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The search for innovators and early adopters of e-collaborative technologies within small and medium sized enterprises in the UK

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The Search for Innovators and Early Adopters of e-Collaborative Technologies within Small and Medium Sized Enterprises in the UK

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Abstract

New product diffusion theory predicts that innovators and early adopters are critical to the success of new innovations. The rate at which enterprises adopt e-Science technologies must therefore rely upon reliable market intelligence so that the critical early stages of adoption are successfully navigated by developers and planners. Failure to understand attitudes towards new technologies can lead to even useful technologies being under-adopted. This paper applies a survey based methodology to develop estimates of demand for web based virtual Collaborative technologies. We show that approximately 76% of the 1029 firms that we interviewed are technologically ready to deploy these technologies. We also show that 10% of all firms are ready look at these technologies as solutions to collaborative problem solving.

1. Introduction

The advent of new internet based communication technologies based on broadband performance will bring faster and more effective information transfer and dissemination opportunities to enterprises; and the opportunity to re-explore the potential of virtual management. Enhanced e-collaborative technologies, like video conferencing and electronic whiteboards, should break down the barriers of time and distance 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 almost ubiquitous (EC, 2003) many more complex applications are not adopted as newer internet based technologies are now too expensive or too complicated for smaller organisations to adopt (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-science technologies to them then we may be able to successfully develop and provide web based virtual collaborative environments that would raise organisational efficiency.

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 crutch services in the form of products and services. The ambition, therefore, is to understand the technological needs of the SME sector so that software based solutions may be developed to optimise operations. The closer we can push this sector towards operational optimality the closer the overall economy should move towards ideal economic capacity, that is, low unemployment and well founded growth brought about by improved competitiveness.

In this research we support the notion that portal based e-collaborative technologies that e-Science develops will help the SME sector by enhancing communications linkages both within and across enterprises. An important element in our research is to measure interest in e-collaborative technologies, directly from SMEs, using market research techniques that explore the potential demand for such products. To accomplish this it is important to understand the nature of new innovations and how they are observed by the potential market place so that the innovation design is well aligned to *user needs*. To provide well founded support for our approach we describe the diffusion of technologies and the demand for e-collaborative tools in terms of innovators and early adopters. In doing so we determine that there is a considerable potential demand for web based e-collaborative technologies within the SME sector, useful information from the perspective of the market planner.

This paper is organised as follows. Section 2 provides a literature review on the process of innovation adoption and how market research is applied to measure ICT penetration. Section 3 describes the market research approach we have undertaken and our data. Sections 4 provides the results of our survey followed by section 5 that discusses the market potential of e-Collaborative technologies within the business context and presents avenues for further research.

2. Literature Review

Innovation diffusion can be defined as the cumulative sales or distribution pathways that some new technologies take from the point of market entry to the time that the market becomes saturated (i.e. when all that want it have it). Observation suggests that diffusion processes tend to follow an S shape (Bass, 1969). Based on this observation Rogers (1962) selected the normal density to model markets as this provided a close fit to observed product penetration patterns. A depiction of this is shown in Figure 1.

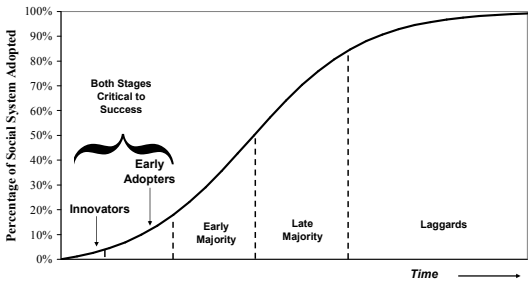

Figure 1:Rogers (1995) Depiction of the Cumulative Adoption Path of a New Innovation

Rogers proposed that there are two types of consumer in the economic system. The first segment is defined as the innovators which are shown in Figure 1 as a very small cohort. Bass (1969) suggested that this cohort adopt an innovation independently of other individuals within the economic system and are affected only by media effects, which should demonstrate to them that the product or service is available and to their liking. The *innovators* are the first adopters to come to the market and are willing to trial and test the product. Importantly, this group act like seeds that recruit from the second segment via word of mouth effects and through the production of media that describes the usefulness of the innovation. The second segment is defined as *imitators* because they use, perhaps even seek, advice from existing adopters within the social system before finally taking the decision to adopt the product or service. This segment is also affected by environmental variables such as mass media, much like the innovators, but also word of mouth from the innovators.

Rogers discussed four types of imitator, the first group are the *early adopters*. Although fairly innovative in their own right, this cohort would have had some encouraging interaction with the true innovators that are already using the product. This interaction effect is critical as limited or negative communication between the early adopters and innovators can stop a new product from reaching mass market entirely (e.g. Moore's Chasm: Mahajan, Muller and Wind, 2000). As more members of the social system adopt the product or service, the word of mouth effect

increases, augmenting further still the rate of adoption. Bass (1969) suggested that the pressure on non-adopters to adopt increases as the number of actual adopters increases. We may think of pressure deriving from factors like network externalities and peer pressure. As time moves on, a second type of imitator manifests called the early majority. This cohort requires more time to digest market information than the early adopters, although the actual rate of adoption increases quite quickly across this group. Since 50% of the market has now been absorbed, and because the market is assumed normally distributed[1], the adoption rate begins to decline through this cohort and into the next. Despite having access to a great deal of information regarding the product or service the laggards are the final cohort to adopt the innovation. The delay in getting the last two cohorts into the market suggests that the propensity to gather market knowledge, perhaps including the methods used to interpret information, vary across the spectrum of the social system. This is not surprising as the evidence suggests that early adopters can be characteristically different from later adopters of innovations within the product cycle. For instance, early adopters of residential broadband technologies tended to be wealthier and better educated than later adopters (Robertson, Soopramanien and Fildes, Forthcoming).

Although Rogers description of the innovation lifecycle is useful it does not illuminate *why* individuals or organisations adopt technologies as they do. To overcome this difficulty Davis (1989) provided us the technology acceptance model (TAM). The TAM was developed by social psychologists to describe user acceptance of information systems within organisations. It determined that colleagues often adopt technologies (e.g. spreadsheets or word processor), not always for their usefulness, but often due to peer pressure effects intra-organisationally, perhaps to maintain likelihood of promotion. One can envisage that this would be evident at the inter-organisational level also. Gatignon and Robertson (1986) and Frambach and Schillewaert (2002) describe the competitive or environmental pressures that may force enterprises to adopt technologies. Frambach and Schillewaert (2002) also describe positive network external effects that can also be thought of as word of mouth effects. Network externality effects were particularly important in the success of fixed line and mobile phone adoption (Fildes, 2002) as an additional subscriber leads to an increase in the utility of all existing and future subscribers thereby augmenting the eventual success of the technology.

Rogers discussion highlights that if the innovation is to be successful, then a firm understanding of the innovators and their needs from the technology is critical to market orientated success. Any failure of the innovators to convey, via media reports or word of mouth, the usefulness of the innovation outwards can lead to the under-adoption of innovations *even if they are useful*. We would suggest that one important attribute of success is to direct a market research strategy that assesses the potential demand for new innovations. In this sense we seek out the innovators and early adopters and determine their perception towards the innovations and its attributes.

A number of approaches can be adopted to draw information from would-be users that would yield useful innovation adoption intentions information. Initial emphasis should be placed on gathering adoption intention data from consumers of the market so that the likelihood of adoption can be assessed. Morwitz (2001) discussed in detail the techniques used to measure the intentions of individuals and how intentions data can be used to forecast new-product penetration. The process of gathering intentions data begins with the design of a survey. The questions within the survey should not lead consumers in to making biased responses. The style of the data gathering exercise should encourage respondents to answer the questions solely from their own perspective or that of the organisation, but that the responses be taken directly from the decision maker so that assumptions made by a second party can be eliminated (Armstrong, 1985). Any response bias that occurs can be minimised via statistical adjustments (e.g. weighting). The resulting adjusted data can then be used to estimate adoption probabilities using general statistical techniques.

This section highlighted that it is useful to think of the market for innovations in terms of early and later adopters but that early product cycle non-adopters may become adopters later in the product

[1] Although Rogers depiction and the Bass (1969) diffusion model propose a symmetric S shape to the diffusion process more recent studies focus on the development of more realistic non-symmetric models.

cycle, *providing that positive market stimuli are present and that the innovation can be purposefully deployed*. It also highlighted that if we are to understand the potential adoption of new innovations then we should seek to measure current attitudes towards it. The benefit of this style of approach, whether it is applied before or after product launch, is that we can try to estimate the level of potential innovation in the market that yields a measure of expected innovation demand. The next section highlights the methodology we have applied, via the development of a large scale survey that seeks to determine the expected demand for e-collaborative technologies within SMEs in the North of England.

3. Research Methodology: The Enterprise Survey

The research we conduct seeks information on the potential level of adoption of e-collaborative technologies within SMEs. To accomplish our research two key elements of knowledge are required that will lead to estimates of potential demand for these technologies. The first element requires us to understand the technological requirements of the innovation. The Java enabled web based tools we develop are delivered via portal technology and are designed to be deployed within an IP environment. No software installation (apart from Java) is required on the local users machine. As long as enterprises use Windows XP and connect to the internet using broadband (or better) technology and/or have IP enabled internal networks then they have sufficient IT resources to apply the e-collaboration technology that we have developed. Although we do not measure the software environments of the SMEs (i.e. whether they use XP) that we survey, we do measure IP network penetration levels and broadband connectivity. Both of these measures together act as the *maximum potential adoption* within SMEs for either intra or inter-enterprise collaborations or both. With these parameters known we then assess, out of the technologically ready enterprises, what are the implications of this technology in their business activities. The Enterprise Survey was designed to meet this need and provides important measures of attitude towards e-collaborative technology.

The Enterprise Survey was administered during December 2006 and January 2007 and 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). Approximately 9000 SMEs were contacted via telephone by a canvassing team trained to administer the survey at Lancaster University Management School. Canvassers were expected to gather survey information from the owners, managing directors, company secretaries, IT managers or from people of similar stature. Administrators in smaller companies were also accepted as respondents. The survey received a response rate of approximately 12% to outbound calls providing a total of 1029 completed forms. It is important to note that problems of sample selection and response bias can lead to results that are difficult to extrapolate to larger populations. In this case two types of bias were encountered. Firstly, regional bias arose due to the over collection of surveys from the NE and too few from the NW. Secondly, the survey contained too few small enterprises, defined by the Department of Trade and Industry as those organisations with less than 50 employees. Both imbalances were corrected using a weighting process called rim weighting (Elliot, 1991; Barnett, 1995). All results generated for this document are weighted implying that the results reflect the general picture to be found in the north of England.

It is important that we understand the level of confidence that we have in the estimates that are presented. To assist with this, all statistics are presented with a confidence interval (CI) set at 95%. A confidence interval places a statistical boundary around the point estimate. The high and low value of this boundary suggests that if the survey was conducted randomly on the same underlying population twenty times, only once would any one of the survey estimates produce a result that falls outside of the confidence interval that we provide. Therefore the narrower the band the greater the reliability of the survey estimate. The band varies in width according to sample size and variability of the data. All CIs presented here are computed individually to the point estimate that is discussed.

4. Survey Results

The SMEs that responded to the survey derive from a broad background of industrial activities that comprise of 348 Standard Industrial Codes (SIC). More than 60% of firms were operating prior to 1990 with some 20% formed before 1970, implying considerable industry experience. Annual turnover was reported by approximately 66% of respondents. Of those firms that reported turnover 8.5% earn less than £250,000 but the median firm turnsover between £1,000,000 and £2,000,000 per year.

4.1 ICT Penetration within SMEs in the North of England

As discussed previously, this research was designed to assess the expected demand for e-collaborative technology. As such, it is important to measure current IT penetration levels within the SME sector to assess maximum potential demand. With regard to this matter we have assessed the penetration of computers within organisations, the type of network technology installed (e.g. IP) and internet connectivity (e.g. broadband versus ISDN or dial-up).

Figure 2 shows the distribution of computers within the SMEs that were surveyed. Approximately 5% of SMEs reported that they did not use a computer to operationalise their business, whereas most enterprises (56%) indicated they operated between 2 and 10 computers. Of the companies that operated two or more computers only 11% (± 3%) indicated that they were not connected by any

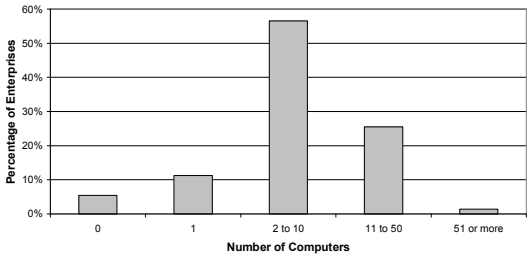

Figure 2: Level of Computing Technology within Enterprises (CI ± 3%)

network. More than 58% (± 3%) of companies suggested that they used IP networks (either hardwire or wireless) to transfer data between computers. This would indicate that intra-organisational e-collaboration is possible with at least 58% of the SMEs that we surveyed.

On internet connectivity, computer owning firms were asked whether they were connected to the internet, 95% (± 1.4%) suggested that this was the case. Of these internet connected enterprises some 85% (± 2.3%) were connected using broadband technologies. This compares to just 6.6% (± 1.5%) for dial-up and 6.2% (± 1.5%) for ISDN. *We estimate broadband penetration across all SMEs to be **76%** (± 2.7%).* This highlights that up to 76% of SMEs are now technologically capable of running the web based e-collaborative technologies that we describe.

4.2 Present Use of e-Collaborative Technologies and Potential Future Adoption

To measure current use of e-collaborative technology *computer owning* enterprises were asked whether they presently used video conferencing, online document collaboration software, virtual training software or provide online video content to customers or suppliers. Figure 3 highlights that although the technologies we seek information on are quite new, they are being applied within the SME sector within a small group of companies, *potentially the innovators we seek.* To this extent, 4.2% of SMEs presently use video conferencing technology and 8.5% use online document collaboration software. Also, 8.7% use virtual training software and 6.8% provide online video content to customers and/or suppliers to assist them in business operations.

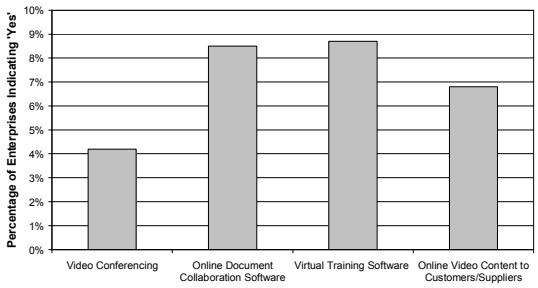

Figure 3: Computer Owning Enterprises Present Use of e-Collaboration Technology (CI ± 2.3%)

We then asked those organisations that did not at the time of the survey use these technologies, whether there would be a role for them in their organisation. Figure 4 indicates a strong potential future uptake for these technologies with 10% of SMEs suggesting video conferencing technologies could be applied to solve business problems. Approximately 10% of the SMEs that were interviewed also indicated that it would be useful to provide online video content to customers and/or

suppliers. Both online document collaboration software and virtual training software were found to have good potential from over 5% of SMEs.

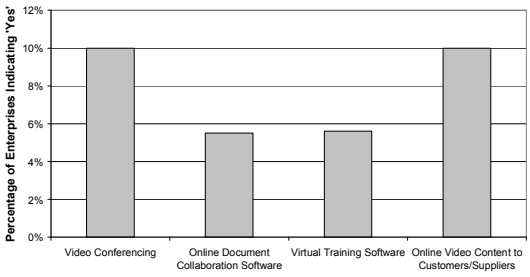

Figure 4: Computer Owning Enterprises Future Potential of e-Collaboration Technology (CI ± 2.5%)

To deepen out knowledge on the intra-organisational communication needs, respondents were asked whether people in their company worked away from the main office or traveled frequently making them less accessible and whether they needed to communicate with these people. Some 478 (46.5% ± 3.3) of respondents suggested that this was the case. The most favoured *present* method of communication to these geographically distant people is telephone (98% ± 1.3), email (38% ± 4.4) followed by fax (5% ± 2). To determine the receptiveness of SMEs to new technologies, the respondents were asked to rate the following statement on a five point scale from 'Strongly Agree' to 'Strongly Disagree'; *"I believe that communication between myself and these people* [i.e. those geographically distant] *could be improved using enhanced technologies"*

In response to this statement 47.8% (± 4.5) either agreed or strongly agreed. This would suggest that approximately 25% of the SMEs that we interviewed understand that technology could enhance communication within their organisations. To build on this, we asked respondents whether during the course of business they needed to share ideas or solve problems with other people who are geographically far away from them. Of all surveyed respondents 243 indicated this to be the case. Of these 243 respondents 33% (± 5.2) suggested that web based video conferencing would be a solution to the costs imposed by geographic distance. Importantly also, 35% (± 5.2) suggested that an electronic online whiteboard would also be an effective collaborative business tool.

Approximately 22% (± 5) of all respondents felt that some meetings should be held face to face between themselves and co-workers but that insufficient resources were available to do so. Free form examples of cases where this occurs were drawn from the respondents. Some of the examples given are provided below and highlight a broad heterogeneity of potential e-collaboration applications:

- Keeping in touch with sales people
- Construction: easier to see a construction issue on building site than have it described to you
- Keeping in touch with field engineers
- When the contract managers are out of the office but they are needed to be involved in a meeting
- Business meetings, international conferences
- Trying to put together a catalogue with colleagues in Glasgow
- Discussing quote with a potential customer, every now and then it would be useful to do that face to face

4.3 Inter-organisational Communication Needs

Respondents who suggested that they worked with people who were geographically far away were asked whether these tended to be suppliers, customers or clients, or business network contacts. Figure 9 shows the outcome to these questions.

More than 70% of SMEs need to work with people that are geographically far away who are customers and clients. Nearly 40% reported these people to be suppliers and 55% highlighted business network contacts. This strongly suggests that the inter-organisational need for e-collaborative technologies will need to account for these varied inter-organisational communication channels.

5. Discussion and Avenues for Further Research

This paper highlights a methodology that can be applied to deepen our understanding on the potential adoption of new technologies, specifically e-collaboration tools within SMEs. Rogers conceptualisation of innovation diffusion suggests that we should seek to understand the needs of the innovators and early adopters if the launch of a new innovation is to be successful. In this paper we propose a market research methodology that assists in uncovering the level of potential innovation and

early adoption in the market for e-collaboration tools among SMEs. Although the empirical research we conducted to measure expected demand was confined to the north of England we assume that the findings of the Enterprise Survey will generalise nationally and beyond.

The Enterprise survey was designed to capture current ICT penetration levels and attitudes towards new portal based e-collaborative technologies from SMEs in the North of England. From this we are able to measure the degree of innovation and early adoption that we may encounter when we provide portal services to enterprises in the future. We find that there is now a case for the application of e-collaborative technologies re-deployed as enterprise e-Management tools. We show, through the application of large scale survey data, that 76% of SMEs are now technologically capable of running the e-collaborative technologies that the Lancaster Centre for e-Science has developed. The evidence from the survey suggests that many SMEs felt that these technologies could play a role in the way that they interact with their business environment. For intra-organisational e-collaboration we also found that more than 58% of SMEs have IP enabled networks, potentially allowing the use of these technologies within organisational boundaries. Overall, our research suggests that up to 10% all UK SMEs could potentially deploy e-collaborative technologies successfully within their organisations to enhance business activities; yielding a potential demand from approximately 400,000 SMEs nationwide. Beyond national boundaries this number would be far greater.

The latest web based e-collaborative technologies will re-open research into Virtual Organisations (VOs) within SMEs that was conducted during the 1990s and 2000s (see Davidow and Malone (1992) for an early discussion of virtual corporations). Much of the academic literature produced in this research area provided at best weak successes (e.g. Rezgui, Y. (forthcoming)). This is hardly surprising as linkages between participants were mostly carried out over modem or ISDN connections that provided limited textual communications. The survey results highlight that the technological times have changed dramatically during the last 4 years. Many organisations now use high speed IP technology to connect computers together or to the web. Both of these statements suggest that web based enhanced technologies may now be applicable to SMEs. In fact, technologies developed at the Lancaster Centre for e-Science, that is, easy to use web based video conferencing and the electronic whiteboard accessed via Agora (See http://agora.lancs.ac.uk), now seems applicable within the SME sector. It is important to note that recent academic research suggests that face to face communications versus text/audio decision outcomes leads to suboptimal decision making (Daly Jones, Monk and Watts, 1998). When comparing to video conferencing the decision outcome remains the same (Credé and Sniezek, 2003). We suggest that the advent of e-collaboration technologies, delivered via broadband connectivity or IP networks, will now allow us to explore the potential of VOs within the business context.

We now need to effectuate the next phase of the research, that is, to determine how organisations are likely to apply these technologies in detail. During this next phase we shall apply qualitative methods to determine how e-collaborative technologies could be deployed into their organisations. Importantly also, we will assess how they will raise organisational efficiency. The research will also analyse at the importance of technological mobility to determine this attributes relevance to business users. The evolution of future technologies, like WiMaX, are likely to lead to more ubiquitous high speed connections implying that e-Management technologies should evolve with them. Within the context of what we wish to deliver, we will also need to assess portal design requirements of organisations. The Northern Leadership Academy, a partnership of Lancaster, Leeds and Liverpool Universities, focuses research into how business portals should be developed to meet business users' needs. We hope that in the future that this research will enlighten us on critical business needs, for example connectivity and security, or whether open source web based solutions should be provided for each firm as a unique case.

To conclude, based on the findings presented here, we are optimistic on the eventual demand for e-collaboration tools within SMEs in the UK. Given this expected demand, and once the qualitative product testing phases are complete, we will be seeking further government funds to produce a portal based open source e-Management toolbox for enterprises. We hope that the easy to use web based technologies that it would provide will lead to improved enterprise performance; culminating in positive benefits to the economy and beyond.

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