Lancaster University Management School
Working Paper
2007/028

Entrepreneurs' attitude towards the computer and its effect on e-business adoption

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Abstract

This paper presents research exploring further the concept that many SMEs do not adopt computer based technologies due to decision maker's negative attitudes towards computers generally. Importantly, by assessing the entrepreneur's belief structure, we provide quantitative evidence how SMEs, particularly micros, are affected. Earlier research that addresses technology acceptance model (TAM) suggests that TAM parameters are particularly influential factors of e-commerce adoption, as perceived by top managers of SMEs. The model we develop is tested using a sample of 655 enterprises. The information was gathered, via a telephone survey of UK SMEs, from decisions makers in the enterprise. Technically, the paper uses k-means cluster analysis to segment respondents using the TAM perceptions, ease of use, usefulness and enjoyment. Based on two determined segments we look at the differential rate of adoption of internet, and the potential adoption of new e-collaborative technologies like video conferencing and electronic whiteboards. The diffusion of internet for low IT utility (LIT) segments was considerably slower than in the high utility segment (HIT). Similarly, the anticipated adoption of e-collaboration technologies was much lower for LIT than HIT. Interestingly, we find that LIT is populated by more micro SMEs than HIT. The results we present are limited however as our sample is considerably underweight in micro SMEs, suggesting that the problem may be much larger in the economy than our model predicts. For policy makers, this research confirms the value of knowledge transfer programs to SMEs in the form of technology support. Our research shows that organisations which have dedicated IT support will tend to be more advanced technologically than those that do not. The implication for entrepreneurs is if they can be persuaded that a technological route is beneficial to them, and that suitable support can be provided via KT, then operational efficiency gains could be made. This paper contributes to knowledge by analyzing a large number of UK based SMEs and assessing IT adoption potential via the TAM belief structure. Although a great many studies highlight the value of TAM to predict user IT adoption for the individual and the individual within an organisation, to date, few studies have looked at organizational decision makers perception towards computers and their influence on general ICT adoption.

Key Words:
Technology, acceptance, ICT, enterprise, SME, computer,

Introduction

The advent of new collaboration based e-management technologies based on broadband performance will bring faster and more effective information transfer and dissemination opportunities to enterprises; and the opportunity to explore the potential of virtualized management. Enhanced e-collaborative technologies, like web based video conferencing, shared desktop and electronic whiteboards should break down the barriers of time, distance and carbon footprint to those organisations that need to share ideas or solve problems with people that are geographically far away. The availability of new technologies does not guarantee adoption however, as investors in WAP technology observed (Fildes, 2002). Although internet penetration and use among Small and Medium Sized Enterprises (SMEs) is becoming ubiquitous (EC, 2003) many are slow to adopt either because the applications are too complex, or too expensive. Crucially also, incentives to the technology providers are not sufficient to enter the market to supply smaller enterprise (Brown and Lockett, 2004; Lockett and Brown, 2005). This information suggests that if we can learn of the technology needs of SMEs and raise awareness of the existence of e-technologies to them (e.g. supply chain information integration; Harland, Caldwell and Zheng, forthcoming) then we may be able to successfully develop and provide web based virtual collaborative environments that would raise organizational efficiency at both the intra and inter-enterprise level; potentially also for business to consumer activities. An important element of the research we present here is to understand why some firms fail to employ enhanced technologies as this will lead to under performance and reduced competitiveness. To accomplish this, we assess the usefulness of the technology acceptance model (TAM) and how decision makers (i.e. managerial/director/owner) perceptions towards computers generally influence final technology adoption within SMEs.

The need for knowledge on this problem is significant as the SME sector is of great importance to the UK economically. According to the Department of Trade and Industry Small Business Service (DTI, 2005), the SME sector accounts for approximately 60% of UK GDP and 58% of employment. Large organisations (full time employees > 250) account for just 0.2% of the 4.3 million registered companies within the UK. Small companies (full time employees < 50) account for a further 99% of the 4.3 million listed organisations. Crucially, the SME sector plays an important role by supporting the larger business sector via the supply of essential services in the form of products and services. The ambition, therefore, is to understand the technological needs of the SME sector so that operational effectiveness is improved. The more effective they become operationally, the greater the benefit to the overall economy leading to lower unemployment and well founded growth brought about by improved competitiveness. Importantly, and in this context, we assess some of the key barriers to technology adoption for smaller companies that would limit the adoption of technologies like those provided by e-science. Using large scale survey data we find that for organisations that existed prior to 1995 that the decision maker's poor technology acceptance thresholds, as measured by TAM, have led to these enterprises adopting internet technology more slowly than other SMEs with the effect felt most strongly among micro's. We also show that the adoption of e-collaborative technologies will be slower for these companies also, potentially limiting any productivity benefits that they provide. This information will be important to researchers and policy maker's seeking a deeper understanding of why some enterprises fail to adopt computer based technologies; but importantly, what outreach activities should target to minimise the under adoption of ICTs among SMEs.

This paper is organised as follows. The literature review is provided in the next section and reviews the process of enterprise innovation adoption and how market research has been applied to understand ICT penetration. Section 3 describes the conceptual and methodological arrangements of this paper including a discussion on the Enterprise Survey that was undertaken to assess our conceptual framework. The next section provides the results of our research followed by the final section that discusses the market potential of e-Collaborative technologies within the business context. This section also presents avenues for further research and policy conclusions based on the results provided.

Literature Review

There is considerable abundance of literature concerning enterprise adoption of ICTs, for instance, Brown and Lockett (2007) have discussed ICT adoption in the specific context of SMEs. More widely Frambach and Schillewaert (2002) described a model of organisational innovation adoption. They suggest a number of determinants that influence the organisations decision on whether to adopt a new innovation; like e-Management technology. Importantly, they suggest that enterprise innovation adoption arises both at the organisational level but also at the individual adopter level. Broadly outlined, these factors are briefly described to highlight key areas of research. Firstly, *innovation supplier marketing effort* that makes enterprise aware of the technology can provide increased adoption. Further increments in adoption can be provided via enterprise network participation and inter-connectivity provided via social networks. In Rogers (1995) innovation diffusion terminology this may, in part, be viewed as word of mouth effects that are known to positively influence the diffusion of innovations among early and later adopters. The previously discussed *innovation supplier marketing effort,* of course, would capture Rogers media effects. Environmental influences can also place sufficient pressure on enterprises to adopt novel technologies. For example, if the prime of a group of companies encourages the use of a new integrating supply chain system, it may be more effective for the supply chain partners to adopt the technology to enhance communication (i.e. a positive network externality); or even essential to remain in the supply chain. Strategically, if a competitor adopts the technology, it may be essential for other competing enterprises to do so if they are to remain viable within the industry sector.

Focusing more on the actual innovation itself, the relative advantage of the innovation over existing technologies is an important adoption driver, as is its compatibility with existing organizational infrastructure. Providing overall complexity is not too great (weighted against its usefulness) and can be easily tested or observed functioning, then uncertainties surrounding it should be minimized. Much of the derived perception towards the innovation will come from both the supplier via marketing effort but importantly also from the existing market of innovators and early adopters (Rogers, 1995). Providing this information is positive, and providing also that the other adoption drivers are in play, then the technology should be well adopted. Organisation characteristics (e.g. size and innovativeness) can act predicatively to describe innovation adoption also. Particularly, enterprise size is found to positively influence ICT adoption, although some smaller firms may have as much propensity to do so if they are sufficiently innovative. The innovativeness derives from factors including environmental influences alluded to earlier (i.e. media, word of mouth). Importantly however, innovativeness is as likely to be driven by the decision maker's attitudes towards technology generally, as the next paragraph highlights.

Intra-organisational acceptance drivers differ from organisational characteristics in that they are directed at the end user of the technology. For instance, the technology adoption literature (see Davis, 1989; Igbaria, Parasuraman and Baroudi, 1996) suggests that individuals within organisations adopt and use innovations due to social influences (e.g. colleagues use technology, therefore so must the individual, potentially for network external reasons but also reasons of worker productivity perceptions). General perceptions towards technology may also influence the decision to adopt and use the technology, although these are affected by technology facilitation such as training, organisational support and positive social persuasion. Several strands in the literature suggest that technological innovations are usually adopted by a particular group of consumers who are commonly referred to as "technophiles". Earlier research on the general level of technological adoption by households found, unsurprisingly, that contemporaneous technology levels acted as a useful predictor of internet demand (see Kridel, Rappoport and Taylor, 1999). Although this finding is fairly obvious (i.e. people that like technology are more likely to adopt more of it!) it highlights the question of what actually drives the underlying psychology of technology adoption and whether a metric may be derived from it that would allow us to segment organisations into groups with similar ICT adoptive characteristics (Soopramanien and Robertson, 2007)?

To understand the underlying belief structure of technology adoption, Davis (1989) provided a psychological framework that highlighted key elements of human technology acceptance. The Technology Acceptance Model was first applied to study how employees accepted ICT

technologies within a work environment. The TAM literature suggests that when an ICT adoption choice exists, providing that it is not influenced unduly by peer pressure then subjects' perceptions toward the technology on its *usefulness* and *ease of use* remain key drivers of the choice. Perceived *usefulness* as described by Davis (1989), is the belief that ICT adoption leads to augmented workplace activity. In this sense a worker may attribute the successful personal assimilation of ICT in work practice to improved promotion/wage/profitability prospects. More simply, the perception of *ease of use* is described as the belief that an IS system is effortless in use. The TAM has been successfully modified to enhance our understanding of the psychology of ICT adoption. For instance, Igbaria, Parasuraman, and Baroudi (1996) included the human perception *enjoyment* with the original usefulness and ease of use perceptions highlighted by Davis (1989). In this sense, the hedonic perception of enjoyment is defined as the belief that one takes pleasure in using ICT, above and beyond the need for usefulness. This fuller and more realistic model provided a better fit to the mental model of ICT choice and use than predecessors. Soopramanien and Robertson (2007) applied the TAM factors predicatively by summarising the three TAM perceptions, ease of use, usefulness and enjoyment into a single variable defined as ICT utility. This metric of technology acceptance, measured through a survey instrument, was then applied into a statistical choice framework that predicts survey respondent association to specific online shopping user groups. The application of TAM in this way intuitively predicted that those respondents with very low technology acceptance thresholds were very much less likely to adopt online shopping technology. How this finding applies to the business context is complex however, for it must be the influence of decision makers and their attitudes towards technology that drives the final ICT investment decision for the firm?

Grandon and Pearson (2004) provide a framework which highlights the effect of the perceptions of top management regarding implementation of e-commerce as a strategy to enhance profitability. During an analysis of the determinants of the adoption of e-commerce they identified four factors that influenced the decision to adopt, two derived from the technology acceptance model described previously. Using survey data from 100 SMEs in the USA, there conclusion not only corroborates the validity of applying the TAM model to assess managerial ICT acceptance within organisations, but also concludes it to be the strongest influence in the choice process. The implication, therefore, is that if decision makers have poor perceptions towards technology then this is likely to result in reduced innovativeness of the organisation generally; potentially negatively to its performance relative to competitors that are more innovative.

Research Questions and Methodology

The review highlighted that there are a number of factors that drive technology adoption in enterprise. Importantly however, it also provided evidence (i.e. Grandon and Pearson, 2004) that the decision maker's personal technology acceptance can influence the firm's innovativeness, or the ability to adopt and use new and innovative technologies that would otherwise increase competitiveness. The logic behind this statement is that if the entrepreneur is good at generating business, it does not necessarily follow that they will be confident or comfortable with IT. In larger organisations this may not matter, as part of the responsibility on deriving a decision on whether to adopt will be placed in the hand of an IT specialist (i.e. IT department or consultant). For smaller companies, this may not be possible as resources are often stretched with employees often taking multiple roles within the organisation. Ferneley and Bell (2006) provide evidence of the effect of small organisations applying new technology without specialist support. They describe the process of *bricolage* that is employed within SMEs to develop IS systems. Bricolage is defined as 'tools at hand' because entrepreneurs and their organizers will tend to put together IT in piecemeal fashion using whatever hardware and software they have available at the time. The authors also envisaged that much of this activity would produce results that are second best solutions to a more fully integrated IS system developed with high levels IT expertise.

This research seeks information on the hypothesis that within smaller organisations the decision makers may not have sufficient IT skill to implement technologies that would enhance business operations; leading to sub-optimal adoption decisions. With this influence in mind we assess

the conceptual model of organizational technology acceptance provided in figure 1, focusing on the decision makers' technology acceptance influence on organizational innovativeness.

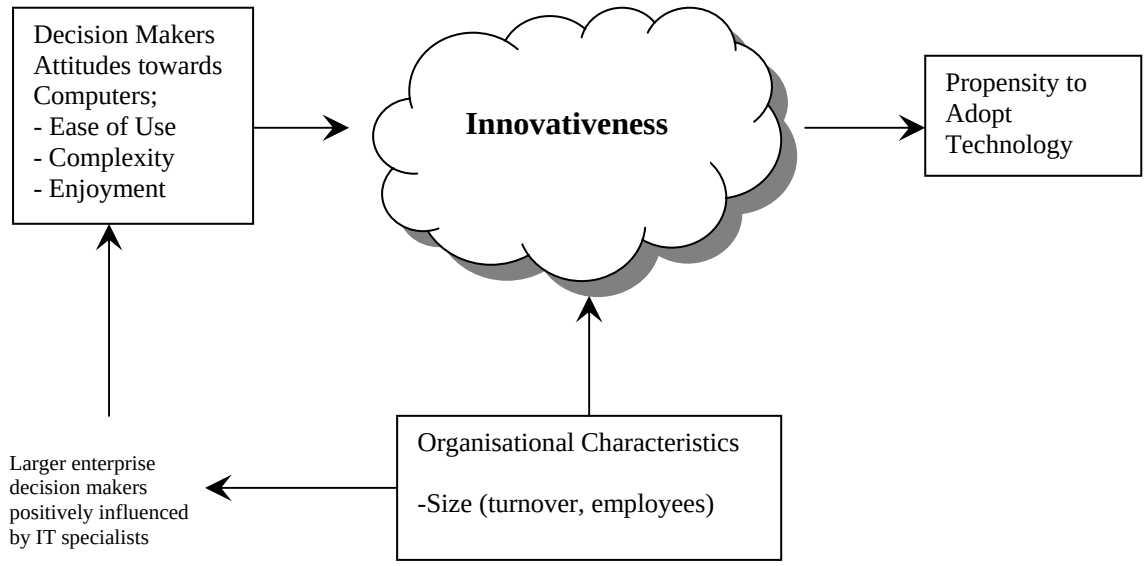

Figure 1: Model of TAM Influence on Innovativeness within SMEs

Figure 1 highlights that key elements of the decision maker's attitude towards computers can drive technology adoption within SMEs. The important point that we wish to derive from this model is to what extent the decision maker's perception towards computers influences the technology adoption process generally? In our model we vision that the decision maker can take many forms, e.g. IT specialists in larger firms, directors/owners in smaller organisations. The influence that this person can direct towards final IT investment decisions can determine the innovativeness of the company. When attitudes towards computer technology is poor (unlikely for the IT specialist or tech savvy entrepreneur), the innovativeness bubble reduces in size, directly affecting the propensity to adopt innovations generally. Organizational characteristics also affect levels of innovativeness. In this model, the affect derives in two parts. Firstly, enterprise size (as measured by annual turnover and the number of employees) directly effects innovativeness as larger and wealthier firms are more likely to be able to draw upon IT specialist skills than smaller organisations; influencing innovativeness directly. In this case the decision maker's perception becomes partly that of the specialist, increasing innovativeness.

We measure decision maker's perceptions towards computers as we see this technology as the hurdle of adopting other computer based technologies (e.g. e-commerce tools). It is intuitive that if an entrepreneur has difficulty in setting up/maintaining computer technology that this may also influence the adoption decision of other technologies that rely on computers. Evidence for this is discussed by Robertson, Soopramanien and Fildes (2007a) who highlight that income and educational attainment effects, important drivers of residential computer adoption, mostly wash out when addressing internet choice issues i.e. the skill required to use computers and cost of installation seems to be the crucial choice factors facing households. What this implies for enterprise is less clear but we assume that for smaller organisations that a similar pattern will emerge, but that the effect would be less apparent for larger or wealthier enterprises. The implications are that we should be able to detect this effect within the business community using sizeable quantities of survey data.

A number of outcomes can be predicted from the model that is presented in figure 1. Firstly, we should be able to segment decision makers on the basis of their perceptions towards computer technology that TAM suggests. Each segment, by definition, should be

characteristically different from the other in terms of its organizational characteristics. Innovativeness, we posit will be influenced by the decision makers attitudes in smaller less wealthy organisations. Not an unrealistic proposition given the evidence provided by Ferneley and Bell (2006) that those who manage IT in smaller enterprises tend not to be IT specialists. If the model holds we will expect to find a significant difference between segments in terms of enterprise size, as defined by annual turnover and the number of employees that they employ. The model also predicts that organisations with low perceptions toward computer technology will adopt other technologies more slowly than those with higher technology acceptance readings. To test these propositions we collected survey data from SMEs. A description of the data collection process is provided in the next section.

The Enterprise Survey

To test our model we developed a large scale survey instrument that was administered to SMEs during December 2006 and January 2007. The survey focussed on SMEs from the north of England, specifically the North West, North East and Yorkshire and Humber regions. Companies were selected from the Dunn and Bradstreet database of UK companies (via the 192.com database). Canvassers were expected to gather survey information from the owners, directors, company secretaries, IT managers or from people of similar stature who had good knowledge of computing used by the enterprise. Administrators in smaller companies were also accepted as respondents. In total, 655 complete surveys are used for the analysis that we provide in the next section. This is believed to be the largest survey of its kind that focuses on SME adoption of ICTs.

The survey was developed to gather information and insights into how organisations presently use ICT, but also, how and why they would adopt e-collaborative technologies like video conferencing, electronic whiteboards and desktop sharing software[1]. During the survey process information was gathered on broadband penetration, how long the organisation had been connected to the internet, whether they presently used e-collaborative technologies and the likelihood of adopting them in the future. It also gathered organisational characteristics, annual turnover and the number of employees that we use as a proxy for size. Within the survey that generated the data respondents were asked to rate statements relating to how they perceive computers[2] on a five point Likert scale ranging from *Strongly Disagree* to *Strongly Agree*. In line with Teo and Tan (1998) and the discussion presented earlier, we collected data on three perceptions, i.e. computer ease of use, computer usefulness and computer enjoyment. Although the application of the TAM framework to assess user acceptance among decision makers has been undertaken previously (Grandon and Pearson, 2004) we extend the testing framework on two dimensions. Firstly, Grandon and Pearson (2004) tested management perceptions towards e-commerce. We, however, seek information on the generalization that computers provide the layer of complexity that could limit the adoption of other computer based technologies. Secondly, above and beyond perceptions on usefulness and complexity we extend the model to that employed by Teo and Tan (1998) to include perceived *enjoyment* of technology, a hedonic dimension. We justify this as it has been applied successfully to studies of individual acceptance of technologies (see Teo and Tan, 1998; Soopramanien et al, 2007).

Soopramanien et al (2007) applied data of this type to segment consumers into ICT utility groups; this is the process we follow here also. Technically, we apply K-mean cluster (see Robertson, Soopramanien and Fildes, 2007a) based on squared Euclidian distance to segment our survey into groups with differential ICT adoption propensities, using only the computer acceptance parameters that have been discussed. Having applied this technique to 2, 3 and 4 clusters we find that clustering at level 2 provides best classification, based on comparing each cluster type to actual computer adoption. It is this variable we use to measure variation in SME characteristic and past, present and future technology adoption.

[1] See http://agora.lancs.ac.uk for a more detailed description of web based e-collaborative technologies.
[2] See http://www.ictresearch.org/publications/EnterpriseSurvey.pdf Q27; for survey form.

Results

To report the responses made by the decision maker's perception to the questions we introduce table 1. In this table the LIT cluster is defined as the segment of SMEs that provided low responses to the TAM constructs, as opposed to the HIT cluster that scored much more highly. On the dimension of Enjoyment we find that 75% of decision maker's from the HIT cluster either agreed or strongly agreed that computers were enjoyable to use versus just 20% in the LIT cluster. Interestingly, most organisations from either segment agreed or strongly agreed that computers are useful, although there still appears to be a moderate and systematic difference between the two groups, i.e. LIT scored less well than HIT (73% versus 99%). The biggest observable difference is found in the dimension of computer ease of use. In this perception, only 24% of this segment found computers easy to use, versus 97% of HIT enterprise decision maker's.

Table 1. The TAM Constructs

Perception	LIT	HIT
Agreed or Strongly Agreed that Computers **Easy of Use**	24%	97%
Agreed or Strongly Agreed that Computers **Useful**	73%	99%
Agreed or Strongly Agreed that **Enjoy** Using Computers	20%	75%

The implication for the results presented in table 1 is that each cluster is uniquely identified by the TAM model. The question now must be asked, what is the influence on actual technology adoption? Past adoption of internet services is shown in figure 2. All respondents to the survey were asked to report how long their organisation had used internet services. The benefit of this line of questioning is that we are able to produce historical internet diffusion curves for each segment (see, Soopramanien and Fildes, 2007b for an application of this technique to gather segmental historical broadband diffusion curves from household survey data). Figure 2 shows the results for SMEs that existed prior to 1995. At this point in time internet services were very basic and few firms used this technology to operationalise business in any way. To limit the effect of new firm start ups that may leap frog technological stages we filtered out firms with start up dates after 1995 leaving 446 of the of the 655 enterprises in the analysis[3]. It is readily observed that although both technology clusters started with low internet connectivity prior to 1996 the diffusion rate was consistently faster for HIT SMEs than LIT. Even to 2006 only 71% of LIT had adopted internet services, versus 94% in the HIT category. This finding suggests that TAM is a useful belief structure to predict the propensity of SMEs to adopt technologies when applied to the decision maker of the organisation.

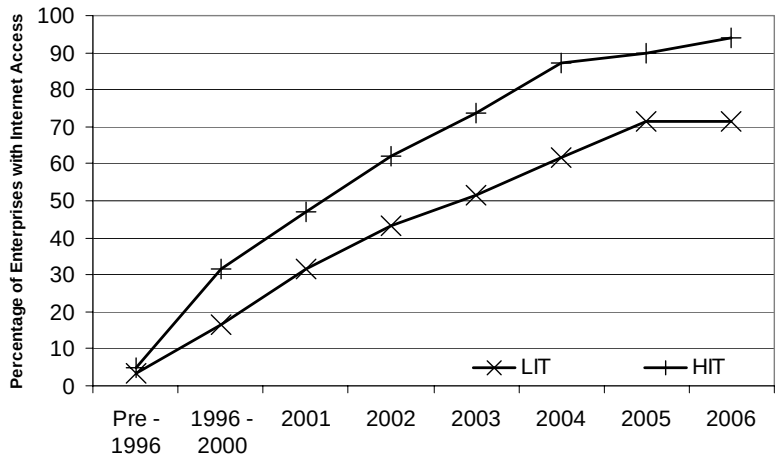

Figure 2. SME Internet Diffusion (n = 446): business start up before 1995

Further evidence of this effect is provided when conducting similar research on all companies (n = 655) in our sample. Important to policy makers is to understand the characteristics of organisations that make up the British economy and how they adopt technologies. Also, if

[3] The same analysis was conducted on the full sample of SMEs with similar results found.

historically a group of SMEs chose to adopt technologies more slowly than others, what effect will this have on future adoption? We address this vexing issue by seeking information on how SMEs report that they will adopt new web based e-collaborative technologies. Typically, these technologies need IP connectivity provided by local networks and/or broadband technologies. Decision makers were asked whether they had or would find useful video conferencing, document collaboration software or provide online video content to customers or suppliers in their organisations. For the case of video conferencing 14% of HIT indicated that they would find a use for this technology in their organisation versus 5% LIT. Similar disparities are found for document collaboration (13% versus 6%) and the provision of online video (17% versus 8%). In all cases, HIT decision makers are more likely to adopt technologies generally than LIT suggesting that if policy is to be initiated to maximize, for example, e-collaborative tool adoption, it should look towards addressing the technology concerns of decision maker's.

The question must now be raised as to the organisational characteristics define the LIT and HIT respectively? Thus far we have provided strong evidence that the technology adoption behaviour varies systematically. In the data we used, LIT is made up of 44% micro SME (defined as employees < 10), versus 26% micros in the HIT segment. This evidence potentially implies a generality that micro SMEs have lower average technology acceptance thresholds than small or medium sized organisations. This may occur as medium sized organisations have better IT support than micros and better finances to draw upon. Unsurprisingly, we also find that the median turnover in the HIT group lies between £1 million to £2 million, whereas for LIT the median turnover lies between £250,000 and £1 million.

Table 2 highlights the make-up of respondent types for each segment. It is readily observable that LIT has considerably more respondents from the director/owner category than HIT and no specialist IT staff. This highlights a further generality that if entrepreneurs have poor perceptions towards technologies and take the decision on ICT investments, then reduced ICT adoption within these firms is likely to arise. All respondents were also asked whether their organisations provided formal IT training to employees. Unsurprisingly we find that only 20% of LIT respondents that used computer and internet provided training versus 40% from HIT.

Table 2. Respondent Type by IT Segment

	LIT	HIT
Director/Owner	48%	28%
IT Management	0%	11%
Managerial	33%	29%
Accounting	8%	8%
Administration	13%	24%

It is important to note that the data we employ to generate statistics understates the real number of micro SMEs in the world around us. Whereas the sample we use is made up of 191 micros and 464 small and mediums, in reality the balance should be pushed the other way. The DTI Small Business Service reports that micro and small organisations make up 99% of the 4.3 million SMEs in the UK, but that 73% of SMEs have no employees. Within our survey, the proportion of micro SMEs is just 29.1%. In our sample, the LIT cluster makes up 15% of the total number of cases. If our survey reflected the true population at large the size of this low technology utilization group may be nearer 30%. Since this is much lower than would be found in the population at large, the strength of effect we highlight is likely to be significantly larger.

Discussion, Avenues for Further Research and Conclusions

In this paper we test the role of the TAM belief structure, as measured from the decision maker, as a predictor of SME technology adoption. Our results concur with that of Grandon and Pearson (2004) as we are able to produce technology adoption clusters based on decision maker's perception towards computers. Earlier in this paper we suggested that the ability to adopt computerized technology, like e-collaborative tools, could be limited by fundamental computer ability. To confirm this effect we showed that within the LIT cluster that very few

decision makers found computer technology easy to use. This implies that many smaller enterprises are likely to be struggling to use e-technology due the complexities that arise through their application. The problem that this is likely to cause is that performance enhancing computer based technologies are less likely to be adopted by these organisations implying reduced organisational efficiency and competitiveness for those that could take advantage of it. Interestingly, even within the LIT cluster, most surveyed respondents perceived that computers were useful. This disparity in response between ease of use and usefulness may well be indicative of a 'skills gap' that could be closed using a suitable policy instrument; for instance offering inexpensive outreach services from the public sector. With good training it may be the case that the low reading on computer enjoyment within the LIT cluster would rise with the enhancement of new skills; moreover, it would likely lead to improvements in the diffusion of newer e-technologies to those firms that should take advantage of them. Given that micro SMEs have less capacity to take on IT consultancy specialists as Ferneley and Bell (2006) highlight, it is interesting to note that 3rd stream activities that link Higher Education Institute skills to the business community are now encouraged by some public funding agencies.

The complexity of computers does seem to inhibit enterprise ICT adoption generally, as predicted by the conceptual model presented in figure 1. Aside from the training issues and solutions alluded to earlier, simplification of technology may provide an alternative route to improve final ICT adoption. Presently, many applications must be installed directly onto the computer before they can be run. If web based applications, like the e-collaborative technologies we highlight, were provided that allow users to access information seamlessly from the web then the computer technology at the work place could be greatly simplified, making them easier to use and maintain. Whether this simplification alone would be sufficient to engage smaller enterprises in higher tech solutions requires further research. For instance, fundamental prejudice against high tech solutions may remain a difficult barrier to overcome; even if application packages, however formed, are simple to use and potentially useful.

Although the TAM belief structure was applied to determine its role in the innovation process of SMEs; it is now time to test further extensions of it. The TAM was originally prepared to describe the psychological process of technology adoption within an organisational setting with later derivations tested on individuals and personal technology adoption. The individually assigned models have been extended considerably to encompass greater detail in the belief structure, for example, the Model of Technology Adoption Household (MATH) provided by Venkatesh and Brown (2001). Although we do not test these models here we suggest that further research be conducted to test some of their underlying assumptions within an enterprise context. Relevant to this research, they model computer adoption by capturing attitudinal beliefs (e.g. utility for work), hedonic outcomes (e.g. enjoyment of use), status gains, word of mouth and/or media effects and control beliefs (e.g. cost and ease of use). It is possible that if these assumptions were tested within the enterprise context that greater degrees of segmentation could be explored that would lead to better description of why some enterprises do not adopt ICTs when perhaps they should.

References

Brown, D., Lockett, N.J., 2004, "The Potential for Critical e-Applications for Engaging SMEs in e-Business: A provider perspective." *European Journal of Information Systems*, 13(1), pp. 21-34.

Brown D.H. and Lockett N.J., 2007, "E-business, innovation and SMEs - the significance of hosted services and firm aggregations" *International Journal of Entrepreneurship and Innovation Management*, volume 7(1), pp. 92-112.

Davis, F., 1989, "Perceived usefulness, perceived ease of use, and user acceptance of information technology", *MIS Quarterly* 13 (3), pp. 318-339.

Department of Trade and Industry Small Business Service, 2006, Statistical Press Release 20th December www.sbs.gov.uk/SBS_Gov_files/researchandstats/SMERegionsPressRelease.pdf.

EC., 2003, "The European e-Business Report/03 Edition" *European Commission*.

Ferneley E., Bell F., 2006, "Using Bricolage to Integrate Business and Information Technology Innovation in SMEs." *Technovation*, Vol. 26 pp. 232-241.

Fildes R., 2002, "Telecommunications Demand Forecasting - a review." *International Journal of Forecasting*, Volume 18(4), pp. 489-522.

Frambach RT., N. Schillewaert, 2002, "Organisational innovation adoption: A multi-level framework of determinants and opportunities for further research" *Journal of Business Research* Vol. 55 pp. 163-176.

Grandon EE., Pearson JM., 2004, "Electronic Commerce Adoption: an empirical study of small and medium US businesses", *Information and Management*, Volume 42 pp. 197–216.

Harland CM., Caldwell ND., Powell P., Zheng J., Forthcoming, "Barriers to Supply Chain Information Integration: SMEs adrift of eLands." *Journal of Operations Management*.

Igbaria M., Parasuraman S., Baroudi J.J., 1996, "A Motivational Model of Microcomputer Usage" *Journal of Management Information Systems*, Volume 13 (1) Summer, pp. 127-143.

Kridel DJ, Rappoport PN, Taylor LD., 1999, "An Econometric Study of the Demand for Access to the Internet." In: Loomis DG, Taylor LD, editors. *The Future of the Telecommunications Industry: Forecasting and Demand Analysis*. Netherlands: Kluwer Academic Publishers.

Lockett, N.J., Brown, D., 2005, "An SME Perspective of Vertical Application Service Providers." *International Journal of Enterprise Information Systems*, Volume 1(2), pp. 37-55.

Robertson A.W., Soopramanien D., Fildes R., 2007a, "Household Technology Acceptance Heterogeneity in Computer Adoption", *Americas Conference on Information Systems* (AMCIS) (Keystone, Colorado).

Robertson A.W., Soopramanien D., Fildes R., 2007b "Segmental New-Product Diffusion of Residential Broadband Services", *Telecommunications Policy*, Volume 31(5), June, pp. 265-275.

Rogers E.M., 1995, "Diffusion of Innovations", *The Free Press*, New York.

Soopramanien DGR, Robertson AW., 2007, "Adoption and Usage of Online Shopping: An empirical analysis of the characteristics of "buyers", "browsers" and "non-internet shoppers", *Journal of Retailing and Consumer Services*, Volume 14, pp. 73-82.

Teo T.S.H., Tan M., 1998, "An Empirical Study of Adopters and Non-Adopters of the Internet in Singapore" *Information and Management,* Volume 34, pp. 339-345.

Venkatesh V., Brown SA., 2001, "A Longitudinal Investigation of Personal Computers in Homes: Adoption Determinants and Emerging Challenges", *MIS Quarterly*, Volume 25(1) March.