BUSINESS ON-LINE? AN EMPIRICAL STUDY OF FACTORS LEADING TO THE ADOPTION OF INTERNET TECHNOLOGIES BY AUSTRALIAN SMES.

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ABSTRACT

E-commerce technologies such as a Web site, email and the use of Web browsers enable access to large amounts of information, facilitate communication and provide niche companies with an effective mechanism for competing with larger organisations world-wide. However, recent literature has shown Australian SMEs have been slow in the uptake of these technologies. The aim of this research was to determine which factors were important in impacting on small firms' decision making in respect of information technology and e-commerce adoption. Findings indicate that generally, the more a firm was concerned about its competitive position, so such a firm was likely to develop a Web site. Moreover, the 'Industry and Skill Demands' dimension suggested that as the formal education of the owner/manager increased, coupled with the likelihood that the firm was in the transport and storage or communication services industries, and realising the cost of IT adoption was in effect an investment, then such a firm would be inclined to develop a Web site. Firms that were presented with relatively geographically dispersed markets, and realising it was necessary to go through the time consuming process of adopting various IT to reach these markets, were more likely to adopt Web sites. Lastly, owners/managers who reported their knowledge of business uses of computers was poor and who were likely to ask for support in installing and utilizing IT were also more likely to use Web sites than those who did not share these characteristics.

INTRODUCTION

Communications technology through the Internet is recognised as a recent and important tool in providing operational efficiencies for Small to Medium Sized Enterprises (SMEs). E-commerce technologies such as a Web site, email and the use of Web browsers enable access to large amounts of information, facilitate communication and provide niche companies with an effective mechanism for competing with larger organisations world-wide. However, recent literature has shown Australian SMEs have been slow in the uptake of these technologies (Yellow Pages Small Business Index 1999, Van Akkeren and Cavaye 1999, Poon and Swatman 1999, Lawrence 1997). Research into the adoption of internet technologies, particularly basic e-commerce ones such as a Web site and email, has been largely ignored. Australia's slow adoption rate of these technologies, particularly when compared with countries with much higher adoption rates, underlie the importance of this research.

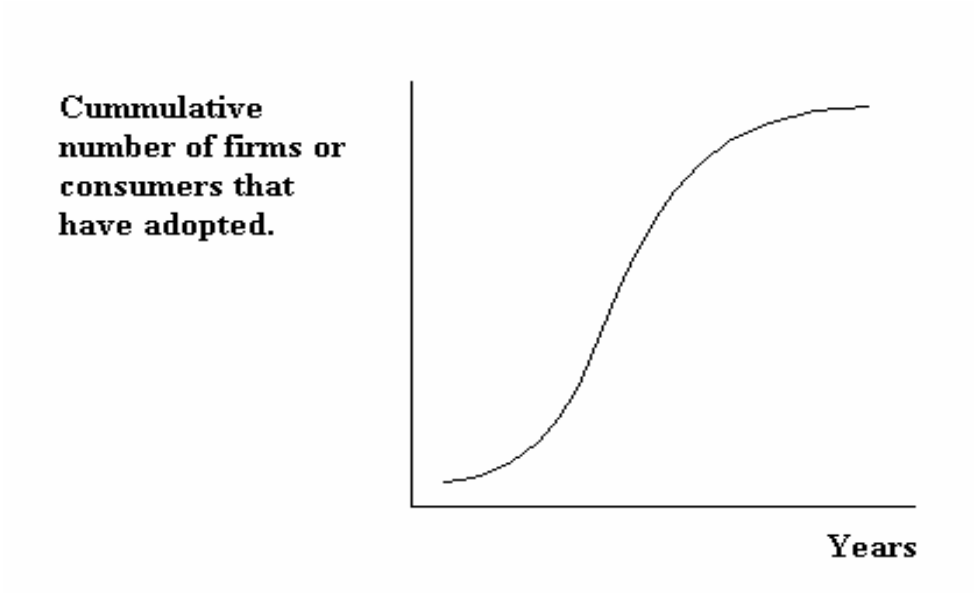
This paper is structured as follows: firstly, literature is outlined on general IT adoption, and then on Internet technology and specifically web site adoption by small business. The research questions are identified and the method used to investigate the problem is then discussed. Detailed analysis of findings from surveyed firms is presented and conclusions outlined. The purpose of the paper is to build a comprehensive framework of the factors associated with the adoption of internet technologies and specifically web sites by SMEs.

General IT Adoption

Researchers have identified a variety of factors that affect technology adoption in small business and use differing models in determining reasons why firms adopt (or do not adopt) IT. Much of the earlier literature is based on Roger's (1995) Diffusion of Innovation theory (DoI), which highlights the characteristics pertinent to the decision to adopt and diffuse information technology (IT). It is these characteristics that help persuade potential adopters to embrace or reject an innovation. The five characteristics of an innovation identified by Rogers (1995 pp. 15-16) are: relative advantage - the degree to which an innovation is perceived as better than the idea it supersedes; compatibility - the degree to which an innovation is perceived as being consistent with the existing values, past experiences, and the needs of potential adopters; complexity - the degree to which an innovation is perceived as difficult to understand and use; trialability - the degree to which an innovation may be experimented with on a limited basis; observability - the degree to which the results of an innovation are visible to others.

Premkumar et al (1994) suggest that the chance of a firm adopting an innovation and the extent of that adoption is largely dependent on the characteristics of the innovation as perceived by the adopting firm. Coombs et al (1987) support this by suggesting that the risk associated with the innovation decreases as more firms adopt and explains diffusion of innovation over time follows an S-curve shape. Hence, adoption can be graphically represented in the form of a logistic diffusion curve as shown in figure 1 where the rate of diffusion first increases up to an inflection point, and then decreases (Coombes et al 1987).

Figure 1: Logistic diffusion curve



It would appear the characteristics of information technologies will impact on the adoption and diffusion of IT. This is highlighted by the fact that in the past, Australian SMEs have been entrepreneurial in adopting technologies and could therefore be placed in the upper portion of the logistic diffusion curve (Yellow Pages Australia, 1997). However, more recent technologies such as the Internet, and e-commerce in particular, have not been adopted and diffused at the same rate, particularly when compared to countries such as Japan, Singapore, the United Kingdom and United State of America (Forrester Research 1997, Van Akkeren and Cavaye 1999).

DoI theory has been challenged in recent years, particularly in relation to the fact that IS/IT innovations may change during the adoption/diffusion process. More recent studies show that DoI theory only partially applies to IT and software adoption/diffusion and it is now recognised that other approaches require further consideration (Larsen 1997). An example is organisational psychology, which includes factors such as adoption beliefs, cognitive thinking and organisational/individual behaviours and beliefs. The next section of literature addresses these alternative approaches to IS/IT innovation and diffusion.

Behavioural and Attitudinal Studies on IT Adoption

IS adoption researchers have focussed on many different factors thought to influence adoption. The main constructs in many of the theories stem from Roger's (1995) work and are based on individual behavioural characteristics such as perception and attitude. The Theory of Planned Behaviour (TPB) model by Ajzen (1991) discusses behaviour as a direct function of behavioural intention and perceived behavioural control. For small business owner/managers, who are responsible for major decisions on IT adoption and capital expenditure, their perceptions and attitudes towards technology could certainly influence their decision.

Taylor and Todd (1995) extend Ajzen's original theory to the Decomposed TPB, particularly in relation to the perceived characteristics of an innovation, relative advantage, and compatibility of the innovation to the adopter's existing values, previous experiences and current needs. The Technology Acceptance Model suggested by Davis (1989) discusses IT adoption, implementation and diffusion in terms of perceived use and perceived ease of use. For a small business owner/manager, their earlier experiences with IT and their level of computer expertise will impact on their perceptions of new innovations. Gefen and Straub (1997) support this with findings that earlier experiences with IT influenced an SME owner/manager's decision to adopt new innovations.

Constructs used in the above models generally focussed on perceptions, attitudes, beliefs and intentions of the decision-maker, combining innovation literature with psychological considerations. However, factors both within and outside the organisation have been shown in later studies to impact on IT adoption and diffusion. An example of this is a study by Thong (1999) which found the innovativeness and level of IS knowledge of the owner/manager, IS characteristics (relative advantage, compatibility and complexity of IS), and organisational characteristics (size, level of employee IS knowledge) will impact on the adoption of IS. In another study, Fink (1997) depicts three main groupings that impact on the rate of IT adoption: IT benefits, organisational culture, IT availability and in-house IT expertise; Internal resources, IT selection and IT implementation; and External selection, IT implementation.

Another factor that has been shown to impact on the rate of small business technology adoption is the industry group of the organisation, whether the organisation is franchised or independent, and the technology inherent in distribution channels used by the organisation. Treadgold (1990) found small retail businesses with high IT adoption rates had been influenced by the distribution channel, trade associations, wholesalers, and voluntary groups and franchisers that encouraged IT adoption.

Internet Technologies and Small Business Adoption

Large organisations generally have the funding, resources and expertise to pursue technological innovation and adoption. In contrast, small businesses have to rely on a smaller number of employees and are further constrained in terms of time and capital availability. More recent literature supports this with findings that the characteristics of the firm (size, sector, status), and economic factors (cost, pressure from suppliers/customers/competitors) influence e-commerce adoption by SMEs.

Piovesana and Raush (1998) found the cost of implementation inhibits adoption of e-commerce technologies. Fielding (1996) adds that small businesses find Internet technologies too complex, difficult to implement and expensive. Similarly, Lawrence (1997), in a study of Australian SMEs found limited resources, a low level of existing hardware, the need for immediate returns on investment, resistance to change and lack of available information had inhibited internet technology adoption. Further research by McGowan and Madey (1998) and Sillence et al (1998) suggests the size of the small business, resource availability, the level of technological knowledge and pressure from external bodies influence internet technology adoption.

Van Akkeren and Cavaye (1999), in a review of the literature focussing on the adoption and use of information technologies (IT) by small and medium sized enterprises argued that small firms are somewhat constrained by their size when considering the adoption and use of various IT based business solutions. Certainly, the expenditure of monies on technologies may seem foreign and outside the experience of small business owners would seem to be doubtful. Against this, given some knowledge of computing and business based IT, many owners and managers would be in a position to understand the possible scale economies that might reside in IT. Moreover, through time, the costs of IT have been falling, and there have been more and more potential and actual uses of the technology in business settings generally. Seemingly, an important aspect of the adoption of IT by small businesses must lie in the knowledge and understanding of IT potentialities by decision makers in the sector.

Iacovou et al (1995) identified the following factors as having an impact on IT adoption by businesses; organisational readiness, financial and technological resources of the firm, and the level of external pressure adopt, both from competitors and trading partners.

Kirby and Turner (1993) argued computer literacy of small business owners, the extent of knowledge of IT benefits, and the extent of dependency of customers and suppliers had significant impacts on IT adoption.

Julien and Raymond (1994) argued that several factors had an influence on technology adoption by small businesses. They were the structural sophistication of the firm in terms of centralisation and complexity, the level of assertiveness, rationality and interaction in business decision processes, as well as the size and status (whether independent or affiliated) of the firm, and the sector in which it operates.

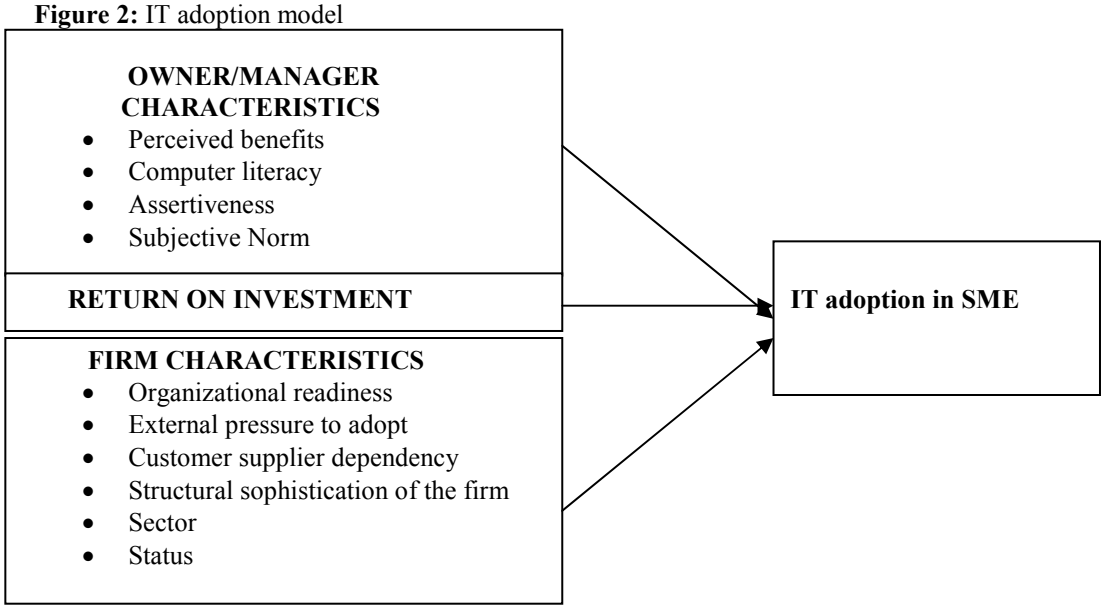
Thong and Yap (1995) posit two main factors as important in influencing IT adoption by small and medium sized businesses (SME's). They were the individual characteristics of the owner or manager in respect of innovativeness, attitude towards IT adoption, as well as IT knowledge, and second, organisational characteristics, being business size, the competitiveness of the environment and information intensity.

Harrison et al (1997), in attempting to predict a small businesses owner's/manager's decision to adopt IT, argued the following were important owner/manager characteristics that had a bearing on the decision making process. First, the decision processes of the key decision maker, which were largely attitudinally based, then subjective norm, the level of perceived control in respect of IT adoption, the firm's size, the sector it operated in and its status, and last, a set individual characteristics.

Van Akkeren and Cavaye (1999) constructed a typology of factors thought to bear on IT adoption rates, and divided them into owner/manager characteristics and firm characteristics. Additionally, they incorporated return

on investment (ROI) as a single and important factor in determining IT adoption in SME's. The model is presented below.

Figure 2: IT adoption model



They argue that their model could be a take off point for further and more empirically based research. The question arises as to whether or not the factors outlined would have a significant effect on IT adoption by themselves, or whether they tend to act in conjunction with other factors, in groups. This implies the possibility of conjoint action, and that taken individually the variables might have little effect. However, when two or more of them are present, then action is likely to occur. In other words, a situation of necessary and sufficient conditions would have to exist before anything were to happen. Certainly, many of the models presented in this paper suggest some of the factors might act conjointly. For example, Iacovou (1995), in identifying organisational readiness to adopt and external pressure to adopt as factors impelling adoption of IT, imply various factors tend to act conjointly. Kirby and Turner (1993) argued structural sophistication of the firm, the nature of business decision making, and the nature of the industry that the firm is operating in are important in leading firms to adopt IT. All these are constituted as a number of factors, and not isolated single variables. Thus there is a strong possibility that conjoint effects offer more explanation than isolated effects operating alone. This conjointness tends to suggest the drivers of IT adoption are probably more complex and difficult to model than what at first meets the eye.

The aim of this research was therefore to determine which factors were important in impacting on small firms' decision making in respect of information technology, particularly Internet technology adoption. Further, it was decided to investigate the possibility as to whether or not the factors might act in a conjoint fashion. Following this the relative magnitude of the factors in determining the rate of adoption of some forms of IT was carried out. From the literature review, a number of propositions were devised in respect of the factors impacting on small firms' decision making when considering IT and Internet adoption. The propositions below outline each of the issues addressed in this research and the literature from which they originate.

PROPOSITIONS

Table 1: Propositions and their source

Proposition	Reference
1. Small firms, in terms of their numbers of employees and the levels of assets employed in the business, are less likely to adopt IT such as websites, as compared with larger firms.	Piovesana and Raush (1998), Harrison et al 1997, Thong and Yap 1995, Iavovou et al 1995, Fielding 1996, McGowan and Madey (1998), Sillence et al (1998)
2. Many of the elements that are important in improving the competitive advantage of a firm can be enhanced by adopting or improving IT.	McGowan and Madey (1998), Sillence et al (1998), Kirby and Turner 1993, Sillence et al 1998, Gefen and Straub 1997, Thong 1999, Poon and Swatman 1999.
3. Smaller firms, lacking human, financial and physical resources, are impeded from adopting IT.	Iacovou et al (1995), Julien and Raymond (1994), Harrison et al 1997, Piovesana and Raush 1998, Fielding 1996.
4. It is likely that firms operating in more technologically demanding environments impose a need for a higher level of formal education on their owners/managers.	Thong and Yap (1995), Kirby and Turner 1993, Thong 1999.
5. Those firms with geographically spread markets (both in terms of suppliers and customers) are more likely to adopt various IT's to cover this space/time dimension, than those firms that buy and sell locally.	Thong and Tap 1995, Treadgold 1990, Kirby and Turner 1993, Harrison et al 1997.

The first proposition is congruent with findings from previous literature that the cost of implementation and the financial resources of the firm, along with the size of the firm (number of employees) will impact on adoption (Harrison et al 1997, Thong and Yap 1995, Iacovou et al 1995, Fielding 1996).

Proposition 2 posits that firms can be impelled to adopt IT as a result of market imperatives. Small firms are impelled to adopt IT to enhance or maintain their competitive situation, even though the owner/manager may not be particularly computer literate. Such owner/managers would be forced to rely on the capability of sellers and installers of IT. Competitors, in adopting IT, can threaten market share, customers come to expect levels of technological sophistication, and suppliers often force a need for the adoption of IT (Kirby and Turner 1993, Thong 1999, Gefen and Straub 1997). There is a necessity to maintain and improve ROI and the benefits of IT adoption can include the gaining of competitive advantage. McGowan and Madey (1998), Poon and Swatman (1999) and Sillence et al (1998) argue that small businesses can gain a competitive advantage by the adoption of IT, and external bodies play a role in its introduction. Thus, even owners and mangers with no knowledge of computing are forced to adopt the IT solution.

The third proposition relates to the size of the firm in terms of financial and physical assets (Piovesana and Raush 1998, Fielding 1996, Harrison et al 1997). Small firms are generally simpler structures than larger ones, and sole traders are less likely to adopt IT than larger public companies with complex structures and reporting arrangements. Iacovou et al (1995) point to organisational readiness, being financial and technological resources of the firm, as being important in the adopt/non-adopt decision. Julien and Raymond (1994) suggested the structural sophistication of the firm, as well as its size and status and the sector in which it operates, as being important in determining the likelihood of IT adoption.

The forth proposition posits that the formal education and IT literacy of the owner/manager may or may not impact on adoption. Owner/manager characteristics in terms of innovativeness, IT adoption and IT knowledge are listed as important determinants of IT adoption (Kirby and Turner 1993, Thong 1999). Moreover, the businesses' size, environment and information intensity are important in the IT adoption decision (Thong and Yap 1995).

The final proposition suggests that those firms with geographically spread markets (both in terms of suppliers and customers) are more likely to adopt various IT's to cover this space/time dimension, than those firms that buy and sell locally (Thong and Yap 1995, Harrison et al 1997, Treadgold 1990). The reverse might hold as well. This is because some small firms, freed up from geographical constraints by IT would be more likely to locate away from areas of high rents and congested infrastructure represented by the larger urban concentrations.

RESEARCH DESIGN

Data Collection

It was decided that the use of a mail out questionnaire was appropriate to address the research aims and propositions. Much of the previous work reviewed to derive the propositions tended to be of the exploratory case study type. (See for example, Fink (1997), Gefen and Straub (1997), Harrison, Mykytn and Rienenschneider (1997), Iacovou, Benbasat and Dexter (1995), Julien and Raymond (1994), Lawrence (1997), Poon and Swatman (1999), Van Akkeren and Cavaye (1999)) One of the aims of the current work was to expand on the previous exploratory research, and to try to understand how previously derived variables might be at work in a broad or wider context, than in just a few case studies.
A random sample of businesses on the Sunshine Coast (Queensland) was drawn from the "Yellow Pages Australia on Disk" database of Australian businesses. A mail questionnaire was sent to 1750 businesses requesting information on their levels of IT adoption and investment, e-commerce use, industry type, and so on. Thus in all cases the survey relied upon self reporting by the respondents. Three hundred and thirty nine (339) completed questionnaires were returned and two hundred and fifteen were sent back as address unknown. Thus, the useable response rate was 19.37%, which is consistent with studies involving small business (see for example Perry, Meredith and Cunnington (1988); Callahan and Cassar (1995)). To address the possibility of non response bias, the 'final wave' of respondents (to surrogate late respondents for non respondents) was compared with the initial groups of respondents within each industry. Chi square and t test statistics revealed no significant differences at the 5% level for any of the variables in the study.

Definition and Measurement of Variables.

There is a sense in which this work is somewhat tentative or exploratory. The variables were deduced from the literature and it was recognised that some of them might act in conjunction with one another, or that their full effect could only be observed in the presence of others. Thus, the variables defined and selected in this study were recognised as being equivocal and open to challenge. Moreover, given the large number selected (as shown in table 2), there is the possibility of a violation of Ockham's razor and a lack of parsimony. However, and once again, given the exploratory nature of this work, variable selection proceeded as follows. The questionnaire contained questions that investigated a number of variables taken from the literature review. Those focussed on for the research were:

Factor Analysis (Principal Components Analysis).

Consideration of the literature dealing with the factors that impinge upon firms' decisions to adopt or not adopt various forms of ITT has revealed that there is a tendency for more than one factor to be important in the decision making process. See for example Iacovou et al (1995), Kirby and Turner (1993), Julien and Raymoond (1994), Thong and Yap (1995), Harrison et al (1997). These factors might be operating simultaneously or in a conjoint fashion.
It is also conceivable that many of the factors might not be directly observable, and appear to be contructs derived from other, more directly observable variables. This is the case reported by Julien and Raymond (1994), where they suggest that structural sophistication of the firm in terms of centralisation and complexity, the level of assertiveness, rationality and interaction in business decision processes, as well as size and status of the firm, and the sector in which it operates. All these are held to impact n the decision making of the firm in respect of IT adoption.

Table 2: Definitions of Variables and their source.

Variable Name	Definition	Reference
ED	The formal educational attainment level of the owner/manager.	Sillence et al 1998, Thong and Yap 1995
IND	The industry the firm operated in, using the standard ANZSIC classification.	Julien and Raymond 1994, Harrison et al 1997
MKT	The geographical spread of the firm's market, for example, in the local area, the Sunshine Coast, South East Queensland, all Queensland, Australia wide, exporting, etc.	Thong and Yap, 1995, Treadgold 1990
EMPS	The number of employees in the business.	Harrison et al 1997, Fielding 1996, McGowan and Maddy 1998
ORG	The form of business ownership, from sole trader, through to public companies.	Julien and Raymond 1994, Harrison et al 1997
ASSETS	Approximate level of business assets used in the business in the current year.	Van Akkeren and Cavaye 1999.
KNOW	Owner/manager's assessment of their knowledge of business uses of computers.	Kirby and Turner 1993, Thong 1999, Van Akkeren and Cavaye 1999
USE	The use to which various forms of electronic information technology in the business were put.	Julien and Raymond 1994, Iavovou et al 1995
BIN*	Derived from USE; whether or not the business had a Web site.	
COST	Self reported assessment as to whether or not implementing internet technologies are (or would be) cost prohibitive.	Piovesana and Raush 1998, Fielding 1996, Lawrence 1997
TCONS	The extent to which installing and implementing internet technologies is (or would be) time consuming.	Fielding 1996
TBENS	Whether or not the time spent implementing internet technologies would be (or has been) beneficial.	Harrison et al 1997, Iavovou et al 1995
ROI	The extent to which internet technologies have (or would be) an impact on a firm's return on investment.	Lawrence 1997
WILL	The extent to which the firm's employees are ready to switch to and operate internet technologies.	McGowan and Maddy 1998, Sillence et al 1998
STECH	The extent to which other firms in the same industry having internet technologies lead to this firm adopting internet technologies.	Harrison et al 1997, Iacovou et al 1995
CUST	The extent to which the firm's customers would expect adoption of internet technologies.	Sillence et al 1998, Kirby and Turner 1993
COMP	The extent to which internet technologies are perceived to improve a firm's competitiveness.	Kirby and Turner 1993, Taylor and Todd 1995
PIMP	If a non-adopter of Internet technologies, an assessment of the extent to which they could improve competitiveness.	Thong and Yap 1995, Taylor and Todd 1995, Iacovou et al 1995
HSELL	The extent to which installers and sellers of internet technologies have aided businesses to adopt the technologies.	
BENS	Types of benefits arising from adopting internet technologies.	Kirby and Turner 1993, Fink 1997

* For the purposes of stage two of this work, a logistic regression was run using BIN as the dependent variable. Hence, USE was recoded to BIN, whereby a firm was assigned 1 if it adopted a Web site, and 0 if it didn't.

Thus a problem arises as to how best to analyse and represent a relatively large number of variables or factors that might be acting in some conjoint fashion, or which might essentially be constructs which are not directly observable or are made up of other non directly observable variables.
Factor analysis can be used to identify a relatively small number of factors among sets of many interrelated variables. Further, the technique helps identify underlying, not directly observable constructs which might be operating within a milieux of many, closely related variables. Thus the basic assumption of factor analysis is that

underlying dimensions or factors can be used to explain complex phenomena. Accordingly, eighteen of the variables in the database were subjected to the process of factor analysis, using the principal components method. Principal components was used because linear combinations of the observed variables were desired.

Given that the mathematical model for factor analysis is somewhat similar to a multiple regression equation, each variable (or extracted component) can be expressed as a linear combination of the original variables. Thus, the groups of variables that cluster together constitute the factors. Under most circumstances the factors (or components) that are found useful in characterising a set of variables are not known in advance, but are determined by the factor analysis.

A total of six components were found to have eigenvalues greater than one. These six components between them explained 59 percent of the variance of the original eighteen variables. Consideration of the component to variable correlation matrix (table 3) shows the following make up of components.

Cronbach's coefficient alphas for reliability were estimated for each of the components to ascertain the extent to which variables making up each component shared a common core and the extent to which items in the questionnaire were related to each other. Cronbach's alpha is based on the average inter item correlation. Table 4 shows that somewhat low reliability held for items which composed component 3 (ED, IND COST). Component 1 shows a marginal result for reliability, while the rest of the components were satisfactory or better. Given the exploratory nature of this research and bearing in mind that the main aim of this factor analysis is to reduce the number of variables to gain parsimony, the low Cronbach's alphas for two of the components was not considered to be of overwhelming importance. Further, reliability tests are of more importance in research that aims, for example, to construct robust questionnaires through frequent sampling and testing, and for instruments for further and wider application. Examples might include various psychological tests, market and product satisfaction surveys and so on.

Table 3: Correlation Matrix

Component	Variables	References	Correlation Coefficients
1	COMP	Kirby and Turner 1993, Taylor and Todd 1995	.727
	ROI	Lawrence 1997	.594
	PIMP	Thong and Yap 1995, Taylor and Todd 1995, Iacovou et al 1995	-.592
	CUST	Sillence et al 1998, Kirby and Turner 1993	.539
	STECH	Harrison et al 1997, Iacovou et al 1995	.507
	TBENS	Harrison et al 1997, Iavovou et al 1995	.503
	BENS	Kirby and Turner 1993, Fink 1997	.496
2	EMPS	Harrison et al 1997, Fielding 1996, McGowan and Maddy 1998	.635
	ASSETS	Van Akkeren and Cavaye 1999.	.626
	ORG	Julien and Raymond 1994, Harrison et al 1997	.543
3	ED	Sillence et al 1998, Thong and Yap 1995	.754
	IND	Julien and Raymond 1994, Harrison et al 1997	.582
	COST	Piovesana and Raush 1998, Fielding 1996, Lawrence 1997	-.502
4	TCONS	Fielding 1996	.595
	MKT	Thong and Yap, 1995, Treadgold 1990	.494
5	WILL	McGowan and Maddy 1998, Sillence et al 1998	.613
6	KNOW	Kirby and Turner 1993, Thong 1999, Van Akkeren and Cavaye 1999	-.516
	HSELL		.415

Table 4: Cronbach's Alpha Reliability

Component	Variables	Cronbach's Alpha
1, Competitive Advantage	COMP	.5269
	ROI	
	PIMP	
	CUST	
	STECH	
	TBENS	
	BENS	
2, Organisation and Structure	EMPS	.7867
	ASSETS	
	ORG	
3, Industry and Skill Demands	ED	.3207
	IND	
	COST	
4, Geographical and Temporal Demands	TCONS	.5770
	MKT	
5, Staff Capacity	WILL	N/A
6, Support	KNOW	.7734
	HSELL	

The variable IND appeared in component three. It comprised the respondents' answers to the industry they considered they were operating in (the industries conformed to the ANZSIC). It was necessary to isolate the industries in which firms were more likely to adopt Web sites (as a proxy for a given level of IT adoption), from those industries where adoption was not common. Accordingly, a Wilcoxon-Mann-Whitney test was used to ascertain whether or not firms that adopted technology tended to be in industries that were different from those which did not adopt IT. The results are presented in table 5.

Table 5: Wilcoxon-Mann-Whitney Test

	Variable; IND by BIN
Mann-Whitney U	9466
Wilcoxon W	31832
Z	-2.496
Significance	.01

Perusal of the results of adopting firms by industry as against non-adopting firms by industry showed that adopters were more likely to be in either the transport and storage or communication services industries than non-adopters. Non-adopters tended to be in retail trade, construction and accommodation, cafes and restaurants. Thus there was a significant difference between firms that adopted Web sites (specifically) and those that did not, in terms of the industry they were likely to be in. Consideration of the dimensionality of each of the components proceeded next.

Component 1, comprising COMP, ROI, PIMP, CUST, STECH, TBENS and BENS would suggest a strong focus on a firm's competitiveness. Thus, it appeared that IT improved competitiveness, had a positive impact on ROI, and its adoption, while time consuming would be worth it. Moreover, firms' customers expect IT adoption, other firms in the same industry were adopting, and there was a need to emulate them to maintain competitiveness. Firms that had not moved into IT solutions still said that adopting various technologies would improve their competitiveness. Thus, component 1 was labeled 'Competitive Advantage'.

The variables that constitute this component and its naming as competitive advantage are to an extent, a reflection of the literature and previous research. Kirby and Turner (1993) pointed to the importance of the extent of dependence on customers and suppliers, coupled with the nature of the industry the firm operates in as being important in the IT adoption decision. Thus, in a highly competitive environment and industry, and given low levels of customer and supplier dependency, IT adoption is made much more likely. It is in an attempt to maintain or gain a competitive advantage that a firm is much more likely to adopt some form of IT. Iacovou et al (1995) pointed to the role of the level of external pressure to adopt IT, from both competition and trading partners. Sillence et al (1998) have also indicated that the role of pressure from external bodies acts as a spur oto IT adoption. Lastly, Taylor and Todd (1995) have pointed to the importance of gaining and maintaining a relative advantage through IT adoption.

Component 2, comprising EMPS, ASSETS and ORG, suggested that as the level of assets used in a firm increased, so too did the number of employees, and that structure of ownership became more complex, and the more likely a firm was to adopt various forms of IT. This component was named 'Organisation and Structure'. This second component is in some ways reflective of the argument made by Harrison et al (1997), who suggested that the size of the firm plays a role in IT adoption.
Component 3, which was made up of ED, IND and COST, suggested that as the level of education of the owner/manager increased, coupled with the likelihood of the firm being in either the Transport and Storage or Communication Services industries, the more likely they were to be clustered together. Moreover, such firms were likely to report that purchasing IT was not seen as a prohibitive cost. This component was named 'Industry and Skill Demands'.
Thong and Yap (1995) have argued that the individual characteristics of the firm's owner in respect of innovativeness, attitude towards IT adoption and IT knowledge are important in the IT decision process.
Component 4, which comprised TCONS and MKT suggested that as the geographical spread of a firm's market widens, so too the necessity to adopt IT increases. However, firms also recognize that implementing IT can be a time consuming process, but are prepared to spend time acquiring the technologies, to cover the broader market reach. This component was named 'Geographical and Temporal Demands'.
Component 5 was made up of one variable only, WILL, which was an estimate of the capacity of employees to adjust to IT. It was named 'Staff Capacity'. Thong and Yap (1995) have argued for the importance of the geographical spread of the market as being important in the adoption decision.
Component 6, made up of KNOW and HSELL, indicated that as owners or managers rated their knowledge of business uses of computers as poor, the more likely they were to find the sellers and installers of IT as helpful. This component was named 'Support'.

Logistic Regression.

Having derived components from the variables to manageable proportions by decreasing their number through principal components analysis (and thereby gaining a greater degree of parsimony), the next step was to examine the nature of their impacts upon the decision to either adopt or not adopt a web site. The dependent variable was thus binary. Firms either adopted or did not adopt a web site. The independent variables, in the form of the components, were continuous. Under these circumstances, the most appropriate statistical technique to model the phenomena was logistic regression analysis.
To employ logistic regression the variable USE was reclassified to BIN whereby any firm that had implemented a Web site was assigned the value of 1, whilst the rest, being non-adopters, were assigned a value of 0. Following this, the six components (treated as independent variables) were logistically regressed against BIN, being the dependent binary variable. Descriptive statistics for the predictor variables are presented in table 6.

Table 6: Descriptive Statistics for Components.

Component	Mean, Non-Adopters	Mean, Adopters	Student's t Statistic	Significance
Competitive Advantage	.196	.205	-2.347	.02
Organization and Structure	$9.29*10^{-02}$	$9.72*10^{-02}$	-1.097	.275
Industry and Skill Demands	.179	.187	-2.138	.034
Geographical and Temporal Demands	.336	.351	-4.2	.000
Staff Capacity	$7.42*10^{-02}$	$7.76*10^{-02}$	-0.874	.383
Support	.276	.289	-3.379	.001

The means for 'Competitive Advantage', 'Industry and Skill Demands', 'Geographical and Temporal Demands', and 'Support' offered strong evidence that their means for adoption as against non adoption, were different from one another. Given that the components derived from the principal components analysis are orthogonal and a result of varimax rotation, there would not be any multicollinearity present. The results of the logistic regression are presented in table 7.

Table 7: Diagnostic Output for Logistic Regression 1.

Variable	Coefficient (B)	Wald Statistic	Significance	R	Exp (B)
Competitive Advantage	.5461	6.1096	.0134	.1493	1.7265
Organization and Structure	.2400	1.3943	.2377	.0000	1.2713
Industry and Skill Demands	.4680	4.9477	.0261	.1265	1.5968
Geographical and Temporal Demands	.9469	15.8853	.0001	.2745	2.5777
Staff Capacity	.2565	1.1193	.2901	.0000	1.2924
Support	.7647	12.2058	.0005	.2352	2.1484
Constant	-.0449	.0467	.8289		

The Wald statistic and its significance level for the variables, 'Organization and Structure', and 'Staff Capacity', showed that these two had coefficients that were not significantly different from zero. This is to say that the null hypothesis, that the independent variables were not significantly related with the presence or absence of a web site, could not be rejected. Thus it was decided to drop 'Organisation and Structure' and 'Staff Capacity' from the model. By rerunning the logistic regression model without these variables, greater overall significance could be obtained, along with a substantial gain in model parsimony. In other words, more could be said with less, and more significant results would be obtained. Accordingly they were dropped from the model, and the logistic regression was rerun without them. Table 8 shows the results of the second logistic regression.

Table 8: Diagnostic Output for Logistic Regression 2.

Variable	Coefficient (B)	Wald Statistic	Significance	R	Exp (B)
Competitive Advantage	.522	5.927	.0149	.146	1.6859
Industry and Skill Demands	.460	4.770	.0290	.1226	1.5841
Geographical and Temporal Demands	.923	15.851	.0001	.2741	2.5158
Support	.747	11.942	.0005	.2323	2.1106
Constant	-.0463	.051	.8212		

Classification Table

	Predicted Group		
Actual Group	Adopters	Non-Adopters	Percent Correct
Non-adopters	49	19	72.06%
Adopters	17	48	73.85%
Overall Classified Correctly		72.93%	

As things transpired, there was no improvement in significance levels for the remaining variables, and they were very good in the first place. Further, greater model parsimony was obtained, because fewer independent variables explained the action of the dependent variable. Using the Wald statistic, the variables 'Geographical and Temporal Demands', and 'Support' were shown to be statistically significant reliable predictors of Web site technology adoption by firms. The variables 'Competitive Advantage' and 'Industry and Skill Demands', whilst not as statistically significant as the former two, are still useful as predictors.

A test of the full model with all predictors against a constant only model was statistically reliable, $\chi 2$ (4, n=133) = 41.268, p <.001. This indicates that the predictors, as a set, reliably distinguished between businesses that adopted Web sites and those that did not. In other words, the model will predict adoption outcomes more accurately than random guessing 99.9 percent of the time. The model chi square tests the null hypothesis that the coefficients for all the variables in the model (except the constant) are zero. Prediction success was such that 74 percent of firms that were predicted to have Web sites in fact did so, whereas 72 percent of those firms predicted as not having Web sites, did not have one. The overall prediction success was 73 percent.

In logistic regression, the regression coefficients work in the following way. Consider the coefficient for the variable 'Geographical and Temporal Demands', which is .923. When the variable changes from 0 to 1, and the other independent variables remain the same, the log of the odds of the firm adopting a Web site increase by .923. Further interpretation can be gained by considering the column headed Exp (B). In this case, when the variable 'Geographical and Temporal Demands' changes from 0 to 1, the odds of the firm adopting a Web site

are increased by 2.5158. In other words by increasing the value of the variable by one unit, the log odds are increased by .9226, and by increasing the value of the variable from 0 to 1, the odds of adoption of a Web site changed by a level of 2.5158.

DISCUSSION

It is possible to argue that any number of characteristics of small firms could have an impact on whether or not such firms are likely (or not) to adopt IT of various types, and to build Web sites specifically. Much of the literature to date has been of a speculative nature, with little empirical work being done to identify and model variables that do have a role to play in a small firm's decision making.

In this work, many variables were considered for identification and modeling, and few of them were found to be important in having an effect by themselves. Moreover, it was found that when combined with other variables they offered some explanatory power in respect of IT and Web site adoption. Generally speaking, the presence or absence of one variable by itself was relatively unimportant. Rather, it was only in the presence of other variables that much effect was observed. It seemed as though a variety of necessary and sufficient conditions was operable. This is to say that any one given variable might seem necessary for some effects to be observed, but the presence of the variable by itself was not sufficient to observe any effects. Several variables were necessary and sufficient to observe some effects.

Given the possibility of a conjoint relationship between the variables, many of the propositions were shown to be significant in the owner/managers decision to adopt/not adopt web sites. However, single variables such as the size of the firm (proposition 1), were not significant, and only became a useful predictor in the presence of other variables: level of assets used in the business, and the form of business ownership (component 2 – Organisation and Structure). Proposition 2, although not as statistically significant as other variables, was shown as a useful predictor in the adoption of web sites, particularly when combining competitive advantage with ROI, and external pressure to adopt from suppliers and customers (component 1 – Competitive Advantage). In general terms, the more a firm was concerned about its competitive position, so such a firm was likely to develop a Web site which supports proposition 2 based on previous studies undertaken by McGown and Maddy 1998, Poon and Swatman 1999, Sillence et al 1998 and Thong 1999.

The third and fifth propositions matched component 4 (Geographical and Temporal Demands) and were shown to be statistically significant predictors of web site adoption. In particular, the geographical spread of the firm's market will impact on an owner/manger's decision to adopt/not adopt a web site. This study therefore supports earlier findings by Thong and Yap 1995, Treadgold 1990, and Harrison et al 1997 that adoption of Internet technologies is facilitated by the geographic distance of markets in terms of suppliers (Business-to-business) and customers (business-to-consumer). Added to this variable however, is that firms also recognise that implementing IT can be a time consuming process, and they may need to invest to cover the broader market reach, supporting earlier findings by Iacovou et al 1995, Fielding 1996, Julien and Raymond 1994 and Piovesana and Raush 1998. Similarly, proposition 4 (Component 6 – Support) offers strong evidence that the educational level of the owner/manger, the environment the firm operates in, and the level of information intensity will play a significant role on the owner/managers decision to adopt/not adopt IT and internet technologies, supporting previous studies undertaken by Thong and Yap 1995, Thong 1999 and Kirby and Turner 1993.

The findings from this research are not always inconsistent with the ideas put forward by such writers as Iacovou et al (1995), Kirby and Turner (1993), Julien and Raymond (1994) Thong and Yap (1995) and Iacovou et al (1995) who argued that external pressure to adopt was important in determining IT adoption. This dimension is similar to 'Competitive Advantage' and 'Industry and Skill Demands'. Kirby and Turner (1993) and Julien and Raymond (199 4) argue that the structural sophistication of the firm in terms of centralization and complexity as well as the size, sector and status of the firm are important determinants. These dimensions are similar to the variables 'Industry and Skill Demands' and 'Geographical and Temporal Demands', which were formulated in the principal components analysis in this research. Lastly, Julien and Raymond (1994) suggested that certain organizational characteristics such as business size, competitiveness of the environment and information intensity have a role to play in the adoption of IT. These findings are not inconsistent with the four variables used in the second logistic regression estimated in this research.

The following points are made in respect of the logistic regression itself. Generally, the more a firm was concerned about its competitive position (both in respect of the demands from its customers and as competitors moved towards IT solutions, as well as having a recognition that there was the prospect of a positive ROI), so such a firm was likely to develop a Web site. Moreover, the 'Industry and Skill Demands' dimension suggested that as the formal education of the owner/manager increased, coupled with the likelihood that the firm was in the transport and storage or communication services industries, and realising that the cost of IT adoption was in effect an investment, then such a firm would be inclined to develop a Web site. Firms that were presented with relatively geographically dispersed markets, and realising that it was necessary to go through the time

consuming process of adopting various IT to reach these markets, were more likely to adopt Web sites than those that did not share these characteristics. Lastly, owners/managers who reported that their knowledge of business uses of computers was poor and who were likely to ask for support in installing and utilizing IT were also more likely to use Web sites than those who did not share these characteristics. The logit model was robust and was a clear distinguisher between adopters and non-adopters of Web sites using the variables derived from the principal component analysis.

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