Australian. The potential and use of EIS has been discussed for many years since Rockart and Tracy (1982) first defined EIS, with only a small amount of qualitative or quantitative material to assist organisations through the process of developing and implementing EIS.

The effect of industry type as an independent variable was tested using only two of many industry types across the Australian Manufacturing sector.

An investigation on the high variation of response rate across industry types in the Australian Manufacturing sector is important, to determine if a non-response is significant to the low importance of EIS to organisations.

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Appendix A – EIS Related Articles

1. Belcher and Watson (1993) – Case Study (US)
   - Description of the framework for the development and use of EIS
   - Determination of costs and benefits of EIS
2. Watson and Frolick (1993) – Combined Case Study and Survey (US)
   - Executive information requirements as they relate to EIS
3. Mohan (1990) – Case Study (US)
   - Description of the framework for the development and use of EIS
4. Watson, Rainer and Koh (1991) – Survey (US)
   - Description of the framework for the development and use of EIS
   - Executive information requirements as they relate to EIS
5. Whymark (1991) – Case Study (AUS)
   - Description of the framework for the development and use of EIS
6. Fitzgerald (1990) – Combined Case Study and Survey (UK)
   - Description of the framework for the development and use of EIS
7. Lee (1994) – Case Study (AUS)
   - Description of the framework for the development and use of EIS
   - Determination of costs and benefits of EIS
8. Conyngham (1994) – Case Study (AUS)
   - Description of the framework for the development and use of EIS
   - Determination of costs and benefits of EIS
9. Stamps (1991) – Interviews (US)
   - EIS development packages and development tools

10. Lester (1989) – Case Study (UK)
    - Determination of costs and benefits of EIS
    - EIS development packages and development tools
    - Executive information requirements as they relate to EIS
11. McKendrick (1993) – Interviews (US)
    - Description of the framework for the development and use of EIS
    - EIS development packages and development tools
    - Executive information requirements as they relate to EIS
12. Armstrong (1990) – Case Study (US)
    - Description of the framework for the development and use of EIS
    - Determination of costs and benefits of EIS
13. Korzeniowski (1993) – Interview (US)
    - EIS development packages and development tools
14. Mohommed (1992) – Combined case studies and surveys (US)
    - Executive information requirements as they relate to EIS
15. Alexander (1997) – Survey (NZ)
    - Determination of costs and benefits of EIS
    - Executive information requirements as they relate to EIS
16. Menkus (1987) – Interview (US)
    - EIS development packages and development tools
    - Executive information requirements as they relate to EIS
17. Brown (1991) – Case Study (US)
    - Determination of costs and benefits of EIS

18. Byun and Suh (1994) – Literature Review (US)
    - Description of the framework for the development and use of EIS
    - Determination of costs and benefits of EIS
19. Burden (1993) – Combined case studies and surveys (US)
    - Determination of costs and benefits of EIS
20. Watson (1993) – Surveys (US)
    - Determination of costs and benefits of EIS
    - EIS development packages and development tools
21. Brandel (1992) – Case Studies (US)
    - EIS development packages and development tools
22. Paller (1990) – Case Studies (US)
    - EIS development packages and development tools
23. Glover, Watson and Rainer (1992) – Case Studies (US)
    - Description of the framework for the development and use of EIS
24. Ness (1991) – Literature Review (US)
    - EIS development packages and development tools
    - Executive information requirements as they relate to EIS
25. Keen (1991) – Case Studies (US)
    - EIS development packages and development tools
26. Rockart (1991) – Literature Review (US)
    - Executive information requirements as they relate to EIS
27. Leidner and Elam (1994) – Surveys (US)
    - Determination of costs and benefits of EIS
    - Executive information requirements as they relate to EIS

28. Miller (1994) – Survey (AUS)

- EIS development packages and development tools

29. Frolick and Ramarapu (1993) – Case Study (US)

- EIS development packages and development tools

30. Karbowski (1992) - Interviews (US)

- Description of the framework for the development and use of EIS
- EIS development packages and development tools

31. Friend and Norment (1991) – Case Study (US)

- EIS development packages and development tools

32. Carroll and Larkin (1992) - Case Study (US)

- Description of the framework for the development and use of EIS

33. Daneshgar (1993) - Survey (US)

- Description of the framework for the development and use of EIS

34. Rainer, Snyder and Watson (1992) – Survey (US)

- Description of the framework for the development and use of EIS

35. Moynihan (1993) – Case Study (US)

- Description of the framework for the development and use of EIS

36. Watson and Satzinger (1994) – Case Study (US)

- Description of the framework for the development and use of EIS

37. Pervan (1992) – Survey (AUS)

- Description of the framework for the development and use of EIS
- Determination of costs and benefits of EIS

38. Warmouth and Yen (1995) – Literature Review (US)

- EIS development packages and development tools

39. Vandenbosch and Higgins (1995) - Survey (US)

- Executive information requirements as they relate to EIS

40. Pervan and Phua (1997) – Survey (AUS)

- Description of the framework for the development and use of EIS
- Determination of costs and benefits of EIS

41. Rainer and Watson (1995) – Combined case studies and surveys (US)

- Description of the framework for the development and use of EIS

Appendix B - Survey Question References

Question	Reference
1. Most likely "Executive Sponsor"	(Watson et al., 1991); (McKendrick, 1993)
2. Most likely "Operating Sponsor"	(Watson et al., 1991)
11. Rating of Benefit as Justification for an EIS.	
• Reduction in paperwork	(Belcher and Watson, 1993); (McKendrick, 1993)
• Time savings in reporting data to executives	(Belcher and Watson, 1993); (Watson et al., 1991)
• Reduction in request for changes to reports	(Belcher and Watson, 1993); (McKendrick, 1993)
• Savings in finding problems quicker	(Belcher and Watson, 1993); (Mohan, 1990)
• Savings in finding opportunities quicker	(Belcher and Watson, 1993); (Mohan, 1990)
12. Importance of functions/features in a new EIS	
• "Drill down" between layers of information	(Watson et al., 1991) (Korzeniowski, 1993)

Question	Reference
12. Importance of functions/features in new EIS (cont.)	
• Trend analysis	(Mohan, 1990)
• Ease of use	(Mohan, 1990) (Watson et al., 1991)
• Response times	suggested by IS Professionals
• Visual gauges of performance	(Mohan, 1990)
• Modeling and "what-if" scenarios	(Mohan, 1990)
• Access to external data	(Mohan, 1990)
13. Problems in creating/introducing an EIS	
• Justification to develop or use an EIS	(Belcher and Watson, 1993)
• Importance of development of EIS against other projects	Suggested by IS Professional
• Availability of tools	(Conyngham, 1994)
• Cost of developing an EIS	(Watson et al., 1991); (Byun and Suh, 1994)
• Ongoing cost of maintaining an EIS	(Watson et al., 1991); (Byun and Suh, 1994)

Question	Reference
13. Problems in creating/introducing EIS (cont.)	
• Availability of Executives	(Mohan, 1990); (Menkus, 1987)
• Executive lack of computer experience	(Watson and Frolick, 1993); (Mohan, 1990); (Watson et al., 1991); (Menkus, 1987)
• Lack of support by executives	(Mohan, 1990); (Watson et al., 1991); (Menkus, 1987)
• Determining executives EIS needs	(Watson and Frolick, 1993); (Menkus, 1987)
• Availability of company data	(Mohan, 1990); (Menkus, 1987)
• Timeliness of company data	(Mohan, 1990); (Menkus, 1987)

Question	Reference
13. Problems in creating/introducing EIS (cont.)	
• Availability of other external information	(Mohan, 1990)
14. The use of existing EIS or "Custom Built"	(Watson et al., 1991);
15. EIS Project team make-up	(Watson et al., 1991);

Appendix C – Survey Introduction Letter

14 October 1996

Information Systems (Computer) Manager
<<Company Name>>
<<Address Line 1>>
<<Address Line 2>>

Dear Sir/Madam

RE : *RESEARCH PROJECT*

I am writing to seek your assistance and cooperation in a research project on Executive Information Systems (EIS) in Australian manufacturing organisations. The research intends to seek the perceptions and experiences of those most involved and/or affected by the development and use of an EIS (I have provided a definition of EIS on the first page of the survey).

The research is unique to manufacturing in Australia and based on a select number of organisations, making it imperative that a sufficiently high response rate is obtained. All information will be treated with the strictest confidence and only aggregate data will be reported. A copy of the summarised results, including details on the current use of EIS in your industry will be sent to you at your request. The survey will not take long to complete (15 minutes) and your response is highly valued.

I would ask that the survey provided be completed by the person in your organisation that knows most about the development and use of an Executive Information System. This person could be a main user, if your organisation is currently using an EIS, or that person that knows most about this subject area.

I have enclosed a stamped, self addressed envelope for the completed surveys to be returned. The response can also be faxed directly to me on (09) 434 2008.

Many thanks for your time and effort, it is much appreciated. If you have any questions or queries, please feel free to contact me on (09) [redacted] or one of my academic supervisors ; Dr Dieter Fink on (09) [redacted] or Mr Stuart Garner on (09) [redacted]

Yours sincerely

Nigel Warne
Edith Cowan University
Perth, Western Australia.

Appendix D – Survey Questionnaire

Survey of Perceptions about the Development and Use of Executive Information Systems (EIS) in Australian Manufacturing Organisations

Definition - Executive Information Systems (EIS).

There are many names that are synonymous with EIS, including Executive Support Systems (ESS). I have defined an EIS to be ;

A computer based system that is designed to provide the specific information needs of executives in an organisation. These systems may also be used by other employees within that organisation.

Guidelines for filling in survey.

1 Tick boxes where appropriate. ☐

2 For questions with a rating, please circle the number that best represents you opinion of the question/statement, or not applicable (n/a) if the question does not relate to your organisation.

for example;

	Level of Importance					
	1=Lowest				**5=Highest**	
To improve company profit	1	2	3	4	5	n/a

3 Please make comments on the form if you wish to elaborate.

Summary of Results.

Please send me a summary of the findings of this study about the use of EIS in Australian Manufacturing Organisations to :

Contact .....
E-Mail Account .....
OR
Address .....
.....

Detach and send to : Nigel Warne, [redacted]

1 What is your title/position?

.....

2 What type of manufacturing is your organisation primarily involved?

- ☐ <<Industry Type>>
- ☐ Other .....

3 What is the state of EIS in your organisation? (choose one)

- ☐ Not required
- ☐ Not yet considered
- ☐ Evaluating hardware/software for ____ year(s)
- ☐ Being developed for ____ year(s)
- ☐ Developed and effective for ____ year(s)
- ☐ Developed and not used for ____ year(s)

4 What is <u>your</u> involvement in the development and/or use of an EIS? (may choose more than one).

- ☐ Not yet considered
- ☐ Part of the evaluation of EIS packages and tools
- ☐ Helped in the design and specification of an EIS
- ☐ Helped in the development of an EIS
- ☐ Using/have used an EIS

5 If you are <u>not</u> currently using an EIS in your organisation, can you answer how important it is to acquire/develop an EIS in your organisation? (choose one)

- ☐ Not important at all
- ☐ Could be important in the future
- ☐ Needs to happen fairly soon
- ☐ Action needed immediately

6 Please show your indication of the importance of including the following areas in an EIS (whether or not you currently have an EIS).

	Being Used	Level of Importance 1=Lowest 5=Highest					
Financial Monitoring	☐	1	2	3	4	5	n/a
Sales/Market Analysis	☐	1	2	3	4	5	n/a
Competitive Analysis	☐	1	2	3	4	5	n/a
Forecasting/Demand Analysis	☐	1	2	3	4	5	n/a
Non-Financial Monitoring (i.e. Human Resources)	☐	1	2	3	4	5	n/a
Production Monitoring	☐	1	2	3	4	5	n/a
Others	☐	1	2	3	4	5	n/a
.....	☐	1	2	3	4	5	n/a

7	**Please indicate how important that you think that it is for the following people to be using an EIS (whether or not you currently have an EIS).**

	Currently using an EIS	**Level of Importance 1=Lowest 5=Highest**					
Chief Executive Officer	☐	1	2	3	4	5	n/a
Secretary to Chief Executive Officer	☐	1	2	3	4	5	n/a
Executives	☐	1	2	3	4	5	n/a
Executive Secretary	☐	1	2	3	4	5	n/a
Management Staff	☐	1	2	3	4	5	n/a
Support Staff (i.e. analysts, clerks)	☐	1	2	3	4	5	n/a
Sales Representatives	☐	1	2	3	4	5	n/a
Engineers	☐	1	2	3	4	5	n/a
Factory/Warehouse workers	☐	1	2	3	4	5	n/a
Others	☐	1	2	3	4	5	n/a
.....	☐	1	2	3	4	5	n/a

8 **Who would you consider to be the most likely "Executive Sponsor", providing most of the support and backing of an EIS project (choose one).**

- ☐ Chief Executive Officer
- ☐ Vice President
- ☐ Head of Accounting/Finance
- ☐ Head of Sales/Marketing
- ☐ Head of Information Systems
- ☐ Not required
- ☐ Other .....

9 **Who would you consider to be the most likely "Operating Sponsor", <u>managing</u> the development/installation of an EIS project? (choose one)**

- ☐ Chief Executive Officer
- ☐ Vice President
- ☐ Head of Accounting/Finance
- ☐ Head of Sales/Marketing
- ☐ Head of Information Systems
- ☐ Not required
- ☐ Other .....

10 What EIS tools have you heard of, used or evaluated? (may choose more than one)

	Heard of	Evaluated	Used
Developed within the organisation		☐	☐
Lightship (Dunn & Bradstreet)	☐	☐	☐
EIS Commander (Comshare)	☐	☐	☐
Forest and Trees (Forest and Trees)	☐	☐	☐
Express (Oracle)	☐	☐	☐
Powerplay (Cognos)	☐	☐	☐
Holos (Andyne)	☐	☐	☐
CorVu (CorVu Corporation)	☐	☐	☐
SAS/EIS (SAS Institute)	☐	☐	☐
Gentia (Planning Sciences)	☐	☐	☐
Others	☐	☐	☐

11 How would you rate the importance of the following benefits as being used to justify the development of a new EIS?

	Level of Importance 1=Lowest 5=Highest				
Reduction in paperwork by moving enquiries on-line and in a graphical format	1	2	3	4	5
Time savings in reporting data to executives	1	2	3	4	5
Reduction in request for changes to traditional reports	1	2	3	4	5
Savings associated with finding business Problems more quickly	1	2	3	4	5
Savings associated with finding business Opportunities more quickly	1	2	3	4	5
Others	1	2	3	4	5
	1	2	3	4	5
	1	2	3	4	5

12 How would you rate the importance of the following functions/features in a new EIS?

	Level of Importance 1=Lowest 5=Highest				
"Drill down" between layers of information	1	2	3	4	5
Trend analysis	1	2	3	4	5
Ease of use	1	2	3	4	5
Response times	1	2	3	4	5
Visual gauges of performance/non-performance	1	2	3	4	5
Modeling and "what-if" scenarios	1	2	3	4	5
Access to external data (i.e. stock market)	1	2	3	4	5
Others	1	2	3	4	5
	1	2	3	4	5

13 Please indicate your perceptions of the problems of creating and/or introducing a new EIS into your organisation.

	Level of Problem 1=Lowest 5=Highest				
EIS implementation/development issues					
Justification to develop or use an EIS	1	2	3	4	5
Importance of an EIS as against other projects	1	2	3	4	5
Availability of EIS applications and/or development tools	1	2	3	4	5
Cost of developing an EIS (initial)	1	2	3	4	5
Ongoing cost of maintaining an EIS (annual)	1	2	3	4	5
Executive issues					
Availability of Executives	1	2	3	4	5
Executive lack of computer experience	1	2	3	4	5
Lack of support by executives (non-financial)	1	2	3	4	5
Determining Executives EIS needs	1	2	3	4	5
Data issues					
Availability of company data	1	2	3	4	5
Timeliness of company data	1	2	3	4	5
Availability of other external information	1	2	3	4	5
Others	1	2	3	4	5
	1	2	3	4	5
	1	2	3	4	5

14 Would a new EIS be? (choose one)

- ☐ Custom built for you
- ☐ Vendor package
- ☐ Mix of both
- ☐ Not required

15 Who would you include in the implementation/development team of a new EIS? (may choose more than one)

- ☐ Outside vendors/consultants
- ☐ Executives
- ☐ Executive support staff
- ☐ Information Systems/Computing department
- ☐ Others .....
  .....

16 Approximately how many employees would be given access to an EIS in your organisation?

..... users

17 Approximately how much would you consider to be an upper limit to spend on purchasing/developing a new EIS for your organisation, including additional computer equipment, software/development tools, wages, training etc.?

$ .....

18 Approximately how much would you consider to be an upper limit to spend on maintaining an EIS per annum, including wages, data gathering, training etc.?

$ .....

19 Approximately how many employees in total does your manufacturing organisation employ? (choose one)

- ☐ 1-100
- ☐ 101-250
- ☐ 251-500
- ☐ 501-1,000
- ☐ 1,001-2,000
- ☐ 2,001+

20 What is the range of annual revenue of your manufacturing organisation?

- ☐ $ -1 million
- ☐ $ 2-5 million
- ☐ $ 6-10 million
- ☐ $ 11-20 million
- ☐ $ 21-50 million
- ☐ $ 50-100 million
- ☐ $ 101-200 million
- ☐ $ 201-500 million
- ☐ $ 501-1,000 million
- ☐ $ 1+ billion