The Use of Information and Communication Technology (ICT) Tools by Regional Australian Small to Medium Enterprises (SMEs): A Study into factors that influence the update of advanced ICT technology.

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DECLARATION

I declare that I have observed and practiced the ethics of research. All material or ideas in this thesis are original unless explicitly sited. This work has not been presented for credit in another degree or at another institution.

Craig Allan, 4th February, 2004.

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ABSTRACT

The role of the Small to Medium Enterprise (SME) within Australia cannot be underestimated. Small and medium firms are the cornerstone to the national economy and the cultural background of the nation. The SME is able to provide flexible services and cost effective products compared to larger businesses when trading with customers and consumers alike. Operators and managers of SMEs are able to adapt and harness new methods of doing business in many innovative ways. Despite their innovativeness many managers and operators have resisted the potential that Internet and Communication Technologies (ICT) can deliver for their businesses.

Internet based technologies have streamlined many business processes and increased trading performance for many large firms. SMEs use high levels of basic Internet technology such as email and a static website. There is still a large proportion of SMEs who tend not to use more advanced ICT that will offer more functionality. For example, a great amount of benefit may be gained by the use of an online catalogue by SMEs in the retail trade to enhance their marketing and sales. Furthermore, the global reach of ICT allows SMEs to compete worldwide and with larger firms.

This research discusses the phenomenon of ICT usage within Australian regional SMEs. Theory on many aspects of the subject is considered as is a range of contemporary studies. The development of a conceptual framework gives rise to a series of propositions and a range of hypotheses to test. The research evolves with use of a survey of SME proprietors and the resulting data is studied to provide results to the research. The tested hypotheses give indications toward validation of the studied subject and the possibility of insightful initiatives for owner-operators and managers of SMEs. The research has identified trends that indicate specific technical, individual, environmental and organisational factors have significant influence to specific types and levels of ICT activities. The results also indicate a pattern of higher prevalence of specific factors according to the complexity of ICT.

1. INTRODUCTION

Australian Small to Medium Enterprises (SMEs) have an important role in the national economy and community. SMEs provide the majority of employment in Australia. They are able to deliver goods and services at competitive costs and can respond to emerging market demands quicker than corporate businesses (Gagnon, 2000). Despite the flexibility demonstrated by SME operations, use of advanced Information and Communication Technologies (ICT) is lacking.

While some firms only require basic ICT for their operations, others may realise increases in business process efficiencies, marketing and trade with commercial partners. Previous research in this field has developed several theoretical frameworks surrounding the various factors managers face in using and planning for ICT. The decision process used by SME managers is unique and has an effect on how ICT is evaluated for business use by them. Factors have also been identified that can influence the adoption of ICT in SMEs as well as increasing the usage of more advanced technologies. Other theoretical concepts include models of a stage or step process to explain the transition from basic ICT products and procedures to advanced ICT activities.

Regional Australian SMEs have many issues to contend with when considering the use of ICT systems such as the availability of infrastructure and technical advice for example. This research aims to provide insight into the factors faced by regional SME owners considering the adoption of ICT. A range of propositions have been formulated, a survey was conducted and the hypotheses tested to validate the observations. The data was analysed to give statistical structure to the research question and the results have been discussed in detail.

1.1. Objectives and Aims of research

This research aims to deliver possible explanations surrounding limited use of some forms of ICT in regional Australian SMEs. The intention of the researcher is to establish and then validate a series of factors that influence decisions made by managers of SMEs according to their position in an adoption stage process. The resulting findings may identify specific issues that are considered obstacles to specific stages in the ICT evolutionary process.

Research Question:

> What Technological, Individual, Environmental and Organisational factors influence the usage of more complex ICT products and services by owner-operators/managers of SMEs?

The aims of this study are as follows:

- To design a conceptual model that incorporates the factors that influence the non use of some ICT by Australian SMEs.
- To operationalise and test the model with participating SMEs in the Ballarat area, thus establishing the validity of the conceptual model against real world experiences.
- To provide insight into the phenomena of low ICT uptake by Australian SMEs, specifically businesses located in regional areas and assist further action to enable ICT adoption.

The advantages to conducting research may result in the increased uptake of ICT by SMEs within regional Australia. The findings may assist in developing improved strategies in the following areas:

- The higher focus on specific adoption issues can result in more customised educational packages for operators of SMEs.
- Development of adoption strategies that are better suited to each evolutionary stage of ICT development experienced by managers of SMEs.

- Increased coordination of strategy dissemination by Government agencies, Educational institutions and business support groups thus reducing conflicting advice and streamlining the ICT adoption process for SMEs.
- Further focused research on industries where ICT uptake is minimal and specific strategies are required.

1.2. Significance of Study

A large body of research has been conducted into the adoption of ICT by businesses over the past few decades (ABS, 2000, 2002, 2003). However, many researchers have focused on large firms or specific industries. This research attempts to collate information on ICT usage levels pertaining to regional Australian SMEs. This study has attempted to validate a range of theory from contemporary research. A conceptual relationship between components of theory has been derived from existing research in the subject domain. The conceptual framework formulated identifies significant issues considered to have an impact on the levels and usage of ICT within SMEs. This research is significant due to a resistance in the uptake of advanced ICT by owner-operators and managers of SMEs. This research attempts to identify and substantiate the issues impacting this phenomenon.

1.3. Structure of the Thesis

This thesis contains six chapters each addressing a specific part of the research process. The introductory chapter gave a general summary of the issues involved in the research subject and attempts to conceptualise the issues in a framework. From the conceptual framework the propositions and related hypotheses were established.

The second chapter reviews the literature relevant the research. Contemporary theories, theoretical frameworks and exploratory research surrounding the subject of SMEs, ICT adoption and levels of usage are considered. From the information gathered in this stage further refinement of the research is developed prior to the preparation of the methodology.

The third chapter discusses in detail the research methodology undertaken to address the research question and test the stated hypotheses. The process involved in developing an effective research process is discussed at length including such issues as the research sample, development and testing of the questionnaire, administration of the data collection process and preparation of the data for analysis.

The analysis of the data is discussed in the fourth chapter. The results chapter discusses the appropriate analysis process for the data. Detailed results are illustrated and indications on the relationships between the variables are highlighted.

The discussion of the results is covered in the fifth chapter of the thesis. The findings from the results are discussed in depth with reference to the original conceptual framework, propositions and relative hypotheses. The final chapter provides a conclusion to the research by exploring the limitations of the study and possible opportunities for further research in the subject.

2. LITERATURE REVIEW

2.1. INTRODUCTION

The review of literature is paramount for the researcher to place the current study in the context of existing knowledge in the subject. Studies surrounding the various aspects of the research question are detailed in this chapter. The nature of the SME in an Australian context is considered. This includes a discussion of how SMEs in Australia are classified compared to other countries. In the classifications SMEs are differentiated from micro-firms and larger businesses. Managers or owner-operators of SMEs are considered to have a considerable impact to the decision process regarding the uptake of ICT. Issues relating to their role in the low usage of higher end ICT products and procedures are discussed as well. The theories pertaining to the decision making processes, innovation adoption and technology acceptance are described within the context of SMEs.

Influential factors relating to ICT adoption are considered within this chapter. Issues surrounding the levels and type of ICT used by SMEs are considered including two models describing an evolutionary process regarding technology uptake in SMEs. The benefits of adopting ICT is considered including the cost savings and scalability involved by using higher levels of ICT such as Internet Portals and Supply Chain Management. Other issues are discussed such as the impact of resistance to adoption of ICT as well as the strategies being initiated by government and regional authorities.

2.2. Classification of SMEs

The size of the firm in terms of number of employees is normally used to classify Australian SMEs. However, other factors are considered such as independent ownership and operations. Furthermore it is generally the case that a major level, if not all, of the operating capital is sourced from the owner operator. Furthermore there is no doubt that with so much investment in the firm, the principal decision maker is the owner/operator (ABS, 2003b).

The classification of Australian SMEs is diverse compared to international classifications of similar businesses. The ABS has classified Australian small firms employing more than 5 people but less than 20 in such sectors as wholesale, construction, retail and the service sector. In the manufacturing sector the ABS has determined small businesses to be those that employ 5 to 100 employees. Australian medium firms employ less than 200 employees (ABS, 2003d).

The classification f SMEs in other countries can be quite different to those in Australia. In Singapore SMEs are classified as those that employ less than 100 employees and have an annual turnover of less than 15 million Singaporean dollars (Kendall, 2001). Countries such as Canada, the United Kingdom and the United States classify SMEs as employing less than 500 persons (Times, 2000; Wright, 1999). In the United States small firms are classified as employing less than 100 employees; small firms in the U.S.A. would be equivalent of larger Australian businesses (Atkins, 1997). SMEs from other countries should be considered as being completely different to Australian SMEs. There are differences in human and financial resources as the owner-operator/manager spends a great deal of time managing the operations of the firm (Wright, 1999). Studies investigating SMEs in the U.K. or the U.S.A. are investigating different circumstances compared with Australian studies.

SMEs are considered to have unique components that differentiate them from micro-firms and large business. The main focus of this research is to study aspects of SMEs and not those of micro-firms. Micro businesses are those firms that consist of less than 5 employees (ABS, 2003d). Up to 60% of micro-firms are family businesses and therefore inherit management processes that are unique compared to other larger businesses (Harris, Rogers & Tseng, 1999). Micro-firms have been reported to exhibit low levels of innovativeness particularly in such important areas of ICT and training (NCVER, 2001). The importance of high level ICT used for global marketing is possibly less important for micro-firms than larger businesses as only 2% of micro-firms are claimed to be exporters (Harris *et al,* 1999).

2.3. Management of SMEs

Within SMEs decisions are often made by one person, which in most cases tends to be the owner-operator or manager. This person is integral to the running of businesses and he/she can positively or negatively affect the performance and the long-term survival of the firm. The decision-maker's personal beliefs and perceptions on various issues can greatly influence organizational practices (Sparrow, 1999). In particular the decision maker's attitudes towards the level of ICT investments and adoption strategies can determine the future survival of the business (Gagnon, 2000).

The decision making process within an SME to some extent can be determined by the personality characteristics related to the decision-maker and whether entrepreneurial traits or administrative styles dominate his/her character set (Sparrow, 1999). The dominance of entrepreneurial traits or administrative styles can affect the decisions made, directions taken and the level profitability for the firm. An administrator is concerned with maximising existing resources, relying on analysis of data and thinking for the medium to long term. Alternatively the style of the entrepreneur has been characterised as looking for short-term gains, maximising opportunities and being intuitive. The traits of the entrepreneur have been identified as having a negative impact in relation to investment, monitoring and planning (Gagnon, 2000; Van Beveren, 2002).

Although small businesses are innovative, they are often unable to fully leverage these innovations to impact on their market share. In contrast, large firms are constantly able to exploit their innovations by minimising the effect of switching costs over a longer period of time and recoup costs through greater sales volume. SMEs usually find the market place difficult, as they sell fewer products. Due to limited cash flow, longer periods for profits are returned from a launch of new products. The cost of selling products may be more expensive for SMEs compared to larger organizations due to the cost of handling payment systems such as credit cards and EFTPOS, thus reducing profit margins on less volume (Fariselli, 1999).

Levels of adoption of ICT across Australia tend to indicate a high potential for growth provided that the barriers to the uptake of high end technology by SMEs can be addressed. The Australian Bureau of Statistics (ABS) published recent details of usage of ICT within SMEs. They found that computers are being used in the running of the business for 79% of micro firms (less than 5 staff), 91% of small businesses (5-20 employees) and 98% of medium firms (21-99 employees). The levels of Internet usage for these were at 65% for micro businesses, 80% for small enterprises and 93% for medium businesses. Furthermore the percentage of SMEs with a web site or home page was significantly less with only 15% of micro businesses, 34% of small firms and 55% of medium enterprises indicating a large potential for the promotion of the adoption of ICT (ABS, 2000, 2003a).

2.4. Theoretical Origins of Innovation Adoption

The manager's decision process regarding investment is a vital issue and has been likened to the 'consumer decision making processes' as the manager is generally the sole decision maker when considering business investments (Gagnon, 2000). Early research in adoption theory established the foundational concepts of innovation and adoption. Zaltman's (1971) research highlighted issues surrounding an individual's perception of a new or different innovation, a person's perceived use of the new innovation and how a person enacts on attainment of the innovation.

Rogers (1995) developed a Model of Innovation Decision Process in which a step approach is used to represent the decision process enacted by a consumer (Figure 2.1). Each level of the process can be considered similar to the actions carried out by an operator of a SME while evaluating an innovation. The model constitutes a five-stage process whereby an individual may attain knowledge of an innovation. The manager (or consumer) initially becomes aware of the innovation and is attracted to it on the basis of socio-economic advantages, personality enhancements or increases in communication abilities. Further persuasion is actioned on the basis of

perceived advantage, compatibility, complexity, trialability and observability by the individual. From this point the decision to adopt the innovation is assessed resulting in a decision ranging from adoption, delayed adoption, discontinuance and rejection. Should adoption be considered, the tasks of implementation and confirmation are actioned, which are illustrated in Rogers fourth and fifth stages in the model (Kendall, 2001).

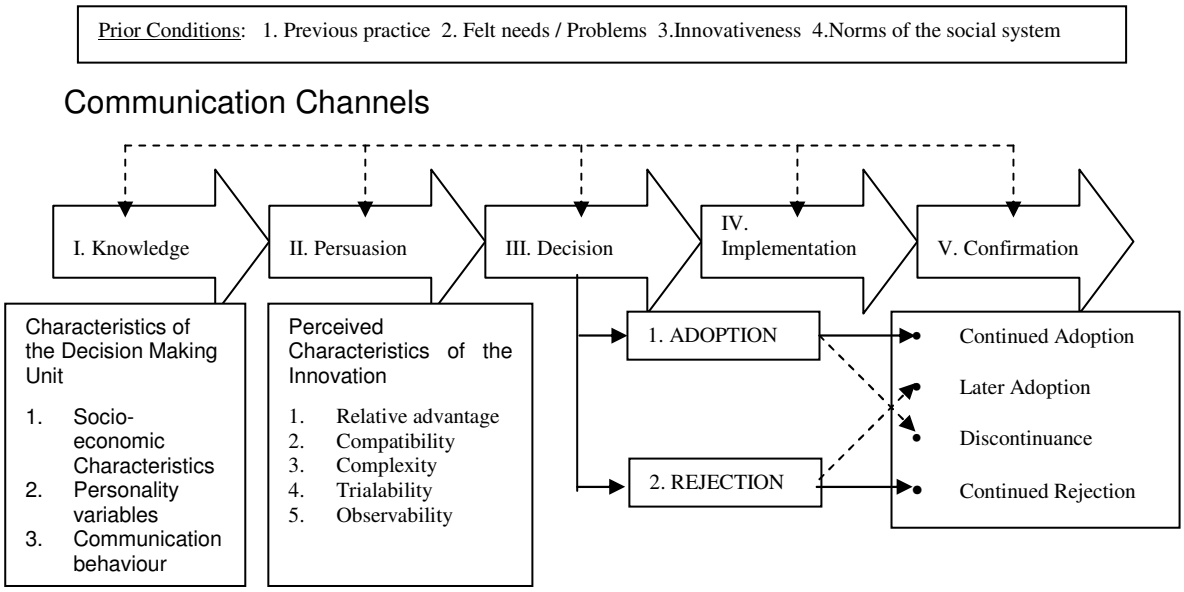

Figure 2.1: The 5 Stage Model of Innovation Adoption Process (Rogers, 1995)

A recent study of ICT adoption in the Australian SME context has applied Roger's model in researching slow adoption of electronic commerce (Sathye, 2001). An initial focus group formed the basis of a qualitative study from which a questionnaire was developed. A mail survey was distributed to 2000 SMEs across Australia covering questions on the 5 characteristics required for the adoption of innovations. A response rate of 19% produced a body of data that has established new findings regarding ICT adoption by SMEs. Positive relationships were established between ICT adoption and the compatibility and the relative advantage of the technology. The complexity of ICT was considered to be a barrier to adoption. However the results of the study identified a positive effect to adoption. The research identified that smaller SMEs were generally quicker to adapt to changes in the market than larger SMEs (Sathye, 2001).

There has been a vast quantity of research specific to the adoption of technology resulting from early adoption theories. One of the most influential theories is the Technology Acceptance Model (TAM) developed by Davis (1989) and also Bagozzi *et al* (1992). The TAM measures two technology acceptance measures of 'ease of use' and 'usefulness'. The model focuses on behaviour elements such as the assumption that when a person forms an intention to act they will then feel free to act without any limitations (F. D. Davis, 1989). Perceived usefulness has been defined as being the degree to which a person believes that using a particular system will enhance performance. Ease of use is defined as being the degree to which a person believes that using a particular system will be free from effort. Several studies have repeatedly tested the TAM and have successfully established the validity, reliability and consistency of the theory (Adams, Nelson & Todd, 1992; Hendrickson, Massey & Cronin, 1993: Segars, 1993).

Further testing of the TAM in relation to ICT adoption has been used to study use of agent technology in an Australian workplace (Goldschmidt, 1999). The study was conducted with librarians and university undergraduates measuring their attitudes towards ICT. The researchers gathered quantitative data on the respondent's familiarity and experience with Internet–based information agents for searching information. A questionnaire was developed from the TAM measuring perceived ease of use and perceived usefulness (Goldschmidt, 1999). The results supported Davis's TAM as the perceived ease of use of ICT and changes in their after prolonged use of the technology (Goldschmidt, 1999).

The adoption of innovations by SMEs often requires policies and procedures within the firm to be reviewed (Lissoni, 2000). The concept of technology diffusion within enterprises has produced various models. The classic model supports the concept of immediate diffusion of technologies. However the realistic basis of innovation adoption is a gradual change and may even be a sequence of incremental innovations, especially when the practice of adopting intermediate technologies is considered (Jensen, 2001; Lissoni, 2000; Tan, 1994).

2.5. Factors influencing ICT adoption

Contemporary studies relating to adoption of technology in SMEs have identified various factors that have had an impact on a manager's decision process when planning to adopt new technologies into the business. A recent conducted by Rashid (2001), collated a number of studies conducted within Australia and New Zealand and attempted to classify the factors found into four distinct categories. The resulting theoretical framework classified the factors as being a technological, organisational, environmental and the individual's influential aspect of the firm (Rashid, 2001).

The adoption framework is illustrated in Figure 2.2. The four factors within the framework interplay within a SME and serve as an evaluative structure to determine the propensity of innovation adoption specific to the firm, thereby directly impacting the decision process of the manager (Rashid, 2001). The technological or innovation factors include issues such as the relative advantages of the innovation, the complexity, compatibility, cost and the image surrounding the innovation. Organisational factors influencing adoption cover such aspects as the size of the firm, the quality of the existing information systems, the intensity of the information being processed, the level of specialisation of the firm as well as the level of support of adoption originating from management. Environmental factors impacting adoption include the pressure from competition and within the supply chain, public policy as well as the role of government. Individual factors affecting innovation adoption according to Rashid's framework incorporate the decision maker's innovativeness as well as their knowledge of technology.

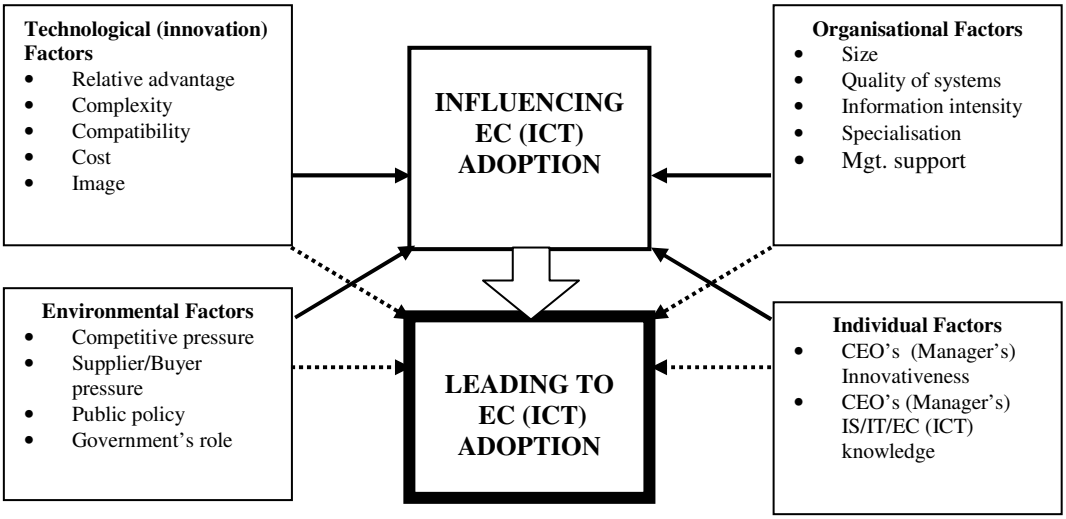

Figure 2.2: A framework for EC (ICT) technology adoption by SMEs (Rashid, 2001)

A very recent exploratory study into Australian SMEs and ICT adoption has also created a theoretical framework with a range of factors that can influence the decision process (Akkeren, 2003). The combined qualitative and quantitative study focused on the needs, uses and adoption activities of SME owner-operators and managers in relation to use of mobile ICT products and services. A conceptual framework was developed from the results gathered from the research and illustrated similar factors to Rashid's framework. As seen in figure 2.3, although the framework draws on similar characteristic classifications as Rashid the explanation of how the factors are effective in the process may be clearer to understand with the definition of the availability of applications being a mechanism for adoption (Akkeren, 2003).

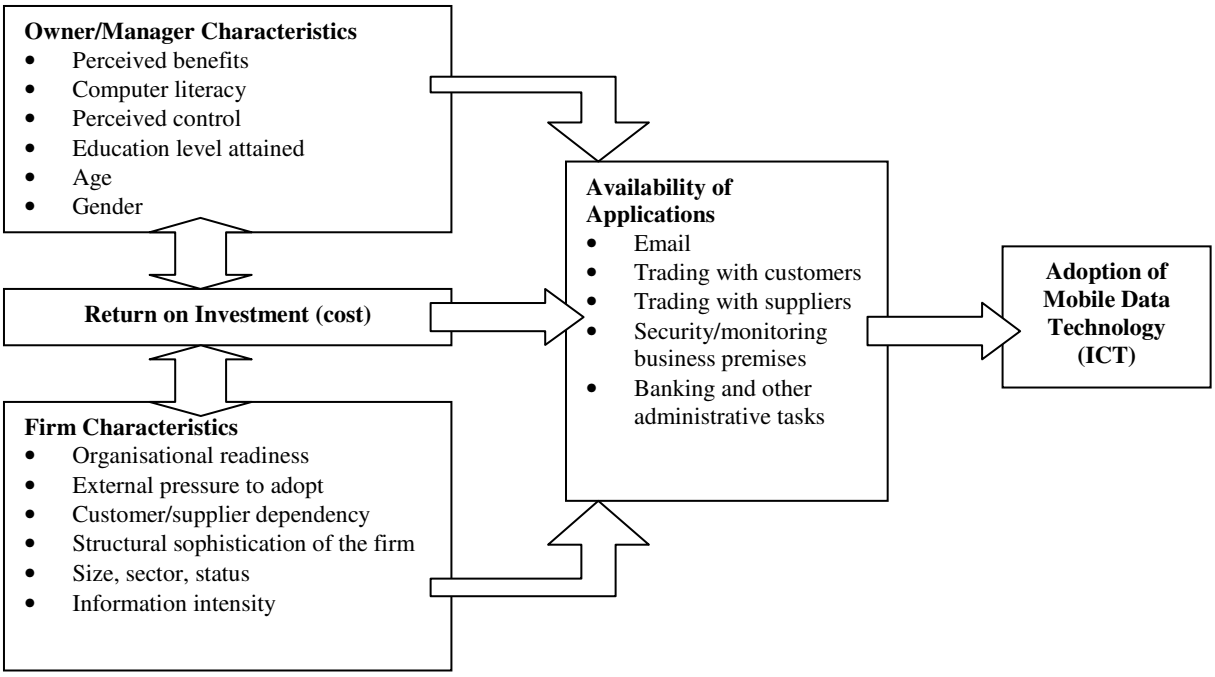

Figure 2.3: Factors impacting SME adoption of Mobile Data Technology (ICT) (Akkeren,

2.6. Evolutionary Innovation Adoption in Australian SMEs

The levels of ICT adoption by SMEs can be addressed in terms of an evolutionary process. The simplest and easiest ICT tools are best promoted first, thereby developing positive attitudes to technology and cultural acceptance to more complex forms of ICT (CEC, 1996). The evolution of e-business for firms has been described in the literature illustrating the transition from email use, website, online store, then to a fully digitised e-business identified as reformation (Earl, 2000). A SME might progress from developing a static website (brochure ware) on the Internet to selling on the Internet and eventually grow into a fully transactional enterprise (Booty, 2000).

A 6-stage framework (Figure 2.4) has been developed that illustrates the path taken by businesses in the evolution to an e-enterprise (Earl, 2000). The first stage incorporates external communications with the development of a home page, the second stage of internal communication occurs with the use of the firm's Intranet, the third stage involves e-commerce and is reflected by the buying and selling online, the development of the fourth stage of e-business involves the adding of key capabilities of the firm. The fifth and sixth stages

have yet to be realised by most firms involved in progression to digitisation. Stage five, e-Enterprise, incorporates the concept of decision by wire, the sixth stage highlights the transformation of the business into the fully digitised enterprise whereby differentiation of an 'E' business is omitted entirely (Earl, 2000).

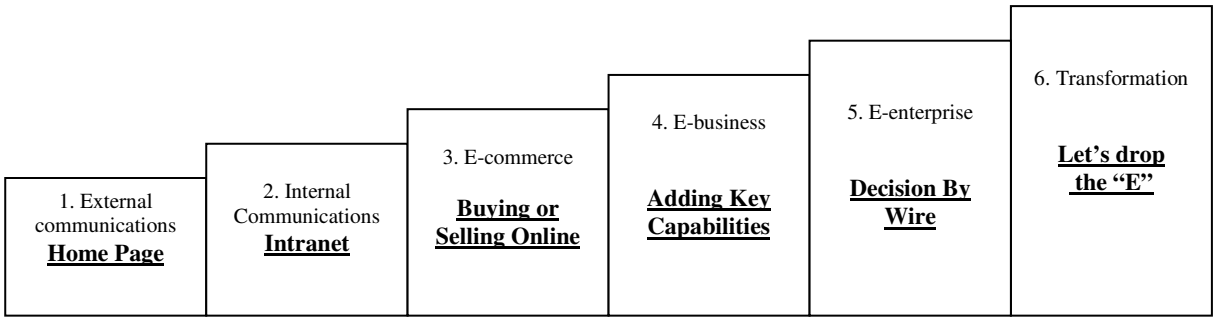

Figure 2.4: Evolving the E-enterprise (Earl, 2000)

The theoretical framework Earl has proposed is based on a linear evolution which, as this author argues, is not necessarily always the case for business operators. The step approach fails to explain activities of massive ICT investment that may be experienced such as the adoption of a complete online store from nothing by contracting a web developer. Although Earl is successfully able to explain the general rule of an evolutionary process the framework is not considered to be robust.

Burgess and Cooper (1998) conducted research on the Internet commerce activities in the metal fabrication industry and in doing so developed the Internet eCommerce Staged Model. The 3 stage model addresses the issue of linearity that Earl's framework is criticised for. The first level considers the use of ICT for promotion purposes by using a static web site. The ICT used in the 'Promotion' stage focuses on basic marketing of the business and its products and services. The second or 'Provisioning' stage considers all aspects of ICT the give value to the first stage. ICT activities such as email, FAQ, online enquiries and other value-added links and information are offered. The third stage, 'Processing', encapsulates further value adding activities with the adoption of online sales, ordering and payments as well as fulfilment status enquiries and links to distributors or warehouses. The

activities identified at each level are not exhaustive and is only used as an example of what could be available.

Further refinement of the Model of Internet Commerce Adoption (MICA) was carried out in a study of manufacturing SMEs in industrial suburbs of Melbourne and Sydney, Australia (Lawson, 2003). The resulting findings have been published very recently and serve as the most recent exploratory research in the area of SME ICT adoption. The study examined the level of progress the manufacturing industry had made in terms of Web presence since 1998. The comprehensive study evaluated the status of 170 SMEs in terms of the level of ICT activities according to the 3 stages in MICA (Lawson, 2003). Figure 2.5 illustrates the MICA from both studies (Burgess, 1998; Lawson, 2003).

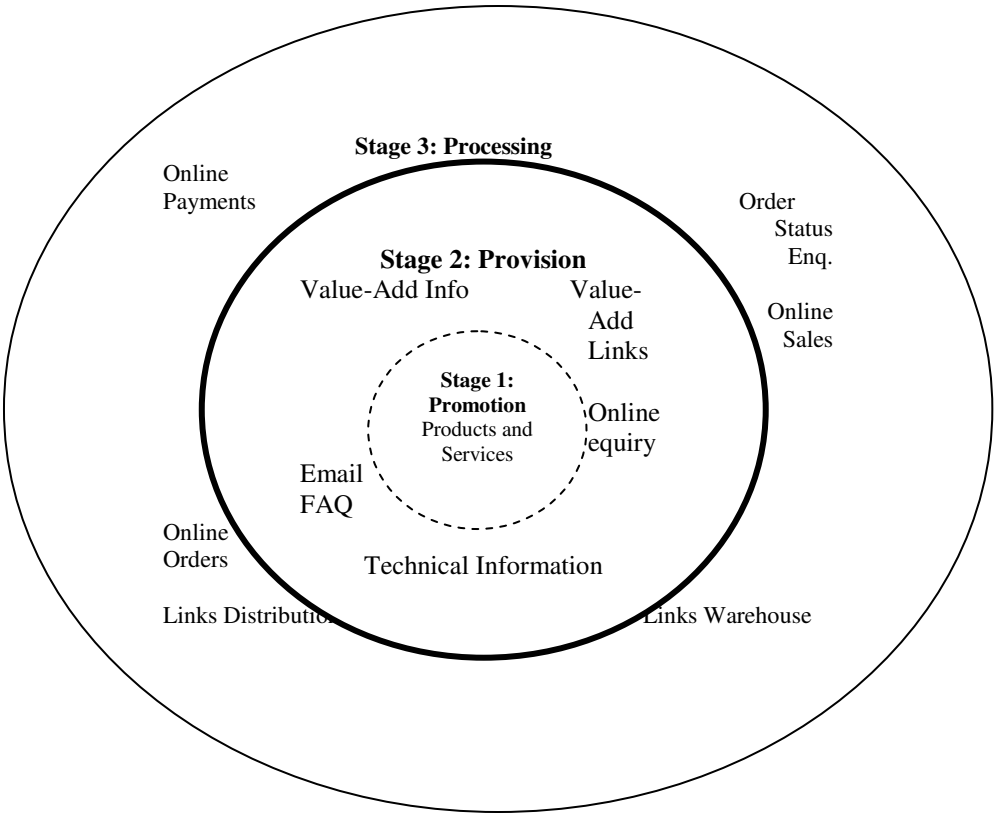

Figure 2.5:
The Model of Internet Commerce Adoption (MICA) for manufacturing SMEs (Lawson, 2003)

As SMEs move up from Stages 1 to 2, the effort taken to add extra provisioning to a firm's web site is considered to be relatively easy and is

illustrated by a broken line. A hard barrier between Stages 2 and 3 has been identified by Lawson (2003) and is identified by a bold line. The authors of the research state that issues such as businesses practices require reviewing prior to embarking on further processing ICT activities (Lawson, 2003).

Research suggests that Australian SMEs are lagging behind similar businesses internationally regarding uptake of technology, thus placing themselves in a less competitive position (Simpson, 2002; Times, 2000). The products and processes adopted by SMEs at an earlier stage can provide an increased competitive edge and simultaneously create an environment that is conducive to further innovations and faster evolution (Damanpour, 2001). The adoption of ICT in the early stages of trading not only assists in the more rapid development of the firm, but also allows the firm to compete with medium sized firms while remaining small (Bridge, 1999).

2.7. Benefits of ICT Adoption

The online component of a business can be leveraged to deliver effective marketing, value added services to customers and market reach. This can result in the positive networking with other business, government as well as consumers alike (Haynes, 1998). Supply chain management has been seen as one of the primary benefits to the incorporation of ICT into SMEs. Costs are driven down as business relationships and partnerships, both developing and entrenched, are reinforced (OECD, 2000). Recognition of the benefits of adopting ICT throughout the business by SMEs, can positively reinforce the concept and possible evolution of the firm toward a truly digitised enterprise where ICT co-ordinates and supports all business processes (Varadarajan, 2002).

Issues that lead operators of SMEs to consider the adoption of ICT into their businesses may also result from a defensive reaction to competitors who have already adopted technology. This defensive reaction is often an attempt to address retention of market share. Early adopters are at an advantage due

to taking a lead in adopting advantageous technology in their market niche, therefore forcing competitors to catch up (OECD, 2000).

The Internet is particularly beneficial to SMEs due to the level of scalability that the technology is capable of delivering. The promotion of products, services and transactions to customers and consumers can be increased with little impact to service quality (OECD, 2000). The advantages of scalability would become evident due to a reduction of the need to re-invest in different technology as the firm grows. Furthermore the use of Internet technologies is not platform specific so the risk of being locked into a proprietary system is reduced (Booty, 2000).

To maximise the full extent of benefits that result from ICT adoption, firms need to formulate a timeline and an effective strategy to minimise disruption to social and process aspects of business practices. The best practices of implementing such strategies will result in positive uptake in all levels of the business thus fully realising the advantages of digitising earlier (OECD, 2000). The benefits to adopting firms also provide a substantial threat to non-adopting firms and therefore creates an increased need to adopt to remain competitive (Varadarajan, 2002).

2.8. Business to Business (B2B)

The evolution of SMEs into fully digitised businesses involves a transformation that is beyond the scope of the capabilities and aspirations of most firms. The automation of transactions removes them from view and direct control of the operator. The common business interactions between buyers, sellers and suppliers is less visible to the daily processes as carried out by SMEs (Parasuraman, 2002). This concept offers up a new range of concerns for the managers of SMEs regarding trust, legal implications, competition, security and relationships.

Financial gains are the most obvious advantage of automated transaction processing. The supply chain management benefits to SMEs include more streamlined administrative processes particularly in the fields of taxation, invoicing and human resources. Increases in B2B interactions will create networks of association where knowledge is communicated interactively both vertically and horizontally across the supply chain (Van Beveren, 2002).

The most effective element of ICT considered for SMEs to be involved in is the Internet Portal. The concept of the portal is the online equivalent of traditional Industrial District or Marketplace in the "bricks and mortar" world and would be of benefit to SMEs in terms of relationships, leveraging resources, the sharing of ideas and formulation of strategy (Van Beveren, 2002). Furthermore an increased adoption of portals in regional Australia would eventually create a critical mass that would deliver added value to associations incorporated within the portal and increase the level of competition directed to larger businesses from the experienced synergies (Braun, 2003).

Collective benefits for SMEs would include the adoption and maintenance of technology including online payment systems, the adoption or development of education, as well as the creation of channels of communication between SMEs, Government and the large organizations. The development of production networks would link processes and share in the maintenance of finance as well as research and development. Support services activities such as legal, insurance and human resource functions could be afforded by associated SMEs in the portal environment (Fariselli, 1999).

The promotion of synergetic strength in numbers, the promise of critical mass and the eventual competitive leverage against larger firms should be considered as an incentive for early adoption and involvement in

portal development by SMEs. Portals and B2B activities in general have not been positively accepted despite the advantages of early adoption (NOIE, 2001). SMEs involved in portal arrangements could provide competitive leverage opposing larger firms and therefore establish better contractual arrangements with corporate enterprises (OECD, 2000).

2.9. Resistance to Adoption

Although many SME administrators understand the benefits of ICT, some consider it to be irrelevant to their operations and are demonstrating significant levels of resistance to adoption. Due to time constraints experienced by managers of SMEs, often they are not fully informed about ICT concepts and the strategies necessary for positive integration into the firm (eCom-Adviser, 2000). Issues such as perceived investment recovery, comfort with traditional forms of supply management and selling, perceived levels of risk, security concerns and training costs are cited as being serious barriers to uptake of ICT by SMEs (Kendall, 2001). Many firms see IT as not being part of the core business function and evade the use of technology as it provides a distraction to delivery of the business products and services (Dagdilelis, 2003).

The perception of risk involved in adopting ICT is a major issue for managers and owner-operators of SMEs; disruption to the business processes and relative position in the market are factors that many administrators have considered to be too great (Sparrow, 1999). The complexity of providing secure payment systems and privacy of personal and company sensitive information are barriers to adoption. This is compounded by the relative general lack of knowledge of ICT by operators of SMEs (OECD, 2000).

The global reach of ICT systems raises issues regarding international laws and in particular how effective those laws are at maintaining competition and

fair-trading. As a result there is limited protection afforded to SMEs, particularly regarding e-business practices. This is demonstrated by the difficulty that government bodies have with policing existing international trade laws (Fariselli, 1999).

2.10. Strategies to adoption

The successful implementation of ICT into SMEs requires the development of IT strategies, business plans and revenue forecasts which are necessary for managers to maintain focus on the firm's performance and survival (Larsen, 2001). During the planning phase the goal for implementation is for the technology to focus on the delivery of service and compliment normal business procedures, not overpower and obscure core business activities (Booty, 2000).

The primary issue for the successful adoption of technology is education and training of managers and employees. Education packages have to be succinct and to the point, as time and cost are critical factors for SMEs. The awareness of ICT must be heightened and demystified, terminology needs to be clarified and strategies must be clear and simple. Demonstrations have been suggested to deliver a 'hands on' approach for operators of SMEs and become familiar with the more commonly used methods of ICT (CEC, 1996; Lissoni, 2000).

Evolution of the SME forces change from a product-centric enterprise to a relationship-centric firm and requires a fundamental rethink for management (Fariselli, 1999). Issues such as collaboration and trust with competitors and customers, relations with government on an electronic level and synergies created with agents across the market are central to change (Braun, 2002). The collective social capital attained by a network of relationships can be contained in the physical representation of a portal, as the portal evolves and the critical mass is realised then the full impact of competitive leverage will become apparent (NOIE, 2001). The harnessing of existing formal commercial networks and informal association networks will assist in the

adoption of online relationships and may become the catalyst to renewed interest in ICT adoption (Braun, 2001, 2003).

Strategies specific to Regional Australian SMEs

SMEs in regional and rural Australia require added strategies to promote information and allow adoption of ICT. The process of ICT evolution within a firm is an important factor as simple usage of e-mail may create advantages for some enterprises yet other businesses may have direct benefits from incorporation of a fully digitised strategy enabling trading in global markets.

The introduction of broadband communication infrastructure is a significant issue regarding small and medium firms located in geographically remote areas of Australia. Communication systems have not been upgraded sufficiently in many locations around the country to provide the system network backbone, which Internet based services require. Nominal dialup speeds are low for many areas in rural and regional Australia and not conducive to optimum e-business processes (Braun, 2002).

Government Strategies for SMEs

The Australian Government's support in ICT adoption strategies for SMEs has highlighted many challenges. Perceptions of low returns on investments and high start-up costs have impacted negatively on SMEs willingness to adopt ICT. The Government therefore has invested in the development of strategies for SMEs to be encouraged in ICT uptake (NOIE, 2002a). The government has recognised that the implementation of higher levels of technology by SMEs will result in the minimising the barriers of time and distance to world markets and greatly increase value of business supply chains (Rashid, 2001).

In 1996 the Australian Federal Government prepared a strategy for the introduction of electronic commerce to SMEs. Recommendations included the increased uptake of ICT, the creation of a committee to identify issues to co-ordinate electronic commerce and appointment a group of industry trainers. Other initiatives included an investigation for the creation of resource centres,

the creation of pre-packaged solutions and enlisting the Rotary, accounting and other business support groups to promote ICT adoption (CEC, 1996). Furthermore, strategies were promoted to increase opportunities for SMEs to trade with Government departments via Business-to-Government (B2G) systems.

The initiative of B2G processes has been promoted as having a positive effect in the business interactions between Government and SMEs. The strategies have been delivered in two main areas; an increase in uptake of ICT and in particularly high-end payment and procurement systems as well as a focus on access for SMEs to information and skills such as business models specific to online businesses. Furthermore a single point of contact for SMEs to interact in B2G trading has also been created and involves strategies to increase to level of SMEs supplying to government procurement requirements (NOIE, 2002b).

The use of educational and demonstrational material to promote the practical benefits of ICT may assist business operators in deciding to take on the technology. Developers of such packages must are able to relate and empathise with SMEs in order to successfully promote their message. Current government e-business strategies include a timeline to deliver the Pathways Guide; the guide will provide a non-technical framework for SMEs to identify and integrate tools and techniques for e-business into their current business profile. Other strategies being delivered include e-business enablers, e-security, frameworks for business cases and broadband adoption programs (NOIE, 2003a).

Some of the most recent government initiatives have been created to advise SME managers of solutions and involve them in strategies for effective planning toward successful ICT adoption. One of the most comprehensive resources available is the ‘e-businessguide’ developed by NOIE and launched in June 2003. The site aims at promoting a step approach toward conducting e-business and covers several broad functions including understanding,

planning, building, protecting, managing and improving ICT products and procedures (NOIE, 2003b).

2.11. Conceptual Framework of ICT Adoption by Australian SMEs

From the literature a conceptual framework has been developed to understand the levels of adoption by SMEs and attempt to explain the factors that may influence such adoption. A relationship is considered to exist between the decision processes taken by managers, influential theories relating to the unique makeup of SMEs and the level of ICT usage within SMEs. The conceptual framework has been formulated from combining several factors from extant theories that are considered to be involved in the relationship and are discussed at length in the Literature Review. Figure 1.1 illustrates the conceptual framework regarding the phenomena.

The framework components are supported by various theories and theoretical frameworks. The contributing influential factors are provided from Rashid's (2001) adoption framework and supported by Akkeren and Harker (2003). Four distinct factors were classified by these studies; Organisational, Environmental, Individual and Technological. The planning and adoption component identifies the contribution of the theories on innovation adoption and technology acceptance developed by (F. D. Davis, 1989; F. D. Davis, Baggozi, R. P., and Warshaw, P. R., 1989; Rogers, 1995; Sathye, 2001). The third component of the conceptual framework identifies the levels of ICT being used in SMEs. Stage 1 ICT is identified by the most basic of technology for business use such as email and a static web site. Use of higher levels of functionality ICT is identified in Stage 2 while in Stage 3 the technology is

integrated into businesses processes and extends the functionality of the firm. Research into the types and complexity of ICT has delivered a body of work encapsulating this issue (Burgess, 1998; Earl, 2000; Lawson, 2003).

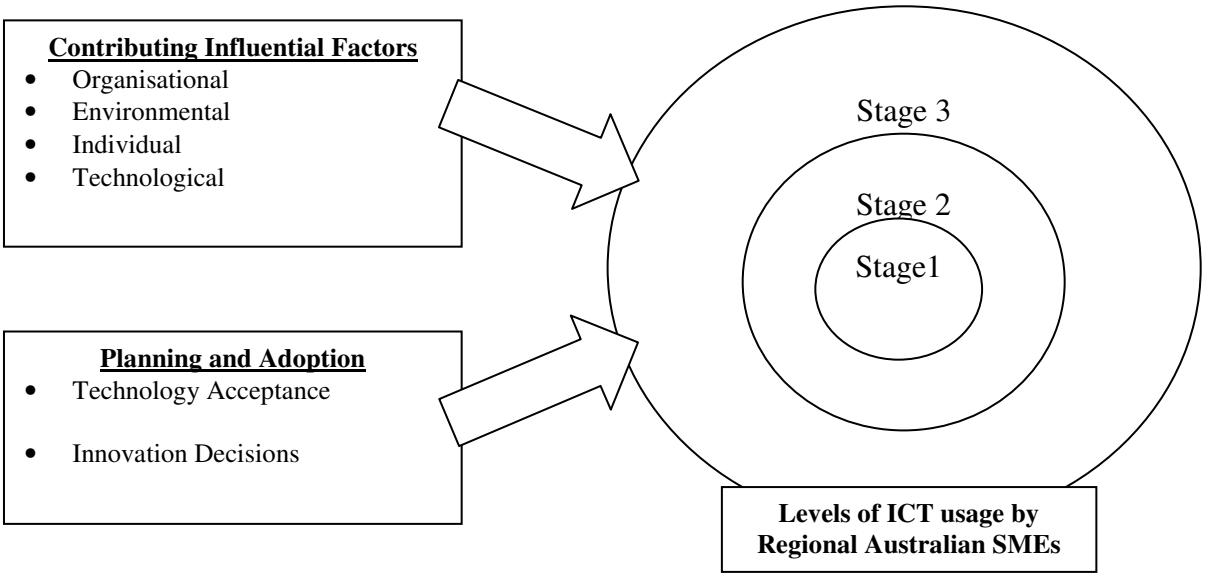

Figure 2.6: A conceptual framework relationship between the manager's decision processes, influential factors unique to SMEs and the level of ICT usage within SMEs.

From the framework developed four propositions have been formed along with 10 hypotheses relating to claimed relationship:

P1: Technological Factors have the major influence on decisions made by Owner-operators/Managers of SMEs during adoption of ICT products and services from Stage 1 to Stage 2.

> **$H1_o$:** SMEs involved in using the *Internet for Purchasing* have equal group means for the set of independent variables compared to the SMEs not involved in using the *Internet for Purchasing.*

$H1_a$: SMEs involved in using the *Internet for Purchasing* have different group means for the set of independent variables compared to the SMEs not involved in using the *Internet for Purchasing.*

P2: Individual Factors have the major influence on decisions made by Owner-operators/Managers of SMEs during adoption of ICT products and services in Stage 2.

$H2_o$: SMEs involved in using the *Internet to Publish a Catalogue* have equal group means for the set of independent variables compared to the SMEs not involved in using the *Internet to Publish a Catalogue.*

$H2_a$: SMEs involved in using the *Internet to Publish a Catalogue* have different group means for the set of independent variables compared to the SMEs not involved in using the *Internet to Publish a Catalogue.*

P3: Environmental Factors have the major influence on decisions made by Owner-operators/Managers of SMEs during adoption of ICT products and services from Stage 2 to Stage 3.

$H3_o$: SMEs involved in using the *eGovernment Systems* have equal group means for the set of independent variables compared to the SMEs not involved in using *eGovernment Systems.*

$H3_a$: SMEs involved in using the *eGovernment Systems* have different group means for the set of independent variables compared to the SMEs not involved in using the *eGovernment Systems.*

P4: Environmental and Organisational Factors have the major influence on decisions made by Owner-operators/Managers of SMEs during adoption of ICT products and services in Stage 3.

$H4_o$: SMEs involved in using *Online Payment Systems have* equal group means for the set of independent variables compared to the SMEs not involved in using *Online Payment Systems*.

$H4_a$: SMEs involved in using the *Online Payment Systems have* different group means for the set of independent variables compared to the SMEs not involved in using the *Online Payment Systems.*

$H5_o$: SMEs involved in using *Secure Access and Transactions have* equal group means for the set of independent variables compared to the SMEs not involved in using *Secure Access and Transactions*.

$H5_a$: SMEs involved in using the *Secure Access and Transactions have* different group means for the set of independent variables compared to the SMEs not involved in using the *Secure Access and Transactions.*

The hypotheses stated in this section have been empirically evaluated at length. The following dissertation discusses in detail the formulation of the research and the subsequent testing process to validate the propositions.

2.12. Conclusion

Managers and owner-operators of SMEs are challenged by several factors when planning and actively adopting ICT in order to enhance their business. The literature described in this chapter illustrates the issues relating to the decision process, the levels of ICT adopted by SMEs and the hurdles faced when attempting to adopt the technology. Several studies and theoretical frameworks were described to explain the phenomena facing managers of SMEs. The conceptual framework illustrated in Chapter 1 has been developed on the basis of previous research on the topic in order to offer a clearer understanding of levels of ICT uptake by SMEs. The following chapter

outlines the methodology employed to operationalise the framework and test the propositions and hypotheses.

3. METHODOLOGY

3.1. Introduction

The aim of this chapter is to describe the research design and data collection phase of this study. The methodology outlines the procedure for collecting and preparing the data for analysis. The statistics obtained from the analysis would then be used to study the relationships between the factors influencing SMEs in ICT adoption.

The main objective of this research was to study the issues affecting adoption of ICT into regional Australian SMEs. From the literature influences such as business size, age of the business, industrial sector and revenue have been identified as being significant contributors to the level and type of ICT being used. Furthermore influences such as the manager's experience in ICT, the trust in the firm's online traders and advice gained by business partners are considered as having considerable effect to adoption rates in SMEs. Other issues such as competitive leverage by other firms by adopting ICT is considered to be a significant predictor of adoption strategies by managers of SMEs.

3.2. Type of Study

The study of ICT adoption by SMEs required the selection of a methodology in which data is treated in a manner that is scientifically recognised. A causal approach to the research question was required thus delivering an appropriate research process.

Quantitative research is generally used as part of formal or causal research. Quantitative research normally uses structured research tools to gather data. Samples are normally established that are representative of the population being studied. Reliability, repeatability and objectivity are key components of causal research (Joppe, 2003).

Causal research methods are used to determine whether a cause and effect relationship exists between variables. In order for causality to be determined the variable considered to be causing the change has a measurable effect on other variables. Due to the complexity of the research other factors cannot be discounted in having some effect on causal relationships. This may include the attitudes and motivations of the respondent as well as other biases from the researcher (Joppe, 2003). Furthermore relationships between variables can be determined, proven and predicted (Malhotra, 1996).

The data collection described in this chapter is identified as primary research. In quantitative research techniques, primary research activities may enlist observation or direct communication methods such as telephone surveys, self administered questionnaires or person-to-person interviews (Joppe, 2003).

3.2.1. Research Design

During the development of the research a decision was made to use telephone survey techniques instead of alternative methods such as mail-outs or interviews. Telephone surveys are considered to be an inexpensive and timely method of survey delivery. Surveys conducted via this method are also considered to be efficient in eliminating bias and sample errors compared to other methods such as mail based or face to face interviews(Joppe, 2003).

The reach of telephone methods enables researchers to contact respondents over large distances (Cavana, 2001). The added benefit of conducting surveys over the telephone includes efficient data capture. Responses from the interviewed person can be entered into a database immediately and therefore reduce the potential for errors when data is transposed from paper-based response sheets to data analysis tools. This issue was circumvented by enlisting the Computer Assisted Telephone Interview (CATI) system during each interview.

Bias originating from the interviewer can be minimized effectively, especially if the interviewer has knowledge in identifying actions that would impact

negatively on the collection of data in this study. The execution of correct procedures can also be monitored by supervisory personnel easily to deliver the best quality survey results (Joppe, 2003). The impersonal communication exchange between interviewer and respondent can be of benefit when asking questions that require sensitive information from the respondent.

Despite the benefits of telephone surveys there are several limitations. Telephone surveys are limited in that the survey must be kept relatively short, usually less than 15 minutes otherwise survey cancellation or refusal to participate by the respondent is likely to occur. Telephone surveys often require that questions be formulated in a way that enables respondents to answer quickly and give limited optional answers due to the lack of visual or body language queues (Joppe, 2003).

3.2.2. Sample Design

Successful sample design begins with a set of clear objectives cognisant of the aims of the survey. The decision to conduct a survey was evaluated on the basis of effective data return rates and efficient administration procedures (StatCan, 2003). A sample allows researchers to draw conclusions about an entire population by examining part of the population. Results from the sample, if correctly selected and questioned, can be then applied to the population as a whole (StatCan, 2003). Effective design of the sample is imperative to obtain successful results otherwise generalisations about the sample made cannot be claimed as being representative of the population as a whole.

The sample design is established under the following guidelines:

- Survey population – what population is being surveyed?
- Survey time frame – how long is the survey going to run for?
- Survey unit – who is the respondent, what capacity do thy have?
- Sample size – what portion of the total population is being sampled?
- Sampling method – How is the sample going to be actioned?

The total population being studied is considered to be the target population. The target population is evaluated and described in terms of the unique characteristics that identify them (Wilkinson, 2000). Traditionally the target population is identified on the basis of the nature of the data, the geographic location, a reference period and other characteristics including socio-demographic information (StatCan, 2003). For the purposes of this study the target population is the prime decision maker within SMEs that are located in the Central Highlands region of Victoria during September and October 2003.

After the researcher has established such issues as the objectives, definitions and guidelines, the survey plan is developed on the basis of sample design, estimation technique and measures of precision. The sample design defines how the collection of the sample will be addressed. Estimation techniques are used to determine the activities required to extrapolate the results to the total population. Measures of precision are monitored and can address sampling errors and how the errors will be measured (StatCan, 2003).

Early determination of an accurately identified sample is crucial to gathering the right information from respondents who have knowledge in the domain of interest. This in turn enables the accurate testing of the hypotheses and delivering credible results. Information on the characteristics of SMEs, levels of ICT adoption and the manager's perceptions on adoption of ICT are required from specific individuals within the organisation. Targeting the appropriate person to provide the required information is crucial to the success of the research and much effort was made to gather their opinion on such issues.

The owner-operator or manager of SMEs are regarded to be the primary decision-maker in such firms; their personal beliefs and perceptions on various issues can greatly influence organizational practices (Sparrow, 1999). Their attitudes towards the level of ICT investments and adoption strategies can determine the future survival of the business (Gagnon, 2000).

The importance of targeting a specific individual within an organization cannot go unstated. The manager or decision maker was selected to provide important information on a range of facts and experiences associated to the adoption of ICT within the business. The technique of targeting an individual within the organization is referred to as the key informant approach. The key informant is the person identified as having in depth knowledge of the technology used as well of decisions made on the basis of technology fit (Pelto, 1978). Essentially the principle of targeting the key informant enables the effective delivery of specific information on many topics. Key informants are advantageous to surveys as they provide the insiders view, they provide a depth of information and permit clarification.

The manager or decision maker is an appropriate source of information for the survey as continuity throughout the survey process is enhanced. The position within the business structure is relatively similar across industries with regard to decision making. Targeting the manager provides a non-random selection of survey respondent therefore minimising response errors and interviewer bias. The key informant within a telephone survey context may provide insight into specific issues surrounding key questions in the research. The added effect of anonymity generated in a telephone survey ensures the key informant would feel more comfortable with answering questions more truthfully.

Within the questionnaire the interviewer was instructed to request to speak with the owner or operator of the firm. Questions within the survey were designed to be answered by the key informant and therefore created a consistency of responses.

Survey Population

The population of the respondents needs to be carefully determined as this will determine the level of accuracy within the survey results. Due to limitations of the research budget or possible geographic constraints sometimes the survey population needs to exclude various potential

respondents. This is particularly important with face-to-face interview type survey delivery but may be less of a barrier to telephone and email delivery of the questionnaire. After some elements have been excluded then the remaining population is considered to be the observed population. The target population is that which the researcher would like to be observed, while the observed survey population is what can be observed (StatCan, 2003). If any elements of the target population are excluded then justification would need to be given, otherwise the results may be skewed due to the omission of survey data from those respondents. It is therefore advantageous to attempt to retain as much as the original target population as possible to provide accuracy in reporting.

The ABS regional statistics for the Victoria indicate the total number of business operating within the Central Highlands totals 5448 firms (ABS, 2002). To enable simplicity in verifying a representative sample the statistical boundaries defined by the ABS were adhered to. The sample population included businesses from such sectors as Manufacturing, Construction, Retail, Property and Business, Health and Community, Agriculture (hunting, fishing, forestry), and other businesses.

Sampling Frame

The sampling frame defines the tool to gain access to the population and is established either on the basis of an available list or based on geographical boundaries. The list frame essentially is a list of contact details for individuals, institutions or businesses. The area frame defines geographic boundaries then identifies the target population within the area. The use of geographic boundaries is also determined as being an indirect method of using a list as usually a list is established after the area is considered (StatCan, 2003). When considering an effective frame certain issues need to be addressed. The completeness of the list needs to be established, duplicates and entries not appropriate to the sample should be removed. The timeliness of the list is very important as individuals and businesses can be transient and therefore cause issues in the delivery process.

The sampling frame developed for this research was established from listings in an electronic version of the Australian Yellow Pages telephone directory for the Central Highlands region of Victoria. The particular software package used was Marketing Pro and enabled the development of listings for the sampling frame (DtMS, 2002). Marketing Pro allows listings to be generated on the basis of business name, business activity, city, address, phone number, ad size, state, region, directory, post code, industry codes (ANZSIC, SIC, ASIC) and mobile phone number. A listing of postcodes was developed that closely matched the ABS regional format for regional statistics and included the following post codes: 3460, 3350, 3351, 3352, 3353, 3354, 3355, 3356, 3357, 3360, 3361, 3363, 3364, and 3370. The post codes are all within a 40 kilometre radius of the City of Ballarat, thus resulting in a workable sampling frame that also offers representation compared to ABS regional data.

As previously mentioned, 5448 firms were established as being the sampling frame. From this frame a sample of 2000 businesses were selected using the simple random sampling method. 500 businesses were extrapolated from the list and identified as being micro-firms on the basis of business listings referring to a sole proprietor. The list of 500 micro-firms was used to test the survey instrument in a pilot test and refine the questionnaire for use in the final survey. The remaining 1500 listed businesses were used to conduct the main survey. Estimated response rates were considered to be around 10% which is the standard for telephone interviews, which would result in 150 successful responses.

A further refinement to the sample of 1500 firms was required to eliminate listings identified as being not appropriate for the survey. All entries were removed referring to government departments, not-for-profit organisations, large enterprises, franchises, duplicate phone numbers and mobile phone numbers. The sample was reduced to 939 firms that were SMEs and were within the sample parameters required for use in the survey. Businesses with their main contact number being a mobile number were removed in the final

sample on the basis of cost in calling mobile numbers. It was also assumed that these businesses are sole proprietors and thus micro-firms.

Sample Size

In order for a sample to accurately reflect the target population the size of the sample must be significant enough to enable one to draw conclusions from the sample. The survey size more frequently is determined on the basis of accuracy or precision, the budget of the research and the timeframe in which the survey must be completed within. A small sample will reduce the certainty that the findings refect those of the total population. A sample that is too large will be unnecessarily expensive in terms of cost and time. At a certain level the sample size accurately represents the population and increases in size will not change the findings to any significant level. Therefore a large sample does not have any advantage to the researcher (StatCan, 2003; Yaffee, 1997). The continual goal is to have a sample that is large enough to minimize the size of standard error and increase the power of the statistics. Furthermore the sample size must be small enough that it is not wasting valuable resources in the data collection process (Yaffee, 1997).

Sampling and estimation methods can also be determined due to the method of survey delivery. The least efficient method of sampling will require a larger sample in order to minimise the level errors and generate a higher efficiency (Malhotra, 1996). Sometimes due to various limitations in the research the use of the most efficient methodologies are unable to be enlisted, in this case the sample size would need to be increased.

The sample size is needed to be able to have representation from all aspects of the population. In the case of this research much effort has been made to endeavor to comply with the necessary aspects that identify SMEs within the sample population. Industrial sector breakdown is identified as being an important classification as indicated in employee numbers for medium firms within manufacturing compared to other sectors by the ABS (ABS, 2003d). Revenue generated by the business can also indicate variations in

performance as they give insight relating to a firms potential to adopt ICT. The age of the business can indicate the level of maturity that the business is in and shed light toward an owner-operator's propensity toward ICT adoption.

Sampling Method

The method of sampling has a potential effect on the accuracy toward a true representation of the total population. There are two variations of sampling methods used in selecting the survey population. The probability sampling method ensures that every survey unit is given equal weight when being considered a candidate for the sample. The non-probability sampling method does not allocate the same chance for each unit being selected for the sample.

The sample of the population is derived from randomisation or chance. The method is beneficial in terms of every unit having a chance of being selected. However there can be issues which make probability sampling potentially beyond the ability of the researcher. The method can possibly be more time consuming, more expensive and more complicated than non-probability sampling (Malhotra, 1996). Despite the possible negative aspects of the sampling method reliable estimates to sampling errors and representation on the population must be taken into consideration. With this in mind the data collected can directly be used to make inferences about the population as a whole (StatCan, 2003). There are several forms of probability sampling including simple random sampling, systematic sampling, sampling with probability proportional to size, stratified sampling, cluster sampling, multi-stage sampling and multi-phase sampling.

Simple random sampling enables each unit in the population to have the potential of being selected equally for the sample. Any combination of members of the sample equally has a chance of being selected for the sample (Malhotra, 1996). Essentially a list of all the units is required within the survey population. The process can be used in conjunction with replacement or without replacement.

Simple random sampling is the most common form of sampling due to the ease of the process as it does not require extra information on the frame only the list of contacts and their relative contact numbers. Due to the simplicity of the sampling method the theoretical basis is sound and is well established, furthermore the formulae are easy to apply (StatCan, 2003). There is, however, the potential of ignoring extra information which could be advantageous to targeting specific respondents within the population.

The sample method for the research was determined to be simple random sampling and the basis that every firm within the sample frame had an equal possibility of being included. On this basis it is possible to verify to some degree that the sample is a genuine representation of the total population and assumptions on the results can be inferred to the population with some accuracy (Malhotra, 1996). Each business within the listing equally had a 27.5% chance of being selected for the survey.

Measures

It has been proposed in this study that specific factors may influence the decision process and resulting adoption process at differing stages of the SMEs evolutionary level. The propositions identify general groupings of factors that are considered to have the most impact during transition from one level of ICT adoption to the next. A series of questions were created to evaluate the propositions drawn from the individual factors identified in the research. Measurable questions relating to the Technological, Organisational, Environmental and Individual factors have been formulated in the questionnaire.

The questionnaire was divided into three distinct sections. The first section asks about the business characteristics of the firm. The second section gains information on the manager's individual characteristics. The third section covers the levels of ICT usage in the business and intentions to future investment in this area. A full listing of measures is listed in Appendix A.

Scales

Within the questionnaire various response scales were used to maximise the accuracy of the respondent's answers. Likert scales were used as well as dichotomous and categorical scales in order to deliver an effective questionnaire.

Likert scales are designed to examine how strongly respondents agree or disagree with a statement on a five or seven point scale. Anchored responses are associated to each of the points with a midpoint representing a neutral opinion and each end of the spectrum associated with a positive and negative response (Cavana, 2001). Using a Likert scale in a questionnaire is advantageous due to the relative familiarity of the scale to respondents and therefore can be used in mail surveys, telephone surveys and personal interviews. The relative ease in administration and construction also makes Likert scales advantageous (Malhotra, 1996). Within the research questionnaire Likert scales are utilised in gaining responses for seeking advice and planning for ICT adoption with a range of five points from 'highly likely' to 'highly unlikely'. Questions relating to the manager's innovativeness, trust and distrust, complexity of ICT, ICT experience and comparisons on ICT usage in relation to competitors use a Likert scale with five points ranging from 'strongly agree' to strongly disagree'.

Dichotomous and Categorical scales within specific sections of the questionnaire illustrated details on the firm's industrial sector, trading age, size, annual revenue and ICT usage. Dichotomous scales are used to gain either a 'yes' or 'no' answer to the question. The implementation within a questionnaire is a simple task providing the question is thoroughly tested as multiple questions may offer a clearer insight into the survey question (Malhotra, 1996). The Categorical scale is used to gain a single response from multiple items such as age of the firm or annual turnover of the business.

Dependant and independent measures

In order for causality to be determined the variable considered to be causing the change must have a measurable effect on other variables. A variable may be causing a certain behavior and therefore can be stated that a cause and effect relationship exists (Joppe, 2003). Independent variables (or criterion variables) are variables that can be manipulated by the researcher and their effect can be measured. Dependant variables (or predictor variables) are variables which measure the effect of the independent variables, thereby enabling the researcher to derive a cause and effect observation (Malhotra, 1996).

The establishment of specific variables was developed to gather information on the types of ICT usage. A comprehensive list of ICT activities was collated from documentation produced by National Office for the Information Economy (NOIE) and other sources. Such ICT tasks evaluated included the ownership of a company website, purchasing on the Internet, using the Internet to publish a catalogue, receiving orders online, use of a shopping cart system, implementing online payment facilities, secure access or transactions, use of online banking functions, use of online exchanges with government agencies and ownership of any supply chain systems (Akkeren, 2003; Burgess, 1998; Lawson, 2003; NOIE, 2001, 2002a). A simple dichotomous scale was implemented to gain the respondents evaluation of whether they are involved in such ICT activities.

Questions within the survey were developed to establish a linear flow between the researcher and the respondent. This was initiated by establishing general questions about the firm then asking more detailed questions as the survey progressed. The initial questions sort information regarding the demographic properties of the firm and were developed from measures used by the ABS (ABS, 2003c). Information requested by the respondent included 4 categorical questions that covered such areas as the firm's industrial sector, the number of full-time employees employed, the annual business turnover and the amount of years that the firm has been trading for. The questions aimed to establish indications of representativeness as well as classification.

The question regarding sector type were categorised into seven categories such as manufacturing, construction, retail trade, property and business, health and community, agriculture (including hunting, fishing and forestry) and other businesses. The categories used to establish the total number of full-time employees was broken into six including: 5 or fewer employees, 6-25 employees, 26-50 employees, 51-100 employees, 101-200 employees and over 200 employees. In the question regarding the annual business turnover five categories were used such as: less than $500,000, $500,000 - $1M (million), $1M - $3M, $3M - $5M, and greater than $5M. With regards to the question detailing number of years trading there were seven categories established and included: less than 1 year, 1-5 years, 6-10 years, 11-20 years, 21-50 years, 51-100 years and over 100 years. During the survey process the responses given were recorded, each answer was represented by a numerical value and therefore was able to be used easily in data processing.

3.2.3. Development of Questionnaire

There has been much discussion regarding the formulation of the perfect questionnaire, what can be agreed upon is that there is no formula to establish the perfect questionnaire. Designing a good questionnaire can be a skill that enlists technical skill but is easier with experience (Wilkinson, 2000). Questionnaires are best used when information is required from a large number of respondents and/or geographically widespread, for questions that do not require complex answers and for a requirement to target specific respondents for certain information. A step approach to designing an effective questionnaire was employed to construct the questionnaire for this survey. Tasks carried out in the development phase include identifying the type of information required within the questionnaire, how the questionnaire was to be delivered, designing the questions so they were able to be understood and testing of the questionnaire prior to the formal survey process (Malhotra, 1996).

The use of plain language with easy to understand terminology was enlisted to provide added clarity to the questions. Specific effort was made towards minimising assumptions toward the respondent's level of knowledge, especially with regards to ICT. Early stages of the questionnaire design process indicated that the key informant approach was required due to the specific information required in the survey. With this in mind the questions were formulated to gain the best information with little or no discomfort.

Much consideration was given regarding the demographic questions, especially the question regarding business turnover. Many business owners would regard such information as being highly sensitive and could potentially have a negative impact on business performance. This issue was identified as being highly critical and the use of classifications within the question assisted in the respondent's positive response as they were able to answer within one of several ranges. As previously mentioned the flow or layout of questionnaires is an important factor as it assists in the respondent's thought process toward answering increasingly detailed questions.

The survey consisted of three sections including an introductory script and a closing statement. Section A contained the aforementioned demographic questions as well as a range of questions evaluating the level of ICT usage currently within the firm. Further questions requested details on information sources that the key informant uses when considering ICT products for their business

Section B contained a range of questions surrounding the individual manager's characteristics. Previous discussion has covered the role of the manager within the SME with regards to decisions made within the firm. Questions covering views on competition, long and short term goal setting as well as innovativeness were fielded within this section.

Section C covered issues regarding levels of trust and distrust in ICT as well as trading partners. This section attempted to establish the respondent's

willingness to consider viewpoints regarding the issue of online business relationships and the level of trust required within these arrangements.

The introductory statement was established to effectively target the key informant and create a level of rapport between them and the interviewer. Mandatory information was relayed to the respondent such as their right to anonymity and to withdraw from the survey process if required. The conclusion reiterated this issue to the respondent and offered contact information on the principal researcher (the supervisor) as well as the ethics body overseeing the research. The respondent was then thanked for their participation.

Once the design of the questionnaire was established it was necessary for the survey to be tested in order to ensure legibility, logical flow and other potential inconsistencies. A small number of fellow research students were enlisted to thoroughly test the survey resulting in the formation of the questionnaire as seen in Appendix B. This was in turn evaluated further with a pilot test which is discussed in the next section.

Pilot Testing

Pilot studies assist in the determination of response rates from the population and therefore indicate the sample size and response rates of the main survey. The requirements for statistical power and minimisation of errors makes the determination of effective sample sizes important (Yaffee, 1997). The correct sample size for the main survey will minimise the margin for errors and ensure true representation of the main population.

The importance of pilot testing cannot be underestimated. In order to minimise any errors and biases the testing of the questionnaire against a pilot sample was essential. The results of the pilot test illustrated some areas that were required to be changed in order to gain a successful final survey. The questionnaire was also delivered via telephone thus giving insight into the skills required for conducting a survey via the medium.

The results of the pilot test were evaluated to test the question items for validity and reliability. Some questions were omitted from the major survey due to poor reliability or not being valid. The sample population for the pilot study consisted of 500 businesses identified as micro-firms. The sample originated from the initial sample and used as the pilot population on the basis that micro-firms were not to be included in the main survey sample. The survey process was conducted with initial “cold calls”; there were no call-backs or attempts to recontact the respondents.

Of the 500 micro-firms contacted in the pilot survey a total of 60 responses were generated with a response rate of 12%. The statistical analysis of the 60 responses identified levels of reliability and validity in the question items.

Testing of the questionnaire

When testing an instrument for data collection it is important to confirm the statistics obtained on the basis of validity and reliability. If the results from a set of data are valid and reliable then further analysis of the data can be actioned in confidence that the results will have a high degree of significance.

The reliability of data indicates the level of freedom from error (Cavana, 2001). Bias is measured within the testing for reliability and if found to be free of bias can be regarded to offer consistency and stability in the measurement. The stability of measures is tested by means of test-retest reliability or parallel-form reliability. The internal consistency of measures is tested by using inter-item reliability or split-half reliability (Cavana, 2001).

Validity is concerned with the issue of authenticity of the cause and effect relationship (internal validity), and the generalisability to the external environment (external validity) (Cavana, 2001). Construct validity is also used to test how well the results obtained from using the measure fits the theory it was designed to test. Within construct validity, convergent validity,

discriminant validity and nomological validity is enlisted to determine validity of a measure (Cavana, 2001).

Validity and reliability work in conjunction to prove levels of appropriateness for the measure. Reliability ensures high stability and consistency while validity ensures the ability of the scale to measure the intended concept.

Construct Validity

In order to accurately examine what characteristics a scale is measuring it is necessary to use construct validity. When using construct validity the researcher is able to gain insight as to what the scale is measuring and if it is the measurement that is relevant to the research theory. Construct validity is both sophisticated and difficult to establish (Malhotra, 1996). As previously described convergent validity, discriminant validity and nomological validity are all components of construct validity.

Convergent validity measures the extent to which the scale correlates positively with other measures of the same construct. There is no requirement to have conventional scaling techniques enlisted using this method (Malhotra, 1996). Discriminant validity measures the extent to which a measure does not correlate with other constructs from which it is supposed to differ. The method demonstrates levels of non-correlation among differing constructs (Malhotra, 1996). Nomological validity measures the extent to which the scale correlates in theoretically predicted ways with constructs that are different but related. The method aims to develop a theoretical model thus leading to further tests, deductions and inferences. The process then assists the researcher in development of several constructs that are systematically interrelated (Malhotra, 1996).

To establish validity the researcher must use one of three forms of analysis. Factor analysis uses a multivariate technique that confirms the dimensions of the concept defined and establishes the most appropriate measures. The analysis method is used to establish construct validity. Correlational analysis

aims to establish convergent and discriminant validity or concurrent and predictive validity. Multitrait multimethod matrix of correlations is established from measuring concepts from different forms and methods thereby establishing a robustness of measure (Malhotra, 1996). This research enlists exploratory factor analysis to establish construct validity.

Exploratory Factor Analysis

After conducting the pilot test the results were evaluated for validity and reliability. The validity of the measures was examined with Exploratory Factor Analysis (EFA) techniques. Essentially EFA encompasses a class of procedures essentially used for data reduction and summarisation (Malhotra, 1996). In the pilot test section of the research there are a significant number of variables. With the use of factor analysis the number of variables can be reduced by filtering out the variables that do not 'factor' or are not correlated. A factor is a value that illustrates the correlation among a set of variables and explains the correlations among the set (Malhotra, 1996).

The initial factor analysis of the pilot data reduced the questions down to 21 scaled questions from a total of 53 questions. The 21 questions were tested and were found to pass the requirements needed to claim validity. The remaining questions were used within the final questionnaire on the main survey population.

Testing for validity demands some requirements to be met with regards to the data collected. A sample size of preferably 100 or more is advisable with at least five times as many observations as there are variables to be analysed (Hair, 1998). While the pilot data was not within these parameters, there was confidence in the data on the basis of nomological validity was positive. Correlation levels are assessed to verify if each measure has been effective on a statistical basis. The range of adequacy is measured on a scale between 0 and 1 where measures of 0.7 and higher is considered advantageous and offers a significant level of validity. The pilot test yielded a significant correlation level of 47.1% of the questions correlated to 0.7 or higher which

was well above the minimal limit of 30% (Hair, 1998). From the initial results the decision to continue with factor analysis methodology was reaffirmed.

Within EFA there are several assessments that are required to verify validity of measures. Both the Bartlett's test of sphericity and the Kaiser-Meyer-Olkin (KMO) test were enlisted to further evaluate the appropriateness of validity against the data set. The Bartlett's test statistically evaluates the presence of correlations among the variables (Hair, 1998). The method illustrates the probability that the correlation matrix has significant correlations among at least some of the variables. Researchers are cautioned with regards to Bartlett's test as an increase in sample size causes the test to become highly sensitive with regards to detecting correlations between variables. A variable will correlate with itself perfectly (r=1) and will range between an indicator or no correlation with another variable (r=0) and full correlation (Malhotra, 1996).

The KMO measures sampling adequacy and provides an index of 0.0 and 1.0. The index is used to determine the appropriateness of factor analysis with an index rating less than 0.5 indicating factor analysis is not appropriate for the data being evaluated (Malhotra, 1996). The index evaluates the magnitudes of the observed correlation coefficients against the magnitudes of the partial correlation coefficients. Indications toward acceptable values for the index describe levels of over 0.69 to be advantageous while levels between 0.5 and 0.69 to be substantiated by other tests in order to claim suitability for factor analysis. Index levels of 0.7 or higher are highly regarded as being positive indicators of appropriateness (de Vaus, 2002).

Testing the pilot data with KMO and Bartlett's methodologies indicated that the data was sufficient to continue further processing of the measures using factor analysis. It was decided to undertake principal component analysis in order to minimise the total number of questions and maximise to efficiency of the questions as well. Principle component analysis is concerned with creating a minimum number of factors with a maximum variance. This method is recommended when the primary objective is to determine the minimum number of factors in order to account for the maximum variance in the data for

use in subsequent multivariate analysis (Malhotra, 1996). The principal component analysis method was used to establish 5 factors for further processing.

The measures in principal component analysis further indicate the level of appropriateness the method has to the data. It is recommended to retain factors that produce eigenvalues greater than 1.0 as they would have a higher variance associated with the factor (Malhotra, 1996). The data is first processed within an un-rotated factor matrix to illustrate some of the factors required to be removed. The following process required the factors to be rotated thereby maintaining the axes of the factors. Unrotated factor matrices indicate the relationship between the factors and the individual variable but are unable to give insight on any interpretation to the factors (Malhotra, 1996). Rotation enables the factors to be interpreted easier and does not affect any communalities or the total percentage of total variance explained. Use of orthogonal rotation maintains the axes of the factors at right angles; the main method used is the VARIMAX procedure which minimises the number of variables with high loadings on a factor which may impact interpretation (Malhotra, 1996). The VARIMAX offers a clearer separation of factors by indicating a clear positive or negative association between the variable and the factor (Hair, 1998). The results from the processes have resulted in the data presented in Table 3.1.

Indications of significance with regards to the factor results provide specific levels of validity. Variables indicating factor loadings of less than 0.30 are not expected to represent any significance to the researcher. Values representing factor loadings of 0.50 are regarded as being significant enough for further evaluation providing the sample size is large (Hair, 1998). Selection of the factors in the research was determined on the basis of the factor loadings representing at least a value of 0.60 or higher. The resultant data returned 9 factors as seen in Table 3.1.

After applying VARIMAX rotation on the pilot test data each variable was assessed using EFA produced factor loadings at a value of 0.60 or higher and

was significant enough to be regarded as being significant. Component 1 displayed sufficient loadings representing the manager's experience of ICT and was therefore labelled 'Managers experience'. Component 2 displayed sufficient loadings representing the trust in the firm's trading partners online and were labelled 'Online partner's trust'. Component 3 displayed sufficient loadings representing the perceived benefits of ICT and thereby labelled 'Perceived benefits'. Component 4 displayed sufficient loadings representing the advice and influence of external advisors, a label of 'External advisors' was attributed to the component. Component 5 displayed sufficient loadings representing the advice and influence of business partners and therefore labelled 'Business partners'. Component 6 displayed sufficient loadings representing the level of scepticism and cynicism towards trading online and was labelled 'Scepticism and cynicism'. Component 7 displayed sufficient loadings representing the advice and influence from the print media and therefore labelled 'Print media'. Component 8 displayed sufficient loadings representing the level of wariness and vigilance towards trading online and thereby labelled 'Wariness and vigilance'. Component 9 displayed sufficient loadings representing the advice and influence from the Internet and was labelled 'Internet'.

The factor components obtained by conducting factor analysis represented divergent validity on the basis that each factor had not been loaded with scales from other items. Furthermore the analysis had demonstrated convergent validity as the variables had loaded separately on 9 components with no significant cross loadings.

Factor components	Manager's experience	Online partners trust	Perceived benefits	External advisors	Business partners	Skepticism and cynicism	Print media	Wariness and vigilance	Advice from Internet
Magazines and newspapers for advice	.111	<.1	<.1	.166	<.1	.124	**.858**	-.173	<.1
Internet for advice	<.1	.125	<.1	<.1	<.1	<.1	<.1	<.1	**.929**
Customers for advice	<.1	.193	<.1	**.799**	<.1	.143	.162	-.210	.102
Business partners for advice	<.1	.148	<.1	-.128	**.925**	<.1	<.1	<.1	<.1
Magazines and newspapers for planning	-.113	<.1	<.1	<.1	.104	-.179	**.877**	<.1	-.171
Customers for planning	<.1	.305	<.1	**.865**	<.1	-.181	<.1	<.1	<.1
Business partners for planning	.149	.120	<.1	.309	**.833**	-.114	<.1	.135	<.1
Organizations /vendors for planning	.224	-.261	<.1	**.691**	.173	<.1	<.1	<.1	-.184
Familiar with ICT	**.882**	.120	<.1	<.1	<.1	.210	<.1	<.1	<.1
Knowledgeable with ICT	**.822**	<.1	<.1	<.1	.198	<.1	-.134	.114	.210
Proficient in ICT	**.759**	.228	<.1	<.1	<.1	<.1	<.1	.169	-.264
Educated in ICT	**.748**	-.129	<.1	<.1	.319	<.1	<.1	<.1	.364
ICT develops business	<.1	.115	**.795**	<.1	.104	<.1	-.170	.135	-.130
ICT expands markets	<.1	<.1	**.947**	<.1	<.1	-.154	<.1	<.1	<.1
ICT develops new markets	<.1	<.1	**.905**	<.1	<.1	<.1	<.1	<.1	<.1

Faith in online traders	.123	**.880**	.205	<.1	.101	<.1	<.1	<.1	<.1
Confidence in online traders	.223	**.860**	<.1	.143	.263	<.1	<.1	<.1	<.1
Hope in online traders	<.1	**.892**	<.1	.147	<.1	-.134	<.1	<.1	<.1
Skeptical when online trading	<.1	<.1	-.200	<.1	-.161	**.782**	<.1	.278	<.1
Cynical when online trading	<.1	-.124	<.1	<.1	<.1	**.920**	<.1	<.1	<.1
Wary when online trading	<.1	<.1	<.1	<.1	<.1	.260	.115	**.883**	.111
Vigilant when online trading	<.1	-.172	<.1	<.1	.163	<.1	-.256	**.752**	-.182
Quality of ICT in business	**.778**	.153	<.1	<.1	<.1	-.211	.134	-.191	-.120

Table 3.1: Pilot Test Data evaluated using VARIMAX Rotation.

Reliability

The 9 factors developed during the exploratory factor analysis were then tested for reliability. Reliability denotes the assessment of the degree of consistency between multiple measurements of a variable (Hair, 1998). Repeated measurements are made on the specific characteristics of the scale, if the results are repeatedly consistent then it is attributed a high reliability status (Malhotra, 1996). The usage of internal consistency reliability for the pilot data was required as the method calculates the reliability of a summated scale of several items and produces a total score (Malhotra, 1996).

It was decided to use split-half reliability to determine internal consistency by means of dividing the scale into two halves and the correlation assessed from the resulting half scores (Malhotra, 1996). The indicator evaluated for the method is the coefficient alpha or Cronbach's alpha. Cronbach's alpha essentially is the average of all the possible split-half coefficients as a result from multiple types of splitting of the scale item (Hair, 1998). The result is a

value between 0 and 1 thereby a value of 0.6 of better is considered a satisfactory level of internal consistency. Researchers are required to consider the limitations to Cronbach's alpha as artificial inflation of the values may be resultant from inclusion of redundant scales (Malhotra, 1996).

The results from applying split-half internal consistency reliability to the factor components identified eight of the nine factors to be reliable. The ninth factor contained only one variable and therefore could not be tested for reliability. 'Online partner's trust' produced the highest reliability with a Cronbach's alpha value of .8995. The second most reliable component labelled 'Perceived benefits' produced a Cronbach's alpha of .8634. The third highest reliability with a Cronbach's alpha of .8634 was 'Managers experience'. The fourth most reliable component at a Cronbach's alpha of .8384 was 'Business partners'. The component labelled 'External advisors' produced a Cronbach's alpha value of .7503 and was the fifth most reliable component. The sixth most reliable component was 'Scepticism and cynicism' with a Cronbach's alpha of .7383. A Cronbach's alpha of attributed to the seventh most reliable component labelled 'Print media' while the eighth component labelled 'Wariness and vigilance' was the least reliable but resulted in producing a Cronbach's alpha of .6622.

Refining of the questionnaire

The assessment of the pilot data with validity and reliability indicated that a large number of questions were to be omitted during the creation of a new questionnaire for the major survey. A total of 21 scale questions were retained in the final questionnaire including a series of demographic questions.

Final Questionnaire

The main survey required an edited version of the questionnaire to be developed. As well as containing a series of pertinent and effective questions there are benefits made in the ease of survey administration as well. One of the negative aspects of the pilot test survey was that some rejections may

have been due to the length of time taken to complete the questionnaire. Contact time with the respondent would be cut in half with the final survey thus enhancing the respondent's reception toward the survey. The final survey questionnaire can be viewed in Appendix C.

3.2.4. Questionnaire Administration

A team of four honours students were enlisted to conduct the survey. A carefully scripted questionnaire was supplied to each member as well as a list of contact businesses from the sample which was equally divided between the team. An electronic database was created to store the responses received from the survey recipients. The Microsoft Access database also consisted of a version of the questionnaire so responses could be entered easily and without the interviewer having to switch between a script and the database, thus reducing the potential for errors. Developed by the research team, the database also served as the CATI system throughout the data collection process. Preformatted drop-down lists were created to provide effective collection of information from the respondents. The subsequent answer corresponded with a code on the data base so data entry and coding was a one step process. The interviewers worked through the sample contact list and initially would call the key informant without any prior notice, commonly termed 'cold calling'. Some rejections of participation were circumvented by offering the respondent an alternative time to participate in the survey. The call backs were actioned at the agreed day and time by the respondent.

Response Rate

The main sample for the final survey totalled 939 enterprises located within the Victorian Central highlands region. Of the 939 firms to be 'cold called' there were 110 responses to the survey. The response rate for the survey was 12.8%. Of the 672 rejections to participate 83 consisted of missed or unanswered calls. This figure was subtracted from the number of non-responses; the number of non-responses (less missed calls) was calculated to deliver the response rate. The aforementioned call-backs contributed to 8%

of the total calls made. From the 74 call-backs actioned there were 24 rejections and 50 successful responses. In total the response rate of cold calls and call backs resulted in an end figure for responses of 18.6%.

Response rates vary depending on the method of survey delivery. Highly personal surveys such as a face-to-face interview often result in response rates of 80% or more (Malhotra, 1996). Traditionally telephone surveys will yield response rates of 60% or more. Mail surveys experience very low response rates of no more than 15% (Malhotra, 1996). The total response rate calculated for the main survey fell short of documented rates for telephone surveys and was close to those of typical mail out surveys.

The issue of experiencing a very low response rate was discussed at length by the interview team resulting in some observations to account for the low figure. The University of Ballarat conducts a high level of research upon a relatively small population base. Some issues of 'survey overload' may be apparent and resultant in the high rejection rate. Another issue possibly was the time of year as a high number of respondents indicated that administration of Business Activity Statements was actioned around the same time of the survey. Finally the length of time to complete the survey was considered to be too long by many business owners resulting in their telephone being tied up in a non-revenue generating activity.

Sample Characteristics

The total number of respondents to the final survey consisted of 110 'cold calls' and 50 successful call backs thereby equalling 160 responses. Initial observations on the respondent data indicated 96 entries originating from SMEs and 64 were identified as micro-firms. As the research was focused toward the specific characteristics of SMEs, the data from micro-firms was not used in the final data processing.

Demographic details of the 96 respondents indicate a significant representation of many industries operating within the Central Highlands area

(Figure 3.1). The largest proportions of businesses canvassed in the survey were Retail traders and represented 26% of the total. 19.8% of the respondents operated in the Manufacturing sector as well as 10.4% of the firms assessed operated in the Property and Business sector. Respondents identified as being in the Construction sector represented 6.3% of the group while 4.2% of the group identified themselves as trading in the Health and Community sector. Agriculture (including hunting, fishing and forestry) represented 2.1% of the total number of respondents. The remaining 31.3% identified the prime operations of the firm in the Other businesses category as defined by the Australian Bureau of Statistics (ABS, 2000).

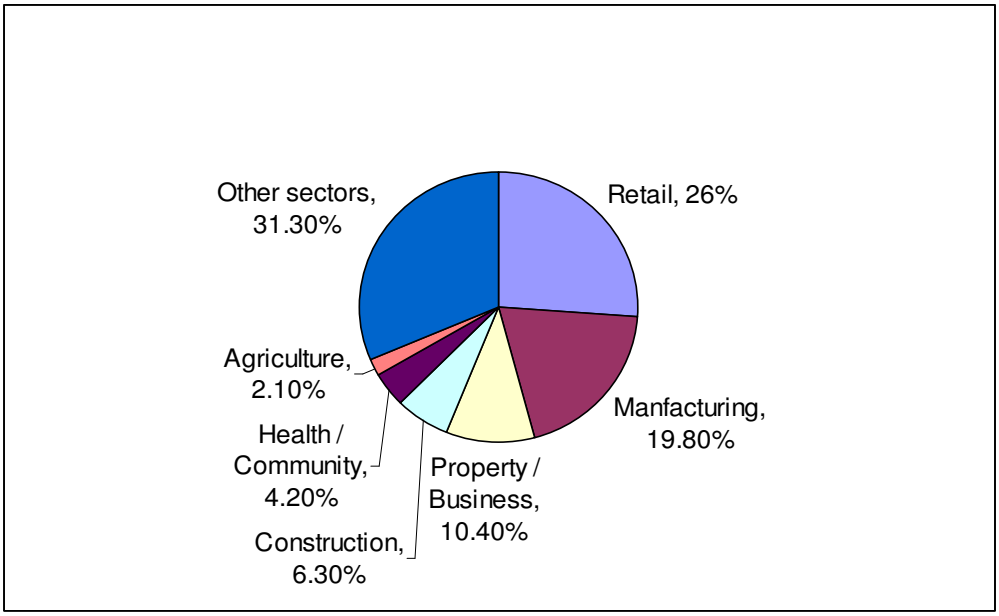

Figure 3.1: Proportion of respondent SMEs according to Industrial Sector

Figure 3.2 illustrates the proportions of respondent firms by size in number of employees. A significant proportion (85.4%) of the surveyed firms consisted of less than 25 employees. Firms with 26 to 50 employees represented 11.5% of the total respondents. Firms with 51 to 100 employees represented 2.1% while only 1% of the total respondents advised that 101 to 200 staff were employed at the business.

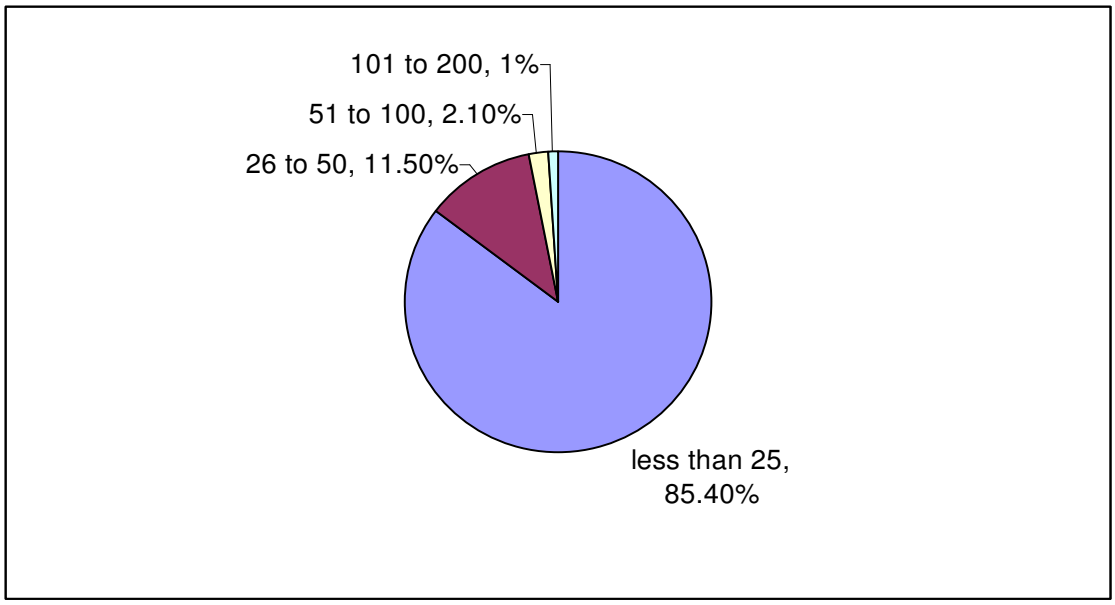

Figure 3.2: Proportion of respondent SMEs according to number of employees

Figure 3.3 illustrates the proportion of respondent SMEs according to number of years trading. The number of years that the firms had been trading for consisted of 13% of the total SMEs had operated for 5 years or less, 9.8% of the businesses had been operating for 6 to 10 years, while 26.1% of the SMEs in the respondent group had been trading for 11 to 20 years. The major population (41.3%) of the surveyed firms had been trading for over 21 years but less than 50 years. Significantly fewer firms had been trading over 51 years at 12.8%.

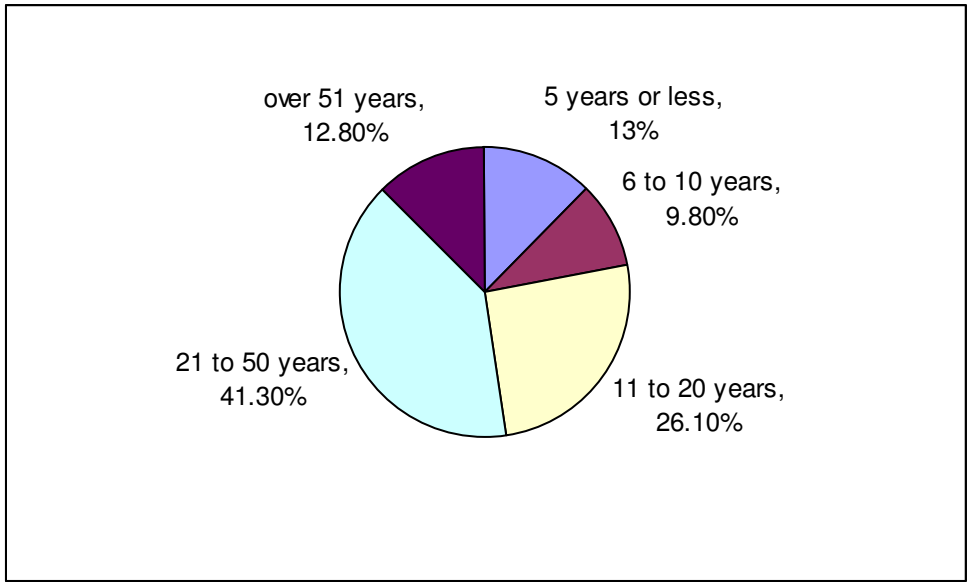

Figure 3.3: Proportion of respondent SMEs according to years trading

Data pertaining to the type and levels of ICT usage by the respondent SMEs illustrated three distinct classifications for ICT adoption. Many firms have indicated high levels of adoption in activities that involve email, Internet searches and eBanking as well as owning a company web page. ICT adoption of highly functional online activities such as online ordering, shopping carts, online payments and supply chain systems have been adopted at very low levels. ICT activities such as use of the Internet to make purchases and publish a catalogue as well as secure access or transactions and use of eGovernment systems have been indicated as having a medium level of adoption. The medium adoption activities have been identified as being significant as they signify the level of adoption that most SMEs are adopting in relation to the evolutionary scale. The activities are considered to be the main focus activities for the research at this time as it is considered that managers or owner operators are focusing their attention to the adoption of that level of ICT. It is considered that ICT activities that have been adopted at high levels would not yield benefit to the research as most firms use such technologies. Furthermore those activities identified as being high end ICT are considered to be less relevant to the business activities of many SMEs at this time. Table 3.2 indicates ICT levels according to activity and medium usage functions are highlighted in bold.

ICT usage	Yes	No
Email	94%	6%
Search the Internet	87%	13%
Company Web Page	66%	34%
Internet to make purchases	**51%**	**49%**
Internet to publish catalogue	**44%**	**56%**
Internet to take orders	34%	66%
Shopping Cart Facilities	11%	89%
Online Payment Systems	**31%**	**69%**
Secure Access or Transactions	**41%**	**59%**
eBanking	80%	20%
eGovernment systems	**46%**	**54%**

Supply Chain Systems	18%	82%

Table 3.2: Levels of adoption according to type of ICT

The five activities indicated in bold in Table 3.2 are to be used as the dependent variables for the data analysis section in the research. Statistically the data offers good representation for analysis and will maximise the relevance and significance of the results as the study will be focusing on the ICT being adopted by early adopters while providing benefit to late adopters.

3.2.5. Data Preparation

The 96 respondents were exported from the Microsoft Access database to a Microsoft Excel spreadsheet document and subsequently use in the statistical analysis tool SPSS11. Six entries in the data were identified as being outliers and removed on the basis of data integrity. Outliers are data items that contain values which are not consistent with the values in other data and are different to a high degree compared to other data in the set (Chambers, 2003). A total of 90 responses from the main survey were processed using factor analysis and internal consistency reliability as per the pilot test.

Exploratory Factor Analysis

The data collected from the SME respondents was processed for validity using EFA. The scale item questions were evaluated as being the independent variables in the research. The questions evaluated positively to the range of tests applied to them and were considered sufficient to be processed on the basis of reliability.

Validity levels were studied on the questions relating to the eight components that were statistically powerful from assessments on the pilot data. The process involved use of Kaiser-Meyer-Olkin (KMO) and the Bartlett's test for sphericity. The KMO test produced a value of .550 which according to Hair *et al* (1998) was within the range of acceptability but not outstanding. The

Bartlett's test for sphericity returned a significance value of .000 which substantiated the need to continue with factor analysis.

Further evaluation of the data delivered results with eigenvalues (greater than one) on seven of the eight factor components using the principal component analysis method. The eigenvalues for factor component 1 was 2.996, component 2 returned 2.777 and factor component 3 was 2.686. For factor 4 the eigenvalues were 1.914 and component 5 returned a value of 1.852. The value for factor 6 was 1.684 and was 1.379 for factor 7. Evaluation of the VARIMAX rotated component matrix converged in five iterations; results are illustrated in Table 3.3.

Factor Components Questions	**Manager's experience**	**Online partners trust**	**External advisors**	**Perceived benefits**	**Skepticism and cynicism**	**Competitors performance**	**Print media**
Familiar with ICT	**.806**	.185	.240	>.1	.161	>.1	-.103
Knowledgeable with ICT	**.839**	>.1	>.1	.109	>.1	>.1	-.117
Proficient in ICT	**.770**	>.1	>.1	>.1	.149	>.1	>.1
Educated in ICT	**.772**	>.1	-.292	>.1	>.1	-.192	.142
Faith in online traders	>.1	**.917**	>.1	>.1	>.1	>.1	>.1
Confidence in online traders	>.1	**.883**	>.1	-.100	>.1	>.1	>.1
Hope in online traders	.230	**.698**	.171	-.138	-.222	>.1	>.1

Magazines and newspapers for planning	>.1	-.341	.220	-.181	.351	>.1	**.652**
Internet for planning	.144	>.1	.376	.127	**.640**	>.1	.317
Managers innovativeness	>.1	>.1	-.144	-.132	>.1	**.821**	>.1
Competitors performance with ICT	>.1	>.1	>.1	>.1	>.1	**.872**	>.1
Other organizations /vendors for planning	>.1	.120	**.601**	-.130	.302	-.283	.112
Tested ICT products	>.1	.250	>.1	>.1	-.200	>.1	**.780**
ICT develops business	>.1	>.1	>.1	**.671**	.396	.142	.188
ICT expands markets	>.1	-.115	>.1	**.930**	>.1	>.1	>.1
ICT develops new markets	>.1	-.123	>.1	**.846**	-.141	>.1	>.1
Business partners for advice	>.1	>.1	**.881**	>.1	-.184	>.1	>.1
Business partners for planning	>.1	>.1	**.893**	>.1	-.142	-.145	>.1
Skeptical when online trading	-.148	.101	.223	>.1	-**.675**	>.1	>.1
Cynical when online trading	>.1	-.185	.129	>.1	-**.610**	-.188	.274

Table 3.3: Rotated Component Matrix for SME data

Results obtained from the statistical analysis using VARIMAX rotation displayed a range of strong factor loadings. As previously indicated the significance of factor loadings resulting in a value of .6 is regarded as

acceptable. However many factors in the seven component factors have loaded higher than .7 therefore being able to describe as being very significant. The components in the SME data were mainly consistent with those drawn from the pilot data and thus labelling of the SME data closely in line with those identified in the plot test.

Component 1 continued to be labelled ‘Managers experience’. Component 2 retained the label of ‘Online partner’s trust’. Component 3 had swapped with component 4 and therefore were labelled ‘External advisors’ and component 4 was labelled ‘Perceived benefits’. Component 5 displayed the same loadings representing in component 6 from the pilot tests and therefore correspondingly was labelled ‘Scepticism and cynicism’ Component 6 resulted in new perceptions regarding the managers regard to competitive forces and displayed sufficient loadings representing the level of competition performance as a result of ICT uptake and was labelled ‘Competitors performance’. Component 7 continued to display sufficient loadings representing the advice and influence from the print media and therefore labelled ‘Print media’.

Reliability

The component factors derived from the factor analysis were tested for reliability in the same manner that the pilot data was evaluated. Internal consistency reliability was applied to the SME data and resulted in two factors not returning a high degree of reliability. The factors were then omitted from the SME data on the basis of insufficient reliability. The identification of two unreliable component factors underlies the value of reliability testing on the SME data and thereby confirming high levels of validity and reliability on the final dataset.

The standard value for sufficient reliability using Cronbach’s coefficient alpha of 0.6 was maintained while assessing the factor components. Component three, termed ‘External advisors’, resulted in an alpha of .7611, however returned an alpha value of .9322 after a question within the factor component

was removed. The question related to being influenced by advice from other organisations or vendors when planning for ICT investment. The remaining questions in the factor component focussed on influences from business partners with regards to seeking advice and planning for ICT investment. The label was changed to ‘Business partners’ to reflect relevance to the construct. Component one, ‘managers experience’, resulted in a Cronbach’s alpha of .8110 and component two, ‘Online partners trust’, displayed a value of .7985. The fourth component, ‘Perceived benefits’, resulted in an alpha value of .7844 and component six, ‘Competitors performance’, obtained a Cronbach’s coefficient alpha of .7202 thus becoming the fifth component factor. Factors representing ‘Scepticism and cynicism’ as well as ‘Print media’ were omitted from the data set on the basis of poor reliability and resulted in alpha values of .5139 and .3018 respectively. Results of the final five component factors are illustrated in Table 3.4.

The research at this stage had validated the statistical power of the scaled questions and delivered a series of factors from which further analysis could be generated when assessed with the dependent variables from the questionnaire. This process is discussed further on in the data analysis procedures section.

Factor Components Questions	**Manager's experience**	**Online partners trust**	**Business partners**	**Perceived benefits**	**Competitors performance**
Familiar with ICT	**.828**	.201	>.1	.180	>.1
Knowledgeable with ICT	**.838**	>.1	.112	>.1	>.1
Proficient in ICT	**.789**	>.1	>.1	>.1	>.1
Educated in ICT	**.747**	>.1	>.1	-.264	-.201
Faith in online traders	>.1	**.921**	>.1	-.120	>.1
Confidence in online traders	>.1	**.884**	>.1	>.1	>.1
Hope in online traders	.193	**.734**	-.133	.214	>.1
Managers innovativeness	>.1	>.1	-.100	-.129	**.832**
Competitors performance with ICT	>.1	>.1	.101	>.1	**.885**
ICT develops business	.136	>.1	**.712**	>.1	.190
ICT expands markets	>.1	-.118	**.924**	.104	>.1
ICT develops new markets	>.1	>.1	**.845**	>.1	-.128
Business partners for advice	>.1	>.11	>.1	**.955**	>.1
Business partners for planning	>.1	>.1	>.1	**.929**	-.188

Table 3.4: Rotated Component Matrix of SME data after Reliability testing

Data Analysis Procedures

Analysis of both the independent and dependent variables required the use of a class of sophisticated statistical methods termed multivariate analysis. Essentially multivariate analysis simultaneously processes multiple measurements on each individual or object under investigation (Hair, 1998). Multivariate analysis techniques are suitable for analyzing data where there are two or more measurements on each element and variables are analysed simultaneously (Malhotra, 1996). The techniques are concerned with simultaneous relationships between two or more phenomena.

Decisions as to the type of multivariate technique to use in an analysis of data can be assessed on the basis the dependence as well as interdependence. Factor analysis has initially been used against the data to verify reliability as well as validity and therefore was used to assess interdependence. The subsequent step in the data analysis involves the study of relationships between the independent and dependent variables and therefore requires a dependence multivariate technique to be enlisted. The questions regarding the type of ICT usage has delivered a number of dependent variables for the study and therefore three techniques is available to select from. Multivariate analysis of variance (MANOVA), canonical correlation and multiple discriminant analysis techniques can be selected on the basis on the type of data used (metric or non-metric) as well as how the independent and dependent variables are processed.

Multiple Discriminant Analysis

Discriminant analysis is recommended as being the most appropriate statistical technique when the dependent variable is categorical (nominal or non-metric) and the independent variables are metric (Hair, 1998). When two or more classifications are identical the technique is referred to as multiple discriminant analysis or MDA. The analysis is based on deriving a variate or linear combination that represents the weighted sum of two or more independent variables that compromise the discriminant function. Discrimination is achieved by setting the variate weights for each variable to

maximise the between group variance relative to the within-group variance (Malhotra, 1996).

MDA is used for testing a hypothesis that the group means of a set of independent variables for two or more groups are equal. The technique multiplies each individual variable by its weight and adds the products together thus resulting in a composite discriminant Z score for each individual in the analysis (Hair *et al*, 1998). To calculate the group mean (or centroid) the discriminant scores for the individuals within the group are averaged. The group centroids indicate the typical position of any individual within the group; comparing group centroids establishes relative distance between them along the dimension being evaluated (Hair, 1998).

A six stage process has been documented in literature relating to MDA in order to effectively carry out the data analysis while minimising errors and maximising appropriate fit of the functions (Malhotra, 1996). Initially the first stage is concerned with the research problem. The selecting of objectives is required to correctly evaluate the group differences on a multivariate profile, to classify the observations in to groups and to identify the dimensions of discrimination between the groups (Hair, 1998). Stage two surrounds the issue of research design, encompassing such points as the selection of the independent variables, considering the sample size and the creation of analysis and holdout samples. The third stage identifies any assumptions made, in particular the normality of the individual variables, the linearity of relationships, and the lack of multicollinearity among the independent variables as well as the equal dispersion of matrices.

Stage four involves the estimation of the discriminant functions, the assessment of predictive accuracy with the classification matrices, the determination of the optimal cutting score, assessing the hit ratio and the statistical significance of the predictive accuracy. Stage five involves the interpretation of the discriminant functions. The evaluation of separate functions is required which involves assessment of discriminant weights, discriminant loadings and partial F values. The final and sixth stage is

concerned with the validation of the discriminant results by enlisting the use of a split-sample or cross-validation and the profiling of the group differences.

Stages 1, 2 and 3: Statistical Strength of data

Many of the tasks required in the first 3 stages have previously been addressed in earlier actions within factor analysis and testing for validity as well as reliability. Other issues will be addressed that are required to action prior to continuing with discriminant analysis. As previously indicated, multiple discriminant analysis is considered as the best technique to use on the basis of the type of dependent and independent variables being studied as well as the desire to test each dependent variable individually against the range of independent variables. This task is indicated in the first stage for the discriminant analysis process.

The second stage addresses issues such as sample size and the division of the sample. The sample size of the study is an issue that may be of concern as the literature indicates a level of 20 observations per predictor variable to be an optimum fit (Hair, 1998). In the research there are 5 factors and four demographic questions which total nine predictor variables. There are 96 eligible responses for the data analysis therefore the ratio is 10.6:1 which is half the indicated sample size ratio. The literature also indicates that at a minimum ratio of 5:1 should be attained; with this in mind the research ratio has attained a middle ground. The division of the sample has been addressed in previous actions according to the literature (Hair, 1998). The pilot test and subsequent validity and reliability verified the variables that eventually composed of the 4 factors. Split-sample and cross-validation enable testing of the discriminant functions on another section of the sample to verify the findings, however the validity of earlier tests indicate high statistical power.

The third stage covers any assumptions made regarding multivariate normality. Normality is the degree to which the distribution of the sample data corresponds to a normal distribution (Hair, 1998). This is particularly important if small sample sizes are being used. However on the research sample size

good normality will assist in the level of accuracy of the results. All 5 factor based independent variables indicated normal univariate distribution. The 9 dependent variables regarding levels of ICT usage indicated positive univariate distribution with an average mean of 1.60. Another assumption of discriminant analysis relates to the multicollinearity among the independent valuables. Multicollinearity indicates that two or more independent variables are highly correlated so there is high predictability by the other variables. While interpreting the discriminate function it is important to be aware of multicollinearity and its impact on which variables enter a stepwise solution method in the discriminant analysis technique (Malhotra, 1996). During the reliability phase the independent variables were assessed on the basis of correlation therefore multicollinearity has been indicated as not being a suspected issue.

Stage 4: Estimation of discriminant model and assessing fit

Stage four involves the estimation of the discriminant functions such as use of simultaneous or stepwise estimation, or to assess the significance of the discriminant functions. The fourth stage also is concerned with the assessment of predictive accuracy with the classification matrices. This involves such tasks as the determination of the optimal cutting score, specification of the criterion for assessing the hit ratio and the statistical significance of the predictive accuracy (Hair, 1998).

Processing the data to produce a discriminant function requires the decision to use either simultaneous estimation or stepwise estimation. Simultaneous estimation computes all the independent variables concurrently thus arriving at a discriminant function (Hair, 1998). The function is based on all the independent variables and does not consider discriminating power of each independent variable. Researchers would use this method if they are only interested in assessing the set of independent variables as a whole. Stepwise estimation involves entering each independent variable one at a time into the discriminant function. This approach aims at identifying the best discriminating variable and then paired with each of the other independent variables one at a

time until the best discriminant function is derived. Earlier entered variables may be removed to boost the function should the information be considered to negatively impact the function. Stepwise is best used when a large number of variables are to be assessed. A reduced set of variables may be found to be better then a complete set of variables. In this study the stepwise method was employed (Hair, 1998).

Stage 5: Interpretation of the results

Stage five involves the interpretation of the discriminant functions and asks how many functions will be interpreted. Furthermore the evaluation on more than one function is actioned then the evaluation of separate functions is required which involves such issues as discriminant weights, discriminant loadings and partial F values (Hair, 1998). These issues are also covered if only one function is to be interpreted. If two or more functions are to be interpreted then after the evaluation of the separate functions is actioned the testing of the combined functions are required. This involves the rotation of functions, the establishment of a potency index, and graphical display of the group centroids and the loadings.

Interpretation of the results involves the examination of the discriminant functions n order to determine the relative importance of each independent variable to discriminate between the groups. This is carried out by means of using such methods as standardization of the discriminant weights, evaluation of the structure correlates (or discriminant loadings) and assessing the partial F values (Hair, 1998).

Traditionally the discriminant functions are evaluated by means of the magnitude of the discriminant weight (or discriminant coefficient) attributed to each variable during the processing of the functions themselves. Independent variables with larger weights than others represent high levels of discriminant power. There are issues relating to taking the discriminant weight at face value due to the effects of possible multicollinearity (Hair, 1998).

Contemporary studies more often use higher levels of sophistication in the interpretation of the results by using discriminant loadings (or structure correlations) (Hair, 1998). These measures are a simple linear correlation between each independent variable and the discriminant function thus reflecting the level of variance between the two and the contribution made by the individual variable. This method too can have some shortcomings as discriminant loadings may be subject to instability.

When stepwise methods are utilized for use in discriminant analysis, an additional method of interpreting discriminating power in the independent variable is available via the interpretation of the partial F value (Hair, 1998). The absolute sizes of the significant F values are ranked with the larger values indicating the higher discriminant power. The F values indicate the associated level of significance for each variable.

Stage 6: Validation of the results

The final and sixth stage is concerned with the validation of the discriminant results by enlisting the use of a split-sample or cross-validation and the profiling of the group differences.

The discriminant results are required to be tested for validity. Inflation of the hit ratio may occur if the discriminant analysis is evaluated upon the analysis sample only, therefore it is necessary to cross-validate on the holdout sample (Hair, 1998). Group profiling is also used to verify that the group means are valid indicators of the conceptual model.

Cross-validation is used to manage upward bias in the prediction accuracy of the discriminant functions. It is also used for developing the classification matrix especially if one of the major issues may be surrounding external validity (Hair, 1998). Another viewpoint is to attain greater confidence in the validity by repeating the procedure several times. The sample is randomly divided and each sample is tested for validity via the creation of the classification matrix and the relevant hit ratio (Hair, 1998). The average hit

ratio could then be calculated from the several results. Other methods include the U-method and the jackknife method which are based on leaving one of the functions out and testing repeatedly. However sample sizes are required to be significantly large enough to offer reliable results.

Profiling group differences focuses on the independent variables and how they correspond to the conceptual bases of the original model formulation (Hair, 1998). After the greatest contributing independent variables have been identified the characteristics of the groups are profiled based on the group means. The characteristics of each group are better understood in relation to the independent variables.

3.3. Chapter Summary

This research has proposed to establish the strength of causal relationships between several factors that impact on managers investing in ICT within SMEs. The methodology enlisted causal based research strategies and focuses on quantitative data collection methods to develop and administer a telephone survey. SMEs located in the Central Highlands region of Victoria were sampled and data collected was analysed to establish relationships between the variables.

Australian SMEs are unique in many ways compared with SMEs in other countries and have a significant contribution to the national economy; however investment of high level ICT products and strategies is not prevalent. The measures that formed the basis of the questionnaire originated from several sources including the ABS, standard marketing measures and theory sourced in contemporary literature.

The collected data was tested for validity and reliability then assessed on the basis of causal relationships. The next chapter presents the results obtained from the statistical analyses conducted to test the proposed hypotheses.

4. RESULTS

4.1. Introduction

In this chapter the results from processing of the data using discriminant analysis is presented. The 6 stage analysis process was adopted to effectively carry out the required actions necessary for conclusive discrimination between the independent and dependent variables. Stages 1 to 3 predominantly are concerned with assessment of the data to verify the level of appropriateness for discriminant analysis. At this point the dependent variables and independent variables are evaluated in totality and the discussion focuses on the data set as a whole. Stages 4 to 6 are studied according to analysis on affirmative and negative aspects of each dependent variable and the discriminant analysis concerns itself with each dependent variable.

4.2. Statistical Analysis

The data analysis method used for this research involved the application of a two-group discriminant analysis. The following results are discussed using each of the six stages of the model-building process cited as being highly suited to multiple discriminant analysis (Hair, 1998).

Stage 1: Objectives of Discriminant Analysis

The objectives set out in the Methodology chapter of the research have illustrated the desire to gain insight into the ICT adoption strategies of managers and owner operators who operate SMEs. The study into a set of statistically robust variables relating to this phenomenon has resulted in 4 dependent variable ICT usage questions to be assessed for discrimination against 9 independent variables resulting from demographic questions and factor scores. The objective was to identify the perceptions of ICT usage that differ significantly between adopters and non-adopters of ICT. Each of the 4

ICT usage questions were identified as being relative to current adoption activities presently being addressed by operators of SMEs.

Stage 2: Research Design for Discriminant Analysis

Within the second stage of the analysis, issues were addressed surrounding selection of the independent and dependent variables, determination of the adequacy of the sample size and the division of the sample for validation purposes.

Selection of Dependent and Independent Variables

Each ICT usage question was identified as being a dependent variable for the research. The range of questions developed and resulting responses received has identified a 3 level classification of ICT usage based on high, medium and low adoption levels. It was identified that the ICT usage data showing medium usage highlighted the point of most importance for several reasons. The data identified an approximately equal split of adopters and non-adopters (no more that 60:40 split in any direction) and therefore pinpointed the type of ICT already adopted by early adopters but not by late adopters. An affirmative and a negative dependent variable from the same ICT usage topic could be processed against the range of independent variables using discriminant analysis.

Division of the Sample

The analysis sample of 58 responses was randomly selected from the main sample. The remaining responses were allocated to the validation sample. The random nature of the samples is regarded to be an important factor in the process to ensure that there is no ordering of the observations which can affect the validation and estimation processes. Furthermore the number of responses used in the validation sample is consistent with recommendations (Hair, 1998).

Stage 3: Assumptions of Discriminant Analysis

Several principle evaluations regarding the statistical strength of the data need to be addressed. The analysis requires the data to be robust in terms of normality, linearity and multi-collinearity for effective formulation of the

discriminant function. As the data has previously been tested for statistical strength along those lines there is a high level of confidence that there is sufficient robustness in the data required for the analysis.

The next stages of the discriminant model analysis are discussed using the results of the 4 dependent variable groups. A detailed analysis of the dependent variable group regarding use of eGovernment systems continues from stages 4 to 6 to illustrate the results. The summary results for the 4 remaining dependent variable groups are then reported at the end of this chapter.

Results for Business use of eGovernment systems

Stage 4: Estimation of Discriminant Model and Assessing Overall Fit

Stage 4 of the discriminant analysis incorporates the establishment of the group means for each of the independent variables calculated against the affirmative and negative aspects of the dependent variable. Panel 1 on Table 4.2 illustrates group statistics such as the mean and standard deviation for each independent variable as well as the total number of units associated to responses. Generally the independent variables with the largest group means are significant at this stage indicating an early possibility for candidature for the discriminant model. In this case further important factors come into play thus identifying another variable for selection for the discriminant model. Panel 2 on Table 4.2 shows the Wilk's lambda and the univariate F Ratio to test the significance between the means of the independent variables for the two groups. The results indicate that seven of the nine variables show significant univariate differences between the two groups and that the independent variable associated with Industrial Sector and Annual Turnover was significantly different. The two variables are the best candidates to discriminate between the two dependent variable groups. The estimation of the discriminant function is required at this stage.

Panel 1: Independent variable group statistics for eGovernment systems.

eGovernment systems		Mean	Std. Deviation
1 = Yes	Industrial Sector	6.142	1.603
	No. of Employees	2.357	.731
	Annual Turnover	3.107	1.030
	Time Trading	1.964	.428
	Manager's Experience	-.318	.622
	Online Partner's Trust	-.070	.632
	Business Partners	-.101	.987
	Perceived Benefits	-.209	.858
	Competitors Performance	0.102	.949
2 = No	Industrial Sector	4.766	1.924
	No. of Employees	2.133	.345
	Annual Turnover	2.533	1.431
	Time Trading	1.766	.727
	Manager's Experience	-.011	1.203
	Online Partner's Trust	.347	.939
	Business Partners	-.046	.975
	Perceived Benefits	-.027	1.098
	Competitors Performance	-.048	1.047

Panel 2: Tests of significance between independent variables within groups.

Total		Mean	Std. Deviation	Wilks' Lambda	F	df (1/2)	Sig.
	Industrial Sector	**5.431**	**1.892**	**.866**	**8.688**	**1,56**	**.005**
	No. of Employees	2.241	.571	.961	2.270	1,56	.138
	Annual Turnover	**2.810**	**1.276**	**.949**	**3.030**	**1,56**	**.087**
	Time Trading	1.862	.605	.973	1.558	1,56	.217
	Manager's Experience	-.159	.971	.975	1.452	1,56	.233
	Online Partner's Trust	.145	.826	.935	3.901	1,56	.053
	Business Partners	-.072	.973	.999	.044	1,56	.834
	Perceived Benefits	-.115	.985	.991	.486	1,56	.489
	Competitors Performance	.024	.995	.994	.330	1,56	.568

Table 4.2: Group Descriptive Statistics for eGovernment systems.

Estimation of the Discriminant Function

In order to determine which variables are best suited in discriminating between adopters of the eGovernment systems and those who do not, it is recommended to use a stepwise procedure. The Malalobis D^2 measure is used to determine the variable with the greatest power of discrimination. The Malalobis distance between the groups has identified Industrial Sector and Annual Turnover as being the independent variables that have the maximum discrimination of the groups. With each step the residual variables are assessed and in this example there were two independent variables that were indicated as being significant. Table 4.3 illustrates the stepwise statistics with Industrial Sector being confirmed as being considerable with levels of the Malalobis D^2 measure significant at .005 and Annual Turnover at .000, both being below the recommended threshold of .050 (Hair, 1998).

As illustrated in Table 4.3, the discriminant function displays a canonical function of .501 and gives indication on the extent Industrial Sector and Annual Turnover can be accounted for or explained by the model. Other canonical discriminant function coefficients are illustrated and provide substantiation to the canonical correlation. The group centroids are indicated in Table 4.4 and represent the mean of the individual discriminant function scores for each group. The group centroids can assist in the interpretation of the discriminant function results from an overall perspective. The group centroid for adopters of eGovernment systems (group1) is .589 whereas the group centroid for non-adopters of the eGovernment systems (group2) is -.550. Further plotting can offer a visual representation of the relationships, however is not within the scope of the research.

The summary of canonical discriminant functions on Table 4.4 gives detail on the multivariate aspects of the model with regards to classification during the interpretation phase. The use of Fischer's linear discriminant function assist in supporting the results when validating ranking obtained from the Stepwise functions.

The Standardised Canonical Function Coefficients also displayed in Table 4.4 indicate the level and direction of the relationship between the dependent variable and the independent variables. The values range between -1.000 and +1.000 with a negative indicating a negative relationship and positives indicating a positive relationship. Some questions in the survey requested a reverse response and therefore would result in a reverse relationship in the values. For this example there are indications that there is a strong positive relationship between eGovernment systems and the type of Industrial Sector (.998) as well as the Annual Turnover (.799).

Step	Entered	Min. D^2	F Statistic	df 1,2	Sig.	Lambda	Canonical correlation	Chi-Square	df	Sig.	Structure Matrix
1	**Industrial Sector**	.600	8.688	1,56	.005	.866	.501	15.905	2	.000	.680
2	**Annual Turnover**	1.297	9.221	2,56	.000	.749					.402

Table 4.3: Stepwise statistics, levels of significance and canonical correlation measures.

	eGovernment systems		
	1=Yes	2=No	
Functions at Group Centroids (unstandardised canonical discriminant functions evaluated at group means)	.589	-.550	
Canonical Function Coefficients			Standardised Canonical Function Coefficients
Industrial Sector	2.303	1.716	.998
Annual Turnover	-.540	.193	.799
(Constant)	-4.796	-2.855	

Table 4.4: Functions at group centroids, canonical function coefficients (Fisher's linear discriminant functions) and standardised canonical function coefficients.

Statistical Significance

Once the discriminant function has been derived a number of statistical criteria are available to be investigated. Measures such as Wilk's lambda (Table 4.3), Hotalling's trace and Pillai's criteria all test for statistical significance of discriminatory power within the function. When a stepwise function is used the Mahalanobis D^2 and Rao's V procedures are able to be assessed (Malhotra, 1996). The Mahalanobis D^2 (Table 4.3) procedure is designed to develop the best one-variable model followed by the best two-variable model and so on until there are no other variables available that meets the selection rule. A significance criterion of 0.05 or more is traditionally used, however many researchers consider measures higher than this to be not significant enough (Hair, 1998).

Assessing group membership prediction accuracy

Each observation must be assessed on the basis of correct classification and a number of issues must be investigated. Considerations must be made toward such issues as the statistical and practical rationale for the development of the classification matrices, determining the cutting score, creation of the classification matrices and setting standards for assessing classification accuracy (Malhotra, 1996). In the development of the classification matrices a hit ratio is developed. The hit ratio determines the percentage of correctly classified groups and reveals how well the discrimination function classified the objects. As seen in Table 4.3 the chi-squared (or D^2) test of significance is used to test the hit ratio (Hair, 1998).

Before a classification matrix can be developed the cutting score must be determined. The cutting score is the criterion against which each object's discriminant score is compared and then can determine into which group the object should be classified (Hair, 1998). If the sample sizes are different between the groups then an optimum cutting score is developed (or critical Z value) that will offer a cutting score equal in portion to the sample size. There

are risks in misclassification of an object into the wrong group if an optimal cutting score is not used when unequally sized groups are compared.

The construction of the classification matrices is used to validate the discriminate function by means of the creation of two randomly divided groups. The first group (termed the analysis sample) is used to compute the discriminant function while the other group (termed the holdout or validation sample) is used to develop the classification matrix (Hair, 1998). The weights generated by the analysis sample are multiplied by the raw variable measurements of the holdout sample, which then can be compared with the critical cutting score and results in a matrix form. The formula can be used with more than two groups and sample sizes that are unequal.

Measuring the predictive accuracy on the discriminant functions relative to chance is evaluated by the hit ratio obtained from the classification matrix and establishes the acceptable level of predictable accuracy for the function. To action this task a measurement of the percentage that would be classified by chance must be considered (Malhotra, 1996). Chance based criteria is determined simply with equally sized samples by means of dividing 1 by the number of groups; for a 9 group function (individual variables in the research) there is a probability of .11 or 11% chance (C=1/9 groups). Comparison between the hit ratio and chance based criteria addresses the crucial accuracy of the classification. If the correct classifications in the discriminant function groups are higher than observed by chance then an attempt to develop group profiles can be made. If not then there is no predictive accuracy in the information for group membership. There is no set value to above the level of chance for a group to be consider predictive accuracy, however a suggested criterion of ¼ higher accuracy than chance to be considered. Press's Q statistic measure for discriminatory power can be used to assess levels of predictive accuracy over levels of chance (Hair, 1998). The measure compares the number of correct classifications with the total sample size and number of groups, and then compared with the chi-squared value for 1 degree of freedom at the desired level of confidence. If the critical value

(chi-squared) is exceeded then it is deemed as being statistically better than chance.

Assessing Overall Fit

An assessment of the predictive accuracy of the discriminant function is required as part of the second step in the estimation stage, a classification matrix is required to be calculated for the sample and the cutting score is determined. Each observations discriminant Z score is judged to determine which group it belongs to (Malhotra, 1996). The average Z scores for all group members are referred to as the group centroid and are used as a summary measure of the group differences. Successful discriminant analysis will result in significantly different group centroids. Group centroids can be plotted to illustrate the result from a global perspective and are usually prepared for the first two or three discriminant functions as a visual comparison (Hair, 1998)

As the analysis sample of respondents was randomly created from the main sample there is a high probability that the sample accurately reflects the population. Due to the fact that the two groups are of unequal size a weighted average is used to calculate the cutting score. Table 4.5 illustrates the classification matrices of both the analysis and the validation samples thereby validating the results obtained by the discriminant model. The analyses of details from both samples indicate 70% of original grouped cases have been correctly classified.

Casewise diagnostics

A final method of evaluating model fit involves the examination of the predictive results on a case-by-case basis. This process aims to understand which observations have been misclassified as well as not being representative of the remaining group members. The classification matrix while providing overall classification accuracy, does not establish details of individual case results (Hair, 1998). Furthermore a measure of observations similarly compared to the remainder of the group must be established. Considerations must be made toward the impact of inclusion of other independent variables into the discriminant model and the effect this may

have on the overall result. Due to a relatively high percentage of correctly classified cases it was not considered to warrant any value.

Several assessments can be used with the Mahalanobis D^2 distance of the case from the group centroid. The closer to the centroid is evaluated as being more representative of the group. Graphic representations can also illustrate subtle classification issues such as the plotting of the observations based on their discriminant Z scores thus showing any overlap among groups and the misclassified cases. A territorial map can also be used to represent regions corresponding to each group (Hair, 1998).

After the cases have been established on the basis of predictive accuracy, statistical significance and overall fit then the results can be interpreted. The fifth stage involves the interpretation of the results.

Stage 5: Interpretation of the Results

Stage five involves the interpretation of the discriminant functions and asks how many functions will be interpreted. This involves the rotation of functions, the establishment of a potency index, and possibly graphical illustration of the group centroids and the loadings. Interpretation of the results involves the examination of the discriminant functions in order to determine the relative importance of each independent variable to discriminate between the groups. This is carried out by means of using such methods as standardization of the discriminant weights, evaluation of the structure correlates (or discriminant loadings) and assessing the partial F values.

Traditionally the discriminant functions are evaluated by means of the magnitude of the discriminant weight (or discriminant coefficient) attributed to each variable during the processing of the functions themselves. Independent variables with larger weights than others represent high levels of discriminant power. There are issues relating to taking the discriminant weight at face value due to the effects of possible multicollinearity.

Contemporary studies are more often using higher levels of sophistication in the interpretation of the results by using discriminant loadings (or structure correlations). These measures are a simple linear correlation between each independent variable and the discriminant function thus reflecting the level of variance between the two and the contribution made by the individual variable. This method too can have some shortcomings as discriminant loadings may be subject to instability.

When stepwise methods are utilized for use in discriminant analysis, an additional method of interpreting discriminating power in the independent variable is available via the interpretation of the partial F value. The absolute sizes of the significant F values are ranked with the larger values indicating the higher discriminant power. The F values indicate the associated level of significance for each variable.

The results derived from the discriminant function estimation are examined to determine the relative importance of each of the independent variables that have discriminated between the groups. Table 4.5 illustrates the interpretation of the results such as the discriminating weights, the loadings for the functions and the univariate F ratio. The two independent variables included in the function (Industrial Sector and Annual Turnover) are illustrated and ranked with the other seven variables.

The individual variables are required to be interpreted on the basis of statistical and practical significance. The variables with significant loadings are identified and give understanding toward differing group means on each variable. Higher loading scores indicate a more favorable perception of ICT adoption by owner/operators on that attribute. The discriminant loadings and univariate F ratios on Table 4.5 indicate some degree of correspondence when assessing the individual variables. By taking into account the status of the loadings, F ratio and weights the ranking of the independent variables are confirmed. It can then be considered that there is a significant relationship between the industrial sectors that SMEs operate in and the level of annual turnover in having adopted eGovernment systems.

	Standardised Weights	Discriminant Loadings	Rank	Univariate F Ratio	Rank
Industrial Sector	.998	.680	1	8.688	1
No. of Employees	NI	.261	4	2.270	4
Annual Turnover	.799	.402	2	3.030	3
Time Trading	NI	.059	7	1.558	5
Manager's Experience	NI	-.315	3	1.452	6
Online Partner's Trust	NI	.006	9	3.901	2
Business Partners	NI	. .057	8	.044	9
Perceived Benefits	NI	.115	6	.486	7
Competitors Performance	NI	.173	5	.330	8

NI: Not included in stepwise solution

Table 4.5: Summary of Interpretive Measures for Discriminant Analysis

Stage 6: Validation of results

The final and sixth stage is concerned with the validation of the discriminant results by enlisting the use of a split-sample or cross-validation and the profiling of the group differences.

The discriminant results are required to be tested for validity. Inflation of the hit ratio may occur if the discriminant analysis is evaluated upon the analysis sample only, therefore it is necessary to cross-validate on the holdout sample. Group profiling is also used to verify that the group means are valid indicators of the conceptual model.

Cross-validation is used to manage upward bias in the prediction accuracy of the discriminant functions. It is also used for developing the classification matrix especially if one of the major issues may be surrounding external validity. Another viewpoint is to attain greater confidence in the validity by repeating the procedure several times. The sample is randomly divided and each sample is tested for validity via the creation of the classification matrix and the relevant hit ratio. The average hit ratio could then be calculated from the several results. Other methods include the U-method and the jackknife

method which are based on leaving one of the functions out and testing repeatedly, however sample sizes are required to be significantly large enough to offer reliable results.

Internal and external validity of the discriminant function is also addressed at the sixth stage. By assessing the results of the holdout or validation sample the discriminant analysis results from the analysis sample can be confirmed. Internal validity is already established as both samples were obtained from the main sample. As seen in Table 4.6 the classification results have also provided insight into the group predictions of both samples. Selection of both individual variables demonstrated further accuracy toward the discriminant model derived in the analysis. Further steps could be taken to provide extensive validation by means of profiling of the groups and cross-validation of additional samples. These actions were considered to be beyond the scope of this research.

Classification Results for Analysis Sample(a)

			Predicted Group Membership		
		eGovernment systems	1	2	Total
Original	Count	1	20	9	29
		2	9	22	31
	%	1	69.0	31.0	100.0
		2	29.0	71.0	100.0

a 70.0% of original grouped cases correctly classified.

Classification Results for Validation Sample(a)

			Predicted Group Membership		
		eGovernment systems	1	2	Total
Original	Count	1	13	4	17
		2	8	15	23
	%	1	76.5	23.5	100.0
		2	34.8	65.2	100.0

a 70.0% of original grouped cases correctly classified.

Table 4.6: Classification Results for Analysis and Validation Samples

Results summary for use of Secure Access or Transactions

Stage 4: Estimation of Discriminant Model and Assessing Overall Fit

Panel 1: Independent variable group statistics.

Secure Access or Transactions		Mean	Std. Deviation
1 = Yes	Industrial Sector	5.842	1.675
	No. of Employees	2.263	.561
	Annual Turnover	3.421	.961
	Time Trading	1.947	.229
	Manager's Experience	-.608	.777
	Online Partner's Trust	.007	.539
	Business Partners	-.172	1.210
	Perceived Benefits	-.028	1.085
	Competitors Performance	.130	.834
2 = No	Industrial Sector	5.230	1.979
	No. of Employees	2.230	.583
	Annual Turnover	2.512	1.315
	Time Trading	1.820	.720
	Manager's Experience	.058	.990
	Online Partner's Trust	.213	.933
	Business Partners	-.024	.848
	Perceived Benefits	-.157	.945
	Competitors Performance	-.026	1.071

Panel 2: Tests of significance between independent variables within groups.

Total		Mean	Std. Deviation	Wilks' Lambda	F	df (1/2)	Sig.
	Industrial Sector	5.431	1.892	.977	1.341	1,56	.252
	No. of Employees	2.241	.571	.999	.040	1,56	.842
	Annual Turnover	**2.810**	**1.276**	**.887**	**7.164**	**1,56**	**.010**
	Time Trading	1.862	.605	.990	.556	1,56	.459
	Manager's Experience	**-.159**	**.971**	**.894**	**6.605**	**1,56**	**.013**
	Online Partner's Trust	.145	.826	.986	.790	1,56	.378
	Business Partners	-.072	.973	.995	.295	1,56	.589
	Perceived Benefits	-.115	.985	.996	.214	1,56	.646
	Competitors Performance	.024	.995	.994	.314	1,56	.577

Table 4.7: Group descriptive statistics for use of Secure Access or Transactions.

Panel 1 on Table 4.7 illustrates group statistics such as the mean and standard deviation for each independent variable. Panel 2 on Table 4.7 shows the Wilk's lambda and the univariate F Ratio to test the significance between the means of the independent variables for the two groups. The results indicate that seven of the nine variables show significant univariate differences between the two groups and that the independent variable associated with Annual Turnover and Manager's Experience was significantly different.

Step	Entered	Min. D^2	F Statistic	df 1,2	Sig.	Lambda	Canonical correlation	Chi-Square	df	Sig.	Structure Matrix
1	**Annual Turnover**	.561	7.164	1,56	.010	.887	.435	11.519	2	.003	.741
2	**Manager's Experience**	1.021	6.407	2,56	.003	.811					-.712

Table 4.8: Stepwise statistics, levels of significance and canonical correlation measures.

The Malalobis distance between the groups has identified that Annual Turnover and Manager's Experience as being the independent variables that have the maximum discrimination of the groups. With each step the residual variables are assessed and in this example there were two independent variables that were indicated as being significant. Table 4.8 illustrates the stepwise statistics with Annual Turnover being confirmed as being considerable with levels of the Malalobis D^2 measure significant at .010 and Manager's Experience at .003.

As illustrated in Table 4.8, the discriminant function displays a canonical function of .435 and gives indication on the extent Annual Turnover and Manager's Experience can be accounted for or explained by the model. Table 4.9 indicates the group centroids for adopters of Secure Access or Transactions (group1) is .679 whereas the group centroid for non-adopters of the Secure Access or Transactions (group2) is -.331. The summary of canonical discriminant functions on Table 4.9 supports the classification results of ranking obtained from the Stepwise functions.

The Standardised Canonical Function Coefficients also displayed in Table 4.9 indicate that there is a positive relationship between Secure Access and Transactions and the type of Annual Turnover (.704). The value indicated for the Manager's Experience (-.672) indicates a negative relationship; however the value is reversed as the original question required a negative response and therefore the relationship is actually a positive one.

	Secure Access or Transactions		
	1=Yes	2=No	
Functions at Group Centroids (unstandardised canonical discriminant functions evaluated at group means)	.679	-.331	
Canonical Function Coefficients			Standardised Canonical Function Coefficients
Annual Turnover	2.303	1.716	.704
Manager's Experience	-.540	.193	-.672
(Constant)	-4.796	-2.855	

Table 4.9: Functions at group centroids, canonical function coefficients (Fisher's linear discriminant functions) and standardised canonical function coefficients.

Stage 5: Interpretation of the Results

Table 4.10 illustrates the status of the discriminant loadings, F ratio and standardized weights indicated that the ranking of the independent variables are confirmed. It can then be considered that there is a significant relationship between the SMEs annual turnover and the manager's experience in ICT with regards to the level of adoption of Secure Access or Transactions online.

	Standardised Weights	Discriminant Loadings	Rank	F Ratio	Rank
Industrial Sector	NI	-.172	9	.053	7
No. of Employees	NI	.070	5	.009	9
Annual Turnover	**NI**	**.131**	**4**	**.514**	**6**
Time Trading	NI	-.090	8	1.413	4
Manager's Experience	**NI**	**.140**	**3**	**1.139**	**5**
Online Partner's Trust	.880	.835	1	16.717	1
Business Partners	NI	.056	6	.048	8
Perceived Benefits	.552	.480	2	5.525	2
Competitors Performance	NI	-.014	7	3.490	3

NI: Not included in stepwise solution

Table 4.10: Summary of Interpretive Measures for Discriminant Analysis

Stage 6: Validation of results

As illustrated in Table 4.11, the analysis sample resulted in 70.7% of grouped cases being correctly classified and in the validation sample 65% of the grouped cases were correctly classified. Internal and external validation has been confirmed.

Classification Results Analysis Sample(a)

		Secure Access or Transactions	Predicted Group Membership		Total
			1	2	
Original	Count	1	15	4	19
		2	13	26	39
	%	1	78.9	21.1	100.0
		2	33.3	66.7	100.0

a 70.7% of original grouped cases correctly classified.

Classification Results Validation Sample(a)

		Secure Access or Transactions	Predicted Group Membership		Total
			1	2	
Original	Count	1	12	5	17
		2	9	14	23
	%	1	70.6	29.4	100.0
		2	39.1	60.9	100.0

a 65.0% of original grouped cases correctly classified.

Table 4.11: Classification Results for Analysis and Validation Samples.

Results summary for use of the Internet to publish a catalogue

Stage 4: Estimation of Discriminant Model and Assessing Overall Fit

Panel 1: Independent variable group statistics

Internet to publish a catalogue		Mean	Std. Deviation
1 = Yes	Industrial Sector	5.653	1.917
	No. of Employees	2.153	.367
	Annual Turnover	2.961	1.112
	Time Trading	1.769	.429
	Manager's Experience	-.283	.489
	Online Partner's Trust	-.092	.472
	Business Partners	-.314	.467
	Perceived Benefits	-.266	.892
	Competitors Performance	-.022	.794
2 = No	Industrial Sector	5.250	1.883
	No. of Employees	2.312	.692
	Annual Turnover	2.687	1.401
	Time Trading	1.937	.715
	Manager's Experience	-.059	1.233
	Online Partner's Trust	.339	.994
	Business Partners	.123	1.215
	Perceived Benefits	.007	1.053
	Competitors Performance	.063	1.143

Panel 2: Tests of significance between independent variables within groups.

Total		Mean	Std. Deviation	Wilks' Lambda	F	df (1/2)	Sig.
	Industrial Sector	5.431	1.892	.989	.649	1,56	.424
	No. of Employees	2.241	.571	.981	1.107	1,56	.297
	Annual Turnover	2.810	1.276	.988	.657	1,56	.421
	Time Trading	1.862	.605	.981	1.110	1,56	.297
	Manager's Experience	-.159	.971	.987	.755	1,56	.389
	Online Partner's Trust	**.145**	**.826**	**.931**	**4.138**	**1,56**	**.047**
	Business Partners	-.072	.973	.949	2.999	1,56	.089
	Perceived Benefits	-.115	.985	.981	1.105	1,56	.298
	Competitors Performance	.024	.995	.998	.106	1,56	.746

Table 4.12: Group Descriptive Statistics for use of the Internet to publish a catalogue.

Pane

l 1 on Table 4.12 illustrates group statistics such as the mean and standard

deviation for each independent variable. Panel 2 on Table 4.12 shows the Wilk's lambda and the univariate F Ratio to test the significance between the means of the independent variables for the two groups. The results indicate that eight of the nine variables show significant univariate differences between the two groups and that the independent variable associated with Online Partner's Trust was significantly different.

Step	Entered	Min. D^2	F Statistic	df 1,2	Sig.	Lambda	Canonical correlation	Chi-Square	df	Sig.	Structure Matrix
1	**Online Partner's Trust**	.288	4.138	1,56	.047	.931	.262	3.957	2	.047	1.000

Table 4.13: Stepwise statistics, levels of significance and canonical correlation measures.

The Malalobis distance between the groups has identified the Online Partner's Trust as being the independent variable that has the maximum discrimination of the groups. With each step the residual variables are assessed and in this example there was one independent variable that is indicated as being significant. Table 4.13 illustrates the stepwise statistics with the Online Partner's Trust being confirmed as being considerable with levels of the Malalobis D^2 measure significant at .288.

As illustrated in Table 4.13, the discriminant function displays a canonical function of .262 and gives indication on the extent identified the Online Partner's Trust can be accounted for or explained by the model. Table 4.14 indicates the group centroids for adopters of the Internet to publish a catalogue (group1) is -.296 whereas the group centroid for non-adopters of the Internet to publish a catalogue (group2) is .241. The summary of canonical discriminant functions on Table 4.14 supports the classification results of ranking obtained from the Stepwise functions. The Standardised Canonical Function Coefficients also displayed in Table 4.14 indicate that there is a positive relationship between use of the Internet to publish a catalogue and the Online Partner's Trust (1.000).

	Internet to publish a catalogue		
	1=Yes	2=No	
Functions at Group Centroids (unstandardised canonical discriminant functions evaluated at group means)	-.296	.241	
Canonical Function Coefficients			Standardised Canonical Function Coefficients
Online Partner's Trust	-.143	.524	1.000
(Constant)	-.700	-.782	

Table 4.14: Functions at group centroids, canonical function coefficients (Fisher's linear discriminant functions) and standardised canonical function coefficients.

Stage 5: Interpretation of the Results

As illustrated in Table 4.15, the status of the discriminant loadings, F ratio and standardized weights indicated that the ranking of the independent variables are confirmed. It can then be considered that there is a significant relationship between the level of trust in a business partner online and the adoption of ICT to enable a catalogue to be published online.

	Standardised Weights	Discriminant Loadings	Rank	F Ratio	Rank
Industrial Sector	NI	-.172	5	.649	8
No. of Employees	NI	.010	9	1.107	4
Annual Turnover	NI	.072	7	.657	7
Time Trading	NI	-.304	3	1.110	3
Manager's Experience	NI	.177	4	.755	6
Online Partner's Trust	**1.000**	**1.000**	**1**	**4.138**	**1**
Business Partners	NI	.055	8	2.999	2
Perceived Benefits	NI	.480	2	1.105	5
Competitors Performance	NI	.125	6	.106	9

NI: Not included in stepwise solution

Table 4.15: Summary of Interpretive Measures for Discriminant Analysis

Stage 6:

Validation of results

As illustrated in Table 4.16, the analysis sample resulted in 55.2% of grouped cases being correctly classified. Internal and external validation has been confirmed. The level of validation is not as conclusive as the two previously illustrated analyses, however the statistical power of secondary indicators have confirmed the significance of the results. Validation statistics resulting from tests for equality of group means, Box's test and the resulting individual variable selected from the stepwise statistic all give confirmation of validity to the analysis sample results.

Classification Results(a)

		Internet to publish a catalogue	Predicted Group Membership		Total
			1	2	
Original	Count	1	22	4	26
		2	22	10	32
	%	1	84.6	15.4	100.0
		2	68.8	31.3	100.0

a 55.2% of original grouped cases correctly classified.

Table 4.16: Classification Results for Analysis - No Validation Sample

Results summary for use of the Internet to make purchases

Stage 4: Estimation of Discriminant Model and Assessing Overall Fit

Panel 1: Independent variable group statistics

Internet to make purchases		Mean	Std. Deviation
1 = Yes	Industrial Sector	5.382	1.938
	No. of Employees	2.235	.495
	Annual Turnover	2.911	1.055
	Time Trading	1.941	.488
	Manager's Experience	-.274	.608
	Online Partner's Trust	-.184	.188
	Business Partners	-.049	.928
	Perceived Benefits	-.361	.804
	Competitors Performance	-.176	.758
2 = No	Industrial Sector	5.500	1.865
	No. of Employees	2.250	.675
	Annual Turnover	2.666	1.551
	Time Trading	1.750	.737
	Manager's Experience	.002	1.327
	Online Partner's Trust	.613	1.118
	Business Partners	-.106	1.053
	Perceived Benefits	.233	1.124
	Competitors Performance	.309	1.218

Panel 2: Tests of significance between independent variables within groups.

Total		Mean	Std. Deviation	Wilks' Lambda	F	df (1/2)	Sig.
	Industrial Sector	5.431	1.892	.999	.053	**1,56**	.818
	No. of Employees	2.241	.571	1.000	.009	1,56	.924
	Annual Turnover	2.810	1.276	.991	.514	1,56	.476
	Time Trading	1.862	.605	.975	1.413	1,56	.240
	Manager's Experience	-.159	.971	.980	1.139	1,56	.290
	Online Partner's Trust	**.145**	**.826**	**.770**	**16.717**	**1,56**	**.000**
	Business Partners	-.072	.973	.999	.048	1,56	.827
	Perceived Benefits	**-.115**	**.985**	**.910**	**5.525**	**1,56**	**.022**
	Competitors Performance	.024	.995	.941	3.490	1,56	.067

Table 4.17: Group Descriptive Statistics for use of the Internet to make purchases.

Panel 1 on Table 4.17 illustrates group statistics such as the mean and standard deviation for each independent variable. Panel 2 on Table 4.17 shows the Wilk's lambda and the univariate F Ratio to test the significance between the means of the independent variables for the two groups. The results indicate that seven of the nine variables show significant univariate differences between the two groups and that the independent variable associated with Online Partner's Trust and Perceived Benefits was significantly different.

Step	Entered	Min. D^2	F Statistic	df 1,2	Sig.	Lambda	Canonical correlation	Chi-Square	df	Sig.	Structure Matrix
1	**Online Partner's Trust**	1.188	16.717	1,56	.000	.770	.547	15.905	2	.000	.835
2	**Perceived Benefits**	1.704	11.770	2,56	.001	.700					.480

Table 4.18: Stepwise statistics, levels of significance and canonical correlation measures.

The Malalobis distance between the groups has identified that Online Partner's Trust and Perceived Benefits as being the independent variables that have the maximum discrimination of the groups. With each step the residual variables are assessed and in this example there were two independent variables that were indicated as being significant. Table 4.18 illustrates the stepwise statistics with Online Partner's Trust being confirmed as being considerable with levels of the Malalobis D^2 measure significant at .000 and Perceived Benefits at .001.

As illustrated in Table 4.18, the discriminant function displays a canonical function of .547 and gives indication on the extent Online Partner's Trust and Perceived Benefits can be accounted for or explained by the model. Table 4.19 indicates the group centroids for adopters of Internet to make purchases (group1) is -.540 whereas the group centroid for non-adopters Internet to make purchases (group2) is .765. The summary of canonical discriminant

functions on Table 4.19 supports the classification results of ranking obtained from the Stepwise functions. The Standardised Canonical Function Coefficients also displayed in Table 4.19 indicate that there is a positive relationship between use of the Internet to make purchases and the Online Partner's Trust (.880) as well as the Perceived Benefits of ICT (.552).

	Internet to make purchases		
	1=Yes	2=No	
Functions at Group Centroids (unstandardised canonical discriminant functions evaluated at group means)	-.540	.765	
Canonical Function Coefficients			Standardised Canonical Function Coefficients
Online Partner's Trust	2.303	1.716	.880
Perceived Benefits	-.540	.193	.552
(Constant)	-4.796	-2.855	

Table 4.19: Functions at group centroids, canonical function coefficients (Fisher's linear discriminant functions) and standardised canonical function coefficients.

Stage 5: Interpretation of the Results

As illustrated in Table 4.20, the status of the discriminant loadings, F ratio and standardized weights indicated that the ranking of the independent variables are confirmed. It can then be considered that there is a significant relationship between the level of trust in a business partner online and the perceived benefits of adoption of ICT to enable purchasing online.

	Standardised Weights	Discriminant Loadings	Rank	F Ratio	Rank
Industrial Sector	NI	-.172	9	.053	7
No. of Employees	NI	.070	5	.009	9
Annual Turnover	NI	.131	4	.514	6
Time Trading	NI	-.090	8	1.413	4
Manager's Experience	NI	.140	3	1.139	5
Online Partner's Trust	**.880**	**.835**	**1**	**16.717**	**1**
Business Partners	NI	.056	6	.048	8
Perceived Benefits	**.552**	**.480**	**2**	**5.525**	**2**
Competitors Performance	NI	-.014	7	3.490	3

NI: Not included in stepwise solution

Table 4.20: Summary of Interpretive Measures for Discriminant Analysis

Stage 6: Validation of results

As illustrated in Table 4.21, the analysis sample resulted in 74.1% of grouped cases being correctly classified. Internal and external validation has been confirmed. The statistical power of secondary indicators has confirmed the significance of the results. Validation statistics resulting from tests for equality of group means, Box's test and the resulting individual variable selected from the stepwise statistic all give confirmation of validity to the analysis sample results.

Classification Results(a)

		Internet to make purchases	Predicted Group Membership		Total
			1	2	
Original	Count	1	27	7	34
		2	8	16	24
	%	1	79.4	20.6	100.0
		2	33.3	66.7	100.0

a 74.1% of original grouped cases correctly classified.

Table 4.21: Classification Results for Analysis - No Validation Sample

Results summary for use of Online payment systems

Stage 4: Estimation of Discriminant Model and Assessing Overall Fit

Panel 1: Independent variable group statistics

Online payment systems		Mean	Std. Deviation
1 = Yes	Industrial Sector	6.352	1.538
	No. of Employees	2.294	.771
	Annual Turnover	3.176	1.236
	Time Trading	2.000	.500
	Manager's Experience	-.588	.868
	Online Partner's Trust	.008	.558
	Business Partners	-.161	1.011
	Perceived Benefits	.142	1.189
	Competitors Performance	-.035	.972
2 = No	Industrial Sector	5.048	1.909
	No. of Employees	2.219	.474
	Annual Turnover	2.658	1.276
	Time Trading	1.804	.641
	Manager's Experience	.017	.966
	Online Partner's Trust	.202	.914
	Business Partners	-.036	.967
	Perceived Benefits	-.222	.882
	Competitors Performance	.049	1.015

Panel 2: Tests of significance between independent variables within groups.

Total		Mean	Std. Deviation	Wilks' Lambda	F	df (1/2)	Sig.
	Industrial Sector	**5.431**	**1.892**	**.900**	**6.228**	**1,56**	**.016**
	No. of Employees	2.241	.571	.996	.202	1,56	.655
	Annual Turnover	**2.810**	**1.276**	**.965**	**2.013**	**1,56**	**.162**
	Time Trading	1.862	.605	.978	1.254	1,56	.268
	Manager's Experience	-.159	.971	.918	5.005	1,56	.029
	Online Partner's Trust	.145	.826	.988	.662	1,56	.419
	Business Partners	-.072	.973	.997	.195	1,56	.661
	Perceived Benefits	-.115	.985	.971	1.661	1,56	.203
	Competitors Performance	.024	.995	.998	.086	1,56	.770

Table 4.22: Group Descriptive Statistics for Online Payment Systems.

Panel 1 on Table 4.22 illustrates group statistics such as the mean and standard deviation for each independent variable. Panel 2 on Table 4.22 shows the Wilk's lambda and the univariate F Ratio to test the significance between the means of the independent variables for the two groups. The results indicate that seven of the nine variables show significant univariate differences between the two groups and that the independent variable associated with Industrial Sector and Annual Turnover was significantly different.

Step	Entered	Min. D^2	F Statistic	df 1,2	Sig.	Lambda	Canonical correlation	Chi-Square	df	Sig.	Structure Matrix
1	**Industrial Sector**	.518	6.228	1,56	.016	.900	.426	11.016	2	.004	.708
2	**Annual Turnover**	1.033	6.099	2,56	.004	.818					.403

Table 4.23: Stepwise statistics, levels of significance and canonical correlation measures.

As illustrated in Table 4.23, the discriminant function displays a canonical function of .426 and gives indication on the extent Industrial Sector and Annual Turnover can be accounted for or explained by the model. Table 4.24 indicates the group centroids for adopters of Online Payment Systems (group1) is .719 whereas the group centroid for non-adopters of Online Payment Systems (group2) is -.298. The summary of canonical discriminant functions on Table 4.24 supports the classification results of ranking obtained from the Stepwise functions. The Standardised Canonical Function Coefficients also displayed in Table 4.24 indicate that there is a positive relationship between Online Payment Systems and the Industrial Sector (.982) and for Annual Turnover (.757).

	Online payment systems		
	1=Yes	2=No	
Functions at Group Centroids (unstandardised canonical discriminant functions evaluated at group means)	.719	-.298	
Canonical Function Coefficients			Standardised Canonical Function Coefficients
Industrial Sector	2.802	2.251	.982
Annual Turnover	3.432	2.824	.757
(Constant)	-15.044	-10.129	

Table 4.24: Functions at group centroids, canonical function coefficients (Fisher's linear discriminant functions) and standardised canonical function coefficients.

Stage 5: Interpretation of the Results

Table 4.25 illustrates the status of the discriminant loadings, F ratio and standardized weights indicated that the ranking of the independent variables are confirmed. It can then be considered that there is a significant relationship between the SMEs annual turnover and the manager's experience in ICT with regards to the level of adoption of Online Payment Systems.

	Standardised Weights	Discriminant Loadings	Rank	F Ratio	Rank
Industrial Sector	**.982**	**.708**	**1**	**6.228**	**1**
No. of Employees	NI	.319	3	.202	7
Annual Turnover	**.757**	**.403**	**2**	**2.013**	**3**
Time Trading	NI	.081	7	1.254	5
Manager's Experience	NI	-.261	4	5.005	2
Online Partner's Trust	NI	-.087	6	.662	6
Business Partners	NI	.063	8	.195	8
Perceived Benefits	NI	-.022	9	1.661	4
Competitors Performance	NI	.223	5	.086	9

NI: Not included in stepwise solution

Table 4.25: Summary of Interpretive Measures for Discriminant Analysis

Stage 6:

Validation of results

As illustrated in Table 4.26, the analysis sample resulted in 71.7% of grouped cases being correctly classified and in the validation sample 74.3% of the grouped cases were correctly classified. Internal and external validation has been confirmed.

Classification Results for Analysis Sample(a)

		Online payment systems	Predicted Group Membership		Total
			1	2	
Original	Count	1	14	4	18
		2	13	29	42
	%	1	77.8	22.2	100.0
		2	31.0	69.0	100.0

a 71.7% of original grouped cases correctly classified.

Classification Results for Validation Sample(a)

		Online payment systems	Predicted Group Membership		Total
			1	2	
Original	Count	1	8	4	12
		2	5	18	23
	%	1	66.7	33.3	100.0
		2	21.7	78.3	100.0

a 74.3% of original grouped cases correctly classified.

Table 4.26: Classification Results for Analysis and Validation Samples

4.3. Chapter Summary

The results obtained from the data analysis has been presented and discussed in this chapter. A substantial amount of the predictor variables have been fully or partially supported by the findings. The observed relationships and the strength between the variables are discussed further in the next chapter and referred back to the original proposals.

5. DISCUSSION

5.1. Introduction

The results documented in the previous chapter require some explanation in relevance to the original concepts outlined in the introductory chapter of this dissertation. The discussion aims to illustrate the findings in the context of the research question. The hypotheses are assessed against the results documented from the data analysis. An analysis of the results in general will be discussed in relation to the literature relating to the subject.

5.2. General Overview of Findings

Table 5.1 illustrates the extent and strength of the relationship for each predictor when evaluated against the type of ICT identified as being significant to the research. A pattern has emerged between the relationships that are supported fully or partially by the initial propositions and hypotheses. The predictors indicated in the results for specific levels of ICT activities indicate strong links with such issues as trust, turnover and the type of sector that the SME operates within.

The ICT activities and products obtained in the results have indicated support for the principle of an evolutionary basis of ICT uptake. The use of the Internet to make purchases is indicative of the early stages of enhanced functionality online. A strong indicating factor supporting an environment conducive to supporting this activity is the level of trust in partners from which trade is being carried out online. A second indicating factor supporting this ICT activity is the notion of the perceived benefits gained as a result of taking on the technology. The significance to the strength of the relationship between the perceived benefits and purchasing on the Internet is less and is indicated by a lower discriminant weight (.552). It can then be stated that the online partner's trust

is a strong predictor and the perceived benefits are a medium predictor to enable purchasing on the Internet.

The matrix (Table 5.1) also indicates a strong relationship between the level of trust in the online partner and the use of the Internet to publish a catalogue. The discriminant weight is the highest of all results and would indicate a very strong relationship between the two variables. A statement then can be made that indicates that the online partner's trust is a strong predictor to enable publishing a catalogue on the Internet. Both purchasing and publishing a catalogue on the Internet would be considered to be activities that would be considered to be within the early part of Stage 2 or Provision stage of the MICA according to Lawson (2003) and Burgess (1998). Further to this framework the subsequent activities identified in Table 5.1 are indicative of higher levels of ICT usage.

Type of ICT and predictors	Internet to make Purchases	Internet to publish Catalogue	Online Payment System	Secure Access and Transactions	eGovernment Systems
Industrial Sector			.982 High		.998 High
No. of Employees					
Annual Turnover			.757 High	.704 Medium	.799 High
Time Trading					
Manager's Experience				.672 Medium	
Online Partner's Trust	.880 High	1.000 High			
Business Partners					
Perceived Benefits	.552 Medium				
Competitors Performance					

Table 5.1: A relationship matrix between independent and dependent variables from discriminant analysis results.

As indicated in Table 5.1, a relationship exists between the type of industrial sector and annual turnover as well as the use of online payment systems. Both of the predictors indicate a strong relationship between the three components. It is then considered that the type of industrial sector and the level of annual turnover are both strong predictors toward enabling online payment systems for SMEs.

The use of secure access and transactions is considered also to be an increasingly sophisticated form of ICT. As indicated in Table 5.1 there is a relationship between annual turnover and manager's experience with the use of secure access and transactions online. Both predicting factors represent medium discriminant weights and therefore each represents a medium relationship with the ICT activity. It can then be stated that annual turnover and manager's experience are both medium predictors toward secure access and transactions online.

Interactions online between SMEs and government agencies for such activities as taxation or business registrations are indicated as having a substantial level of use by SMEs. From Table 5.1 there is a relationship between the type of industrial sector and annual turnover in conjunction with the use of eGovernment ICT activities. Both predictors indicate strong discriminant weights toward the relationship. A conclusion can be made that annual turnover and manager's experience are both strong predictors toward SMEs accessing the Internet for business interactions with government agencies online.

The results illustrated in Table 5.1 indicate that some predictor variables have very strong relationships with multiple ICT activities while others may only have mild relationships with one ICT activity. The predictors indicating perceived benefits and managers experience both have medium effect in the relationship with the ICT activity and serve only as a secondary indicator of the relationship with a stronger predictor. This does not diminish the effect that the predictor has in supporting the explanation of the relationship. The predictors indicating industrial sector, annual turnover and online partners

trust all have associations with multiple ICT activities. The predicting power can be indicated as being very strong with the activities that they are associated with. The annual turnover predictor is related to three ICT activities and therefore could be stated that the level of annual turnover is the strongest predictor for enabling higher end ICT activities for SMEs.

Another pattern is required to be illustrated within the results shown in Table 5.1. As previously described, the ICT activities of purchasing and publishing a catalogue on the Internet can be described as being indicative of lower ICT than online payment systems, secure access and transactions and eGovernment systems. Purchasing and publishing a catalogue on the Internet are also higher ICT activities than use of email and adoption of a static website on the Internet. Specific predictors have associated with either medium ICT (purchasing and publishing) or higher ICT (online payment, secure access/transactions and eGovernment). The predictors are able to be classified into one of four factor categories as stated in Rashid's (2001) framework for technology adoption. Furthermore the association pattern indicates that specific predictors are stronger determinants toward certain ICT activities relative to the complexity of the technology. Figure 5.1indicates the classification of the predictors in relation to Rashid's framework categories.

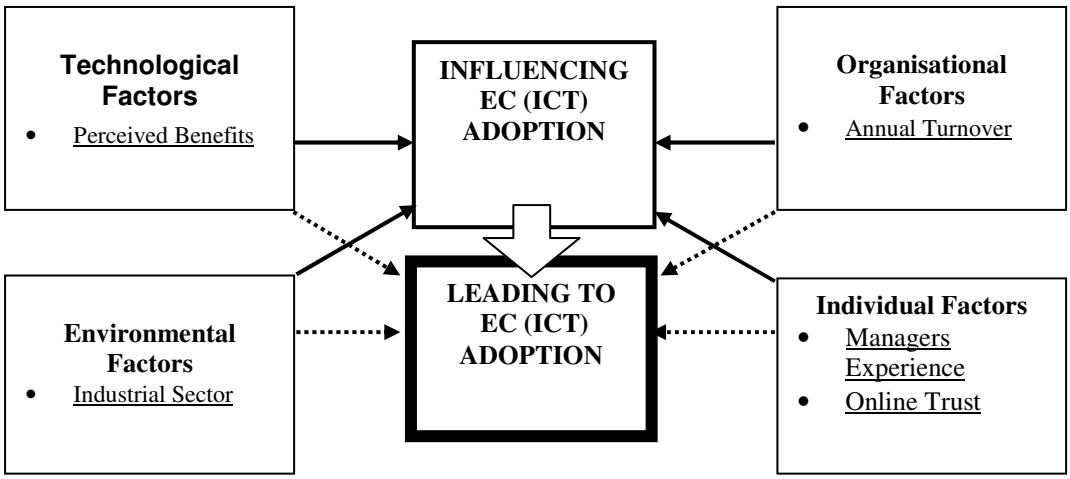

Figure 5.1: Modified version of Rashid's (2001) adoption framework illustrating categorised predictors from results.

From the modified framework illustrated in Figure 5.1 all four factors are represented within the predictor variables. It can then be observed that the perceived benefit predictor of ICT is a technological influential factor and is a medium predictor of purchasing on the Internet. Therefore this technological factor has a medium effect on enabling medium level ICT activities. Trusting an online partner is an individual influential factor and is a strong predictor of both purchasing and publishing a catalogue on the Internet. Therefore this individual influential factor has a strong effect on enabling medium level ICT activities.

Figure 5.1 also indicates that the manager's experience is an individual influential factor and is a medium predictor of secure access and transactions. Therefore this individual influential factor has a medium effect on enabling high level ICT activities. The industrial sector predictor has been identified as being an environmental influential factor and is a strong predictor of both online payment systems and eGovernment systems. It can then be stated that this environmental factor is a strong predictor on enabling high level ICT activities. The annual turnover of a SME has been identified as being an organisational influential factor and is a medium predictor of secure access and transaction systems but also a strong predictor of both online payment systems and eGovernment systems. This organisational factor can be identified as being a strong predictor on enabling high level ICT into SMEs.

A theoretical framework has been created to illustrate the relationships that have been discussed in this section. Figure 5.2 attempts to display the position of the resulting ICT activities in reference to their position on the MICA scale process as discussed by Lawson (2003) and earlier by Burgess (1998). Furthermore the illustration of Rashid's (2001) influential factor framework has been overlayed to explain the significance of the various influences at specific stages of ICT enablement. Earl's (2000) evolutionary scale of ICT adoption has also been overlayed onto the MICA to give validity and to enable a point of reference to both frameworks. The hypotheses can now be evaluated on the basis of the previously discussed results and relationships.

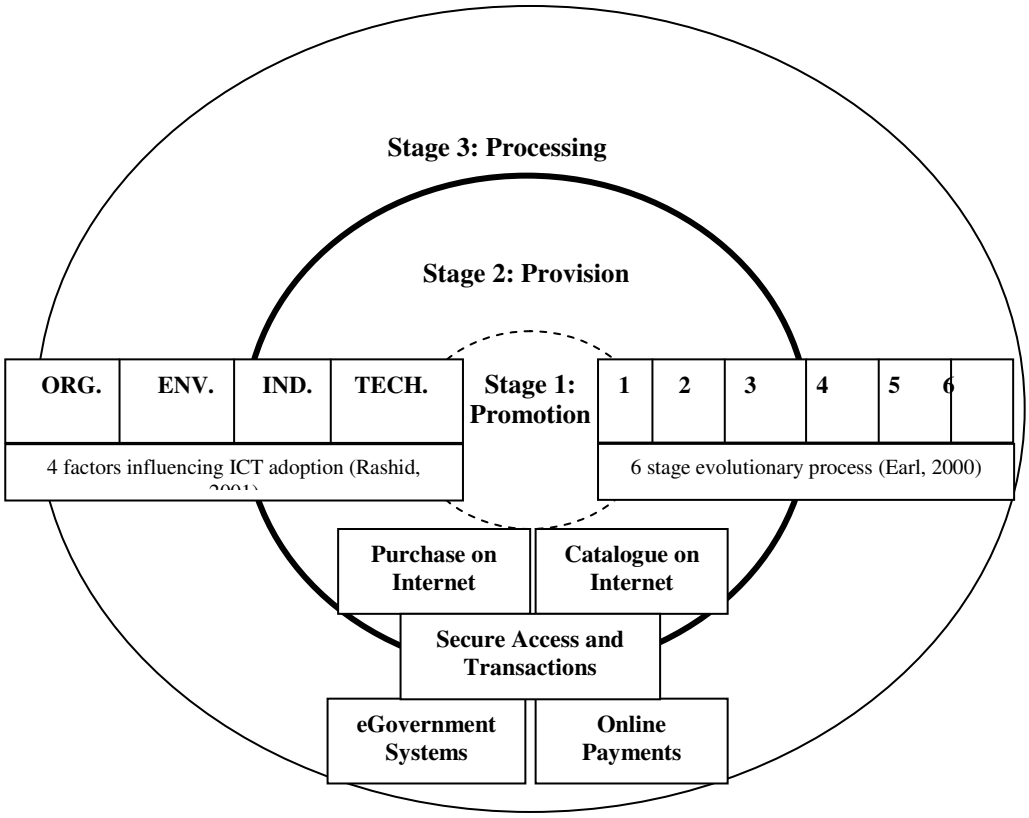

Figure 5.2: A theoretical framework for usage levels of ICT products and procedures according to their relative position on the MICA stage process (Lawson, 2003).

The 10 hypotheses tested in the data analysis are evaluated on the basis of the results. Most of the relationships identified from the data analysis support or partially support the hypotheses developed in the introductory section of this dissertation. An evaluation of the propositions and relative hypotheses has also supported the theoretical framework as illustrated in Figure 5.2.

- **P1:** Technological Factors have the major influence on decisions made by Owner-operators/Managers of SMEs during adoption of ICT products and services from Stage 1 to Stage 2.

  $H1_o$: SMEs involved in using the *Internet for Purchasing* have equal group means for the set of independent variables compared to the SMEs not involved in using the *Internet for Purchasing.*

This hypothesis is partially supported because there is a strong influence from an individual influential factor, namely trust in an online partner, as well as the technological factor of using the Internet for purchasing. It is considered that this ICT activity is possibly the least complex function and would be one of the first activities within the second stage of ICT evolution carried out within a SME. As indicated in Figure 5.2 the technological influential factor is considered to be the strongest influence at the earliest stage and therefore is supported at that level.

- **P2:** Individual Factors have the major influence on decisions made by Owner-operators/Managers of SMEs during adoption of ICT products and services in Stage 2.

  $H2_o$: SMEs involved in using the *Internet to Publish a Catalogue* have equal group means for the set of independent variables compared to the SMEs not involved in using the *Internet to Publish a Catalogue.*

This hypothesis is supported and is substantiated by the theoretical framework as indicated in Figure 5.2. Publishing a catalogue, while not adding a high level of functionality, assists in the provisional stage of ICT evolution for SMEs. Development of a static catalogue at this stage of evolution assists in confirming the potential of the Internet as a marketing platform to the owner-operator/manager.

- **P3:** Environmental Factors have the major influence on decisions made by Owner-operators/Managers of SMEs during adoption of ICT products and services from Stage 2 to Stage 3.

  $H3_o$: SMEs involved in using the *eGovernment Systems* have equal group means for the set of independent variables compared to the SMEs not involved in using *eGovernment Systems.*

This hypothesis is partially supported as a second influence has been identified as being significant in the relationship. Originally eGovernment systems were identified as an intermediary ICT function positioned between stages 2 and 3, however the results have indicated the activity is more complex and therefore has similar influences to online payment systems. Although environmental factors do influence the level of eGovernment systems usage, organisational factors are also a strong influence toward this relationship.

- **P4:** Environmental and Organisational Factors have the major influence on decisions made by Owner-operators/Managers of SMEs during adoption of ICT products and services in Stage 3.

  $H4_o$: SMEs involved in using *Online Payment Systems have* equal group means for the set of independent variables compared to the SMEs not involved in using *Online Payment Systems*.

This hypothesis is fully supported. The factors influencing the usage of this level of ICT activity indicate that usage in the high level ICT activities predominately require a substantial level of annual turnover and must be relevant to the type of industry the SME operates within.

$H5_o$: SMEs involved in using *Secure Access and Transactions have* equal group means for the set of independent variables compared to the SMEs not involved in using *Secure Access and Transactions*.

This hypothesis is partially supported as another factor has been indicated as being influential for enablement of the ICT activity. Although organisational factors are influential to usage of secure access and transactions, environmental factors are not evident in the relationship. Individual factors have been found to be a second influence in the enablement of secure access and transactions. Figure 5.2 indicates the location within the stage process that this ICT activity is positioned. The results from the testing of the

hypothesis have indicated that enablement of secure access and transactions are considered to be a lower level ICT activity than online payment and eGovernment systems.

5.3. Chapter Summary

The discussion of the results in this chapter has illustrated the significance of the relationships between the types and levels of ICT activities with the main predictors of enablement identified in the data analysis. The hypotheses have been evaluated in light of the results and have been either wholly or partially supported. The research findings have illustrated the relationships between the ICT activities and predictors in terms of the basis of a non-linear evolutionary scale. The results have given some support to several theoretical frameworks and exploratory research in the subject area. In the following chapter the limitations to the research are discussed as well as the significance the research has on enabling enhanced ICT activities by regional Australian SMEs. Potential future directions in this field of study are also considered.

6. CONCLUSIONS

In the concluding chapter a general overview of the research is discussed. The limitations to the study are illustrated to highlight possible improvements for further research in the subject area. Indications toward the practical implications of the findings are also considered.

6.1. Limitations of the study

Essentially this study has provided a broad illustration of the research subject. It provides an introduction into a field of research that can have the potential to give insight into increasing the adoption of ICT products and procedures within SMEs. Due to the broad subject area there is a limitation to the amount of detail that can be studied. Other studies could focus on aspects of this research to deliver further detail.

The study focussed on specific aspects of regional Australian SMEs. Considerations toward extrapolating the observations made in this study toward SMEs located in metropolitan areas must be made in this light. The relevance of the findings in this research may not be conclusive when compared to SMEs from differing geographies. Furthermore the study would not be able to be referred to as being consistent to SMEs on an international basis for similar reasons as different classification levels for SMEs exist in other countries.

There have been several limitations to the methodology of the research as well. The population used to sample from was highly researched from previous studies conducted from the University of Ballarat. Subsequently the researcher of this study experienced some degree of resistance to participation during the surveys and resulted in lower than expected response levels.

The telephone surveys had limitations in terms of the type of questions able to be asked of the respondents. The structure of the questions restricted the ability to have open questions and as a result may have missed out on

significant information to the research. The length of the questionnaire has also been considered as being a limiting factor as many respondents commented that the time taken to complete the survey was excessive.

The timeframe in which the survey was conducted possibly contributed to the lower than expected response rate. Part of the survey was conducted during a school holiday period and a significant number of businesses were too busy to participate. Furthermore many business operators were spending time on administrative activities such as the BAS statements for taxation and had limited time.

Despite these limitations there has been a high degree of knowledge attained from the study and will prove to be worthy of consideration by vested interests. The research can be used as a foundation for more study in the area of ICT usage in SMEs.

6.2. Future Research

This study would require further testing for consistency and reliability in order to be considered to be theoretically solid. Replication of the study on a similar sample must be conducted in order for the results to be confirmed.

Variations of this research could be run and prove to offer a clearer understanding of the issues. A combined qualitative and quantitative study could be one option thereby offering the possibility of greater understanding. Replication of this research on metropolitan or internationally based SMEs may identify unique variations between the subject groups thereby enhancing the body of research.

Greater focus on the government's role in this field could also be a matter for further study. The study could evaluate the effectiveness of various strategies and possible refine or enhance existing policy thereby assisting the usage of ICT within SMEs.

6.3. Conclusion

In general the study into the levels and type of ICT being used in regional Australian SMEs has identified significant influential factors that affect how the technology is being enabled. A theoretical framework has been formulated to explain the relationships identified from testing the propositions and relative hypotheses. The research has supported similar studies in this field and has tied together several theoretical concepts in order to explain the relationships. The study provides support for further research in ICT usage by SMEs or can contribute toward policy to further encourage ICT adoption within regional Australian SMEs.

APPENDICES

Appendix A: List of Measures within survey questionnaire.

- Section A: Business Characteristics.
    - Question 1. Sector of industry/service of business operation.
        - The respondent is required to select from a listing of fifteen sectors as standardised and measurable from the ABS.
        - The issue of organisation specialisation would be fielded from this question.
        - Data from answers to this question will also assist future research focusing on specific sectors that characteristically have failed to adopt ICT.
    - Question 2. Number of employees working in business
        - The answers available to the participant are standard within the ABS research in SME size measures.
        - This question directly highlights the organisational size of the business.
    - Question 3. Annual turnover of business.
        - The ABS research in SME size measures the turnover of the business.
        - This question directly highlights the organisational size of the business in terms of financial capability.
    - Question 4. Age of business.
        - A measurement of business in terms of age is again measurable against ABS statistics.
        - The organisational makeup of the business in terms of age is an important factor indicating length of time in the industry as well as possible indicators of family ownership, investment horizon and trust issues.

- Section B: Individual Manager's Characteristics
    - Question 1. Innovativeness.

- Three sub questions are asked of the participant evaluation the level of innovativeness regarding to their attitude to new technology.
- The measures have been derived from Scales Related to Innovativeness: Openness of Information Processing (Leavitt and Walton 1975, 1988) in (Bearden, 1999).

- Question 2. Managers Style
  - Three sub questions focus on elements pertaining to characteristics between administrative and entrepreneurial management styles
  - The measures for the questions are developed from the research regarding contrasts in management attitude in (Gagnon, 2000). Three important issues regarding short and long term planning, seeking new opportunities or maximising existing systems and the participant's perception of intuitiveness are addressed as discussed in Gagnon's literature.
- Question 3. Individual's perception of ICT knowledge.
  - Four sub questions explore the individual manager's consideration of their ICT knowledge currently operating within their business. The respondent is asked to evaluate their attitudes regarding their familiarity, knowledge, proficiency and education of ICT.
  - The theoretical background regarding acceptance of technology by managers in SMEs has been used in the development of measures for this issue (Kendall, 2001; Rashid, 2001).
- Question 4. Perception of ICT technical complexity in firm.
  - Four sub questions explore the manager's appraisal of their ICT currently operating within their business. The respondent is asked to evaluate their attitudes regarding the complexity, compatibility, cost, as well as advantages to developing the business and developing toward new markets.

        - The theory regarding the manager's evaluation of technology operating in the business has assisted in creation of measures for this issue (Dagdilelis, 2003; Rashid, 2001).

- Section C: ICT Planning and Activity
    - Question 1. Level of ICT usage within firm.
        - The participant is requested to identify the level of ICT use with their firm. The response indicates the evolutionary stage that the business operates in.
        - The measures are extracted from theory identifying a stage evolution of ICT adoption identifying use of specific technologies (Booty, 2000; CEC, 1996; Earl, 2000).
    - Question 2. Evaluation of level of adoption.
        - The participant is requested to evaluate the adequacy of ICT levels adopted.
        - The measures are developed from the same literature as Question 1 and indicate the manager's considerations for future adoption.
    - Question 3. Evaluation of ICT quality.
        - The participant is requested to evaluate the quality of ICT levels adopted.
        - The measures are sourced from research illustrating the compatibility of the technology for the business thus indicating considerations on planning (Bridge, 1999; Damanpour, 2001).
    - Question 4. Evaluation of level of ICT in relation to position in market.
        - Three sub questions are asked to determine the manager's perception of the level of ICT compared to their competition. The questions evaluate considerations of lagging behind, keeping up or being more competitive than similar firms.
        - The series of questions have been developed from measures regarding manager's concerns of planning for investing in ICT (Fariselli, 1999).

- Question 5. Intention of ICT investment within short term.
  - Participants are requested to indicate the probability of investing in ICT for the firm in the next 12 months.
  - The measures for the question originate from research indicating that managers who invest aggressively in ICT will increase the competitive advantages. The question also gives indication of levels of planning for investment.

Appendix B: Pilot test questionnaire

PILOT TEST QUESTIONNAIRE
ADOPTION OF ICT BY SMALL TO MEDIUM SIZED ENTERPRISES

Telephone Interview Questionnaire Script

INTRODUCTION

Good morning/afternoon I am *<interviewer name>* from the University of Ballarat. I was wondering if I could speak with *<owner/operator name>*.

If No:
Is there a more convenient time that I can call? etc
If Yes and being transferred:
Good morning/afternoon this is *<interviewer name>* from the University of Ballarat.
If Yes, and owner answered:
We are currently conducting a survey of small to medium sized enterprises in the Ballarat area.

The purpose of this study is to investigate the level of information and communication technology adoption and security adoption in small and medium sized business. The data collected will help us to better understand the factors that influence the adoption information and communication technologies and security by small to medium sized enterprises.

No identifying information will be recorded along with your answers, as we want all participants in the study to remain anonymous. All information collected will be treated with the strictest of confidence and only made available to those directly involved with the research.

I was wondering if I could take fifteen minutes of your time to ask some questions?

No:

Would you like us to call you at a more convenient time?

If no:

Goto closure and thank the person for their time.

If yes:

Participation in this research is voluntary. You are free to withdraw consent and to discontinue participation in the study at any time. Any unprocessed data provided by you will not be used if consent is withdrawn. By answering the questions today, you are giving this consent.

Section A: Business Characteristics

Section A. This section contains questions regarding your business.

1. What is the main sector in which your business operates?

O Mining
O Manufacturing
O Electricity and Gas
O Construction
O Wholesale trade
O Retail trade
O Accommodation
O Transport & Storage
O Communication services
O Finance and Insurance
O Property and business services
O Health and Community
O Cultural and Recreational services
O Personal and Other services
O Agriculture, hunting, fishing, forestry

2. What is the total number of full-time employees in your business?

O 1-5
O 6-25
O 26-50
O 51-100
O 101-200

O 200+

3. What is the annual business turnover (in Australian Dollars)?

O < $500,000
O $500,000-$1 M
O $1M - $3M
O $3M - $5M
O >$5M

4. HOW MANY YEARS HAS THE BUSINESS/FIRM BEEN TRADING FOR?

O <1
O 1-5
O 6-10
O 11-20
O 21-50
O 51-100
O 100+

5. THE FOLLOWING QUESTION ASKS ABOUT THE TYPE OF ICT USED IN YOUR BUSINESS

Please answer 'yes' or 'no' to the following options

Does you business use:

Email	O Yes	O No
The Internet to search for business information	O Yes	O No
A company web page:		
• Internally Hosted (In-house)	O Yes	O No
• Externally Hosted (Outsourced)	O Yes	O No
• Both Internal or External Hosting	O Yes	O No
Web Site Development		
• Internally Developed (In-house)	O Yes	O No
• Externally Developed (Outsourced)	O Yes	O No
• Both Internal or External Development	O Yes	O No
The Internet to make purchases	O Yes	O No
The Internet to publish a catalogue	O Yes	O No
The Internet to take orders	O Yes	O No
Shopping Cart Facilities	O Yes	O No
Online Payment System	O Yes	O No
Secure Access or Transactions	O Yes	O No
e-Banking	O Yes	O No
e-government systems	O Yes	O No

Supply chain management systems O Yes O No

I need you to respond to the following questions with one of the following responses:

Highly Likely	1
Likely	2
Unsure	3
Unlikely	4
Highly Unlikely	5

9. In seeking advice regarding ICT, I source information from

Magazines and Newspapers

Highly Likely **O O O O O** *Highly Unlikely*

1 2 3 4 5

Internet

Highly Likely **O O O O O** *Highly Unlikely*

1 2 3 4 5

Friends and family

Highly Likely **O O O O O** *Highly Unlikely*

1 2 3 4 5

Other Staff

Highly Likely **O O O O O** *Highly Unlikely*

1 2 3 4 5

Customers

Highly Likely **O O O O O** *Highly Unlikely*

1 2 3 4 5

Business Partners

Highly Likely **O O O O O** *Highly Unlikely*

1 2 3 4 5

External Consultants

Highly Likely **O O O O O** *Highly Unlikely*

1 2 3 4 5

Other organisations / Vendors

Highly Likely **O O O O O** *Highly Unlikely*

1 2 3 4 5

10. While planning for ICT I am influenced by

Magazines and Newspapers

Highly Likely **O O O O O** *Highly Unlikely*

1 2 3 4 5

Internet

Highly Likely **O O O O O** *Highly Unlikely*

1 2 3 4 5

Friends and family

Highly Likely **O O O O O** *Highly Unlikely*

1 2 3 4 5

Other Staff

Highly Likely **O O O O O** *Highly Unlikely*

1 2 3 4 5

Customers

Highly Likely **O O O O O** *Highly Unlikely*

1 2 3 4 5

Business Partners

Highly Likely **O O O O O** *Highly Unlikely*

1 2 3 4 5

External Consultants

Highly Likely **O O O O O** *Highly Unlikely*

1 2 3 4 5

Other organisations / Vendors

Highly Likely **O O O O O** *Highly Unlikely*

1 2 3 4 5

Section B: Individual Managers Characteristics

Section B contains questions, which relate to your individual characteristics.

I need you to respond to the following questions with one of the following responses:

Strongly Agree	1
Agree	2
Neutral	3
Disagree	4
Strongly disagree	5

1. Manager's innovativeness

I like to see how my competitors use new forms of ICT before I try them

Strongly Agree **O O O O O** *Strongly disagree*

1 2 3 4 5

I like to see how my competitors perform as a result of adopting new forms of ICT before I try them

Strongly Agree **O O O O O** *Strongly disagree*

1 2 3 4 5

I generally do not like to try new ideas in my business

Strongly Agree **O O O O O** *Strongly disagree*

1 2 3 4 5

I avoid adopting new and untested ICT products

Strongly Agree **O O O O O** *Strongly disagree*

1 2 3 4 5

I usually purchase ICT products that have been tested and are proven in the market place

Strongly Agree **O O O O O** *Strongly disagree*

1 2 3 4 5

2. As a manager, I:

Plan for short-term gains

Strongly Agree **O O O O O** *Strongly disagree*

1 2 3 4 5

Work toward maximising new opportunities

Strongly Agree **O O O O O** *Strongly disagree*

1 2 3 4 5

Am intuitive

Strongly Agree **O O O O O** *Strongly disagree*
1 2 3 4 5

Have long-term ambitions
Strongly Agree **O O O O O** *Strongly disagree*
1 2 3 4 5

Am uncomfortable with the way my business is operating
Strongly Agree **O O O O O** *Strongly disagree*
1 2 3 4 5

3. With regard to ICT, I consider myself to be

Familiar
Strongly Agree **O O O O O** *Strongly disagree*
1 2 3 4 5

Knowledgeable
Strongly Agree **O O O O O** *Strongly disagree*
1 2 3 4 5

Proficient
Strongly Agree **O O O O O** *Strongly disagree*
1 2 3 4 5

Educated
Strongly Agree **O O O O O** *Strongly disagree*
1 2 3 4 5

Constrained by a lack of time
Strongly Agree **O O O O O** *Strongly disagree*
1 2 3 4 5

Constrained by a lack of finances
Strongly Agree **O O O O O** *Strongly disagree*
1 2 3 4 5

4. I consider ICT to be

Complex
Strongly Agree **O O O O O** *Strongly disagree*

1 2 3 4 5

Compatible with needs of my business

Strongly Agree **O O O O O** *Strongly disagree*

1 2 3 4 5

Advantageous to developing my business

Strongly Agree **O O O O O** *Strongly disagree*

1 2 3 4 5

Advantageous to expanding markets

Strongly Agree **O O O O O** *Strongly disagree*

1 2 3 4 5

Advantageous to developing new markets

Strongly Agree **O O O O O** *Strongly disagree*

1 2 3 4 5

Too costly for the business

Strongly Agree **O O O O O** *Strongly disagree*

1 2 3 4 5

Too time consuming

Strongly Agree **O O O O O** *Strongly disagree*

1 2 3 4 5

Section C: Trust and Distrust

1. With regards to the organisations that I choose to transact with over the Internet, I have

Faith in them

Strongly Agree **O O O O O** *Strongly disagree*

1 2 3 4 5

Confidence in them

Strongly Agree **O O O O O** *Strongly disagree*

1 2 3 4 5

Hope that they will look after my interests

Strongly Agree **O O O O O** *Strongly disagree*

1 2 3 4 5

Assurances that they will look after my interests

Strongly Agree **O O O O O** *Strongly disagree*

1 2 3 4 5

The belief that they will use their initiative to look after my interests

Strongly Agree **O O O O O** *Strongly disagree*

1 2 3 4 5

3. With regards to using the Internet to transact with other organisations, I am

Sceptical

Strongly Agree **O O O O O** *Strongly disagree*

1 2 3 4 5

Cynical

Strongly Agree **O O O O O** *Strongly disagree*

1 2 3 4 5

Wary

Strongly Agree **O O O O O** *Strongly disagree*

1 2 3 4 5

Vigilant

Strongly Agree **O O O O O** *Strongly disagree*

1 2 3 4 5

Fearful

Strongly Agree **O O O O O** *Strongly disagree*

1 2 3 4 5

SECTION D: ICT ADOPTION

Please respond to the following questions with one of the following responses:

Strongly Agree	1
Agree	2
Neutral	3
Disagree	4
Strongly disagree	5

3. I am satisfied with the general level of ICT qualifications, training and or experience within my organisation?

Strongly agree **O O O O O** *Strongly disagree*
1 2 3 4 5

4. The level of ICT adopted is adequately meeting the needs of the business?

Strongly agree **O O O O O** *Strongly disagree*
1 2 3 4 5

5. The technology I have operating in the business is of high quality?

Strongly agree **O O O O O** *Strongly disagree*
1 2 3 4 5

6. With regards to the current level of ICT in my business:

I need to upgrade to match my competitors

Strongly agree **O O O O O** *Strongly disagree*
1 2 3 4 5

I am keeping up with my competitors

Strongly agree **O O O O O** *Strongly disagree*
1 2 3 4 5

I am ahead of my competitors

Strongly agree **O O O O O** *Strongly disagree*
1 2 3 4 5

CLOSURE

Thank you for participating in this study. Your time is appreciated and your answers will be very useful to help us better understand the factors that influence security and technology adoption.

If you have any questions concerning the procedures associated with this research you could contact the principle researcher:

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Alternatively if you have any concerns about the conduct of this research project, please contact

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Once again, thank you for your time. Enjoy the rest of your day.

Appendix C: Main Questionnaire

APPENDIX C: MAIN QUESTIONNAIRE
ADOPTION OF ICT BY SMALL TO MEDIUM SIZED ENTERPRISES

Telephone Interview Questionnaire Script

INTRODUCTION

Good morning/afternoon I am *<interviewer name>* from the University of Ballarat. I was wondering if I could speak with *<owner/operator name>*.

If No:
Is there a more convenient time that I can call? etc
If Yes and being transferred:
Good morning/afternoon this is *<interviewer name>* from the University of Ballarat.
If Yes, and owner answered:
We are currently conducting a survey of small to medium sized enterprises in the Ballarat area.

The purpose of this study is to investigate the level of information and communication technology adoption and security adoption in small and medium sized business. The data collected will help us to better understand the factors that influence the adoption information and communication technologies and security by small to medium sized enterprises.

No identifying information will be recorded along with your answers, as we want all participants in the study to remain anonymous. All information collected will be treated with the strictest of confidence and only made available to those directly involved with the research.

I was wondering if I could take fifteen minutes of your time to ask some questions?

No:

Would you like us to call you at a more convenient time?

If no:

Goto closure and thank the person for their time.

If yes:

Participation in this research is voluntary. You are free to withdraw consent and to discontinue participation in the study at any time. Any unprocessed data provided by you will not be used if consent is withdrawn. By answering the questions today, you are giving this consent.

Section A: Business Characteristics

Section A. This section contains questions regarding your business.

1. What is the main sector in which your business operates?

O Manufacturing
O Construction
O Retail trade
O Property and business services
O Health and Community
O Agriculture, hunting, fishing, forestry
O Other Business Sectors

2. What is the total number of full-time employees in your business?

O Less than 5
O 5-25
O 26-50
O 51-100
O 101-200
O 200+

3. What is the annual business turnover (in Australian Dollars)?

O < $500,000
O $500,000-$1 M
O $1M - $3M
O $3M - $5M
O >$5M

4. HOW MANY YEARS HAS THE BUSINESS/FIRM BEEN TRADING FOR?

O <1
O 1-5
O 6-10
O 11-20
O 21-50
O 51-100
O 100+

5. THE FOLLOWING QUESTION ASKS ABOUT THE TYPE OF ICT USED IN YOUR BUSINESS

Please answer 'yes' or 'no' to the following options

Does you business use:

Email	O Yes	O No
The Internet to search for business information	O Yes	O No
A company web page:		
• Internally Hosted (In-house)	O Yes	O No
• Externally Hosted (Outsourced)	O Yes	O No
• Both Internal or External Hosting	O Yes	O No
Web Site Development		
• Internally Developed (In-house)	O Yes	O No
• Externally Developed (Outsourced)	O Yes	O No
• Both Internal or External Development	O Yes	O No
The Internet to make purchases	O Yes	O No
The Internet to publish a catalogue	O Yes	O No
The Internet to take orders	O Yes	O No
Shopping Cart Facilities	O Yes	O No
Online Payment System	O Yes	O No
Secure Access or Transactions	O Yes	O No
e-Banking	O Yes	O No
e-government systems	O Yes	O No
Supply chain management systems	O Yes	O No

I need you to respond to the following questions with one of the following responses:

Highly Likely	1
Likely	2

Unsure	3
Unlikely	4
Highly Unlikely	5

6. In seeking advice regarding ICT, I source information from

Business Partners

Highly Likely **O O O O O** *Highly Unlikely*

1 2 3 4 5

7. While planning for ICT I am influenced by

Magazines and Newspapers

Highly Likely **O O O O O** *Highly Unlikely*

1 2 3 4 5

Internet

Highly Likely **O O O O O** *Highly Unlikely*

1 2 3 4 5

Customers

Highly Likely **O O O O O** *Highly Unlikely*

1 2 3 4 5

Business Partners

Highly Likely **O O O O O** *Highly Unlikely*

1 2 3 4 5

Other organisations / Vendors

Highly Likely **O O O O O** *Highly Unlikely*

1 2 3 4 5

Section B: Individual Managers Characteristics

Section B contains questions, which relate to your individual characteristics.

I need you to respond to the following questions with one of the following responses:

Strongly Agree	1
Agree	2
Neutral	3
Disagree	4

Strongly disagree 5

1. Manager's innovativeness

I like to see how my competitors use new forms of ICT before I try them

Strongly Agree **O O O O O** *Strongly disagree*

1 2 3 4 5

I like to see how my competitors perform as a result of adopting new forms of ICT before I try them

Strongly Agree **O O O O O** *Strongly disagree*

1 2 3 4 5

I usually purchase ICT products that have been tested and are proven in the market place

Strongly Agree **O O O O O** *Strongly disagree*

1 2 3 4 5

2. With regard to ICT, I consider myself to be

Familiar

Strongly Agree **O O O O O** *Strongly disagree*

1 2 3 4 5

Knowledgeable

Strongly Agree **O O O O O** *Strongly disagree*

1 2 3 4 5

Proficient

Strongly Agree **O O O O O** *Strongly disagree*

1 2 3 4 5

Educated

Strongly Agree **O O O O O** *Strongly disagree*

1 2 3 4 5

3. I consider ICT to be

Advantageous to developing my business

Strongly Agree **O O O O O** *Strongly disagree*

1 2 3 4 5

Advantageous to expanding markets

Strongly Agree **O O O O O** *Strongly disagree*
1 2 3 4 5

Advantageous to developing new markets

Strongly Agree **O O O O O** *Strongly disagree*
1 2 3 4 5

Section C: Trust and Distrust

1. With regards to the organisations that I choose to transact with over the Internet, I have

Faith in them

Strongly Agree **O O O O O** *Strongly disagree*
1 2 3 4 5

Confidence in them

Strongly Agree **O O O O O** *Strongly disagree*
1 2 3 4 5

The belief that they will use their initiative to look after my interests

Strongly Agree **O O O O O** *Strongly disagree*
1 2 3 4 5

2. With regards to using the Internet to transact with other organisations, I am

Sceptical

Strongly Agree **O O O O O** *Strongly disagree*
1 2 3 4 5

Cynical

Strongly Agree **O O O O O** *Strongly disagree*
1 2 3 4 5

CLOSURE

Thank you for participating in this study. Your time is appreciated and your answers will be very useful to help us better understand the factors that influence security and technology adoption.

If you have any questions concerning the procedures associated with this research you could contact the principle researcher:

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Alternatively if you have any concerns about the conduct of this research project, please contact

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Once again, thank you for your time. Enjoy the rest of your day.

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