

Understanding the implications of ICT adoption: insights from SMEs

Helen Shiels

Ronan McIvor and

Dolores O'Reilly

The authors

Helen Shiels is a Lecturer, Ronan McIvor is a Senior Lecturer, both in the Faculty of Business and Management, and Dolores O'Reilly is Professor of International Business Strategy, all at the University of Ulster, Londonderry, UK.

Keywords

Integration, Information, Communication, Management, Small to medium-sized enterprises

Abstract

The phenomenon of the Internet has forced businesses and organisations to examine their existing business practices and adopt new methods of working, both for existing and potential customers. This paper presents an analysis of a pilot study of 24 SMEs, which seeks to elicit the various determinants of employing ICTs and the level of sophistication of use. The paper analyses the approach used to facilitate the introduction and implementation of new technologies, with a view to achieving integration with business processes. The discussion, based on the initial findings, examines the circumstances for ICT success and strategic effects resulting from implementation and use of such technologies. A conceptual model provides a framework for determining the level of sophistication of SMEs in their exploitation of ICTs. The findings highlight that characteristics of the firm and industry sector are contributory factors to the extent of adoption and exploitation of ICTs by SMEs, to support business processes.

Electronic access

The Emerald Research Register for this journal is available at
<http://www.emeraldinsight.com/researchregister>

The current issue and full text archive of this journal is available at
<http://www.emeraldinsight.com/0957-6053.htm>

Introduction

Many researchers have been calling for fresh theories and models to explain and understand the phenomena of electronic commerce (Hoffman and Novak, 1996; Evans and Wurster, 1999). Although small and medium-sized enterprises (SMEs) form a substantial constituent of the global economy, there is limited knowledge available surrounding the adoption of information and communication technologies (ICTs) by SMEs whereby it is only recently that interest in the relationship between SMEs and ICT has begun to be explored in any great depth (European Commission, 1995; Iacovou *et al.*, 1995; Lauder and Westall, 1997). For example, the study by Cragg *et al.* (2002) provides evidence that some IT investment can impact on small firm performance and that IT alignment is important in understanding the relationship between IT and firm performance. However, the dissemination and assimilation of ICTs in SMEs is ripe for investigation, due to the paucity of relevant literature, empirically rigorous data and focused research in this area (Martin and Matlay, 2001; Fallon and Moran, 2000).

Electronic commerce (e-commerce) has been defined as "the electronic exchange of information, goods, services and payments" (Harrington and Reed, 1996). It relates to a plethora of business activities which are conducted electronically, including interactions between organisations and their upstream and downstream partners (Umar, 1997). Whilst numerous technologies are used to support e-commerce, including electronic data interchange (EDI) and electronic funds transfer (EFT), one of the most prominent technologies for business managers, is the Internet. The potential of the Internet and more specifically, the World Wide Web (WWW), has derived considerable attention as a commercial medium and a key to many new markets (Alhadef and Cohen, 1997; Hoffman *et al.*, 1995; Indermaur, 1997; Seeley, 1997; Senn, 1996). Indeed, Gunasekaran *et al.* (1996) suggest that many small firms recognise the opportunities offered by global markets as increasingly important to the success of their operations. By allowing the dissemination of information on a global basis the Internet has the potential to "provide an efficient channel for



advertising, marketing and even direct distribution of certain goods and services" (Hsieh and Lin, 1998, p. 115). The phenomenon of the Internet has forced businesses and organisations to examine their existing business practices and adopt new methods of working, both for existing and potential customers.

SMEs often model themselves on organisations that they believe to be successful or market leaders. This is especially relevant to the use of the Internet. SMEs have attempted to emulate leading organisations and their use of the Internet without fully understanding the implications (Kassaye, 1999). Whilst SMEs are impeded traditionally by having less human, financial and technological resources than large organisations, they can be more innovative, flexible and responsive to environmental changes (Julien and Raymond, 1994).

The absence of suitable and sufficient knowledge on this topic exposes a "rhetoric versus reality" argument of whether ICT implementation is critical to SME strategies. For example, in the Northern Ireland (NI) context, the Information Age Initiative (IAI), a government-funded initiative, claims that "adoption and use of ICTs is now accepted as a key driver in the development of a knowledge-based economy and is therefore intimately related to the future sustainability and development of businesses" (IAI, 2000, p. 11). However, such claims fail to address the empirical evidence upon which such sweeping generalisations are made or the basis of future policies. Therefore, determining why small businesses choose (or not) to adopt and implement e-business technologies and for what purposes, have become important issues for both policy makers and academia (Gallaughner and Auger, 1997).

O'Farrell and Hitchens (1988) describe peripheral regions as being viewed as "hostile environments" for new and small firms, due to a lack of resources and entrepreneurial and workforce skills. Whitley (1986) also suggests that regions of the European Community are, in general, characterised by a disproportionate share of SMEs in labour intensive industries, because they cannot support larger enterprises. NI can be described as a peripheral region off a peripheral region, with its industrial landscape dominated by SMEs. For example, SMEs account for over 99 per cent of businesses,

employ 79 per cent of all private sector employees and generate over £23 million (exc. VAT) per annum in NI (Industrial Development Board (IDB) and the Local Economic Development Unit (LEDU), 2001). Hampered by geographical constraints, the Internet presents a platform for SMEs in NI to catapult themselves into the global market arena.

This paper presents an analysis of a pilot study of 24 SMEs, from four industry sectors, including those within the two largest cities in NI, which seeks to elicit the various determinants of employing ICTs and the level of sophistication of use. The paper analyses the approach used to facilitate the introduction and implementation of new technologies, with a view to achieving integration with business processes. The discussion, based on the initial findings, examines the circumstances for ICT success and strategic effects resulting from implementation and use of such technologies. A conceptual model has been developed based upon a review of the literature and the empirical findings. This "ICT exploitation and business integration model", provides a framework for determining the level of sophistication of SMEs in their exploitation of ICTs. The findings highlight that characteristics of the firm and industry sector are contributory factors to the extent of adoption and exploitation of ICTs by SMEs, to support business processes. The commitment of senior management was also found to be a driving force in the adoption and exploitation of technology. Evidence from this initial study also suggests that there is limited integration between the Internet and internal systems. It is argued that further research is required to investigate the transferability of the proposed conceptual model to other industrial sectors and beyond the initial geographic locations identified.

Adoption and use of ICT

The adoption of information technology (IT) and information systems (IS) has been analysed most often in relation to diffusion and assimilation of innovation, (Bouchard, 1993; Lee, 1998). Whilst Rodgers' (1995) classical diffusion of innovation model has provided the theoretical foundation for many of these studies, innovations adopted by

organisations *vis-à-vis* autonomous adoption by individuals and innovations encompassing complex technologies with an inter-organisational locus of impact in which adoption decisions are adjoined, needs to be enriched (Eveland and Tornatzky, 1990). Levy *et al.* (1998, p. 6) identified "innovation" firms, where "information systems are an integrated and tightly woven part of the business strategy". SMEs face specific problems in the formulation of their innovation strategies due to their deficiencies arising from their limited resources and range of technological competencies (Tidd *et al.*, 1997). In the absence of a more general theory of innovation, Fichman (2000) suggests that researchers should develop mid-range theories "tailored to specific classes of technologies [in this case, ICTs] and/or particular adoption contexts [in this case, SMEs]". Fichman's (2000) suggestion is apparent from the contradictory models purported by Venkatraman (1994) and Poon and Swatman (1997).

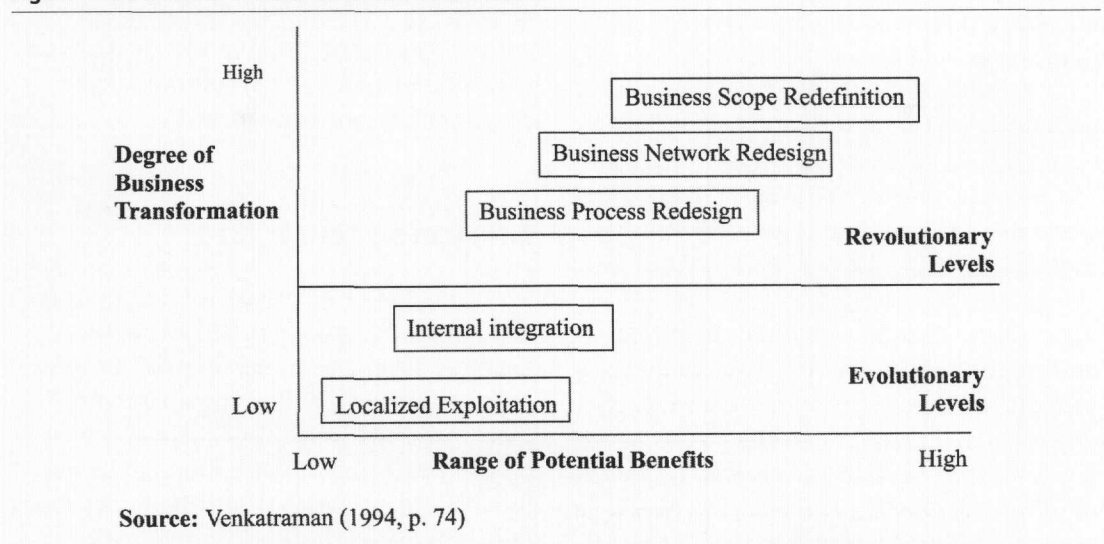
Venkatraman's (1994) model (see Figure 1) of IT-enabled business transformation is based exclusively on large corporations (including IBM, Otis Elevators, Bose Corporation), which examines the range of potential benefits from employing IT and the degree of organisational transformation. The model suggests, that organisations adopt a "bottom up" approach and progress through a five-stage process in a sequential manner, beginning with local business functions within the organisation (localised exploitation), expanding to inter-organisational (business network redesign) and culminating in sector-wide transformation (business scope

redefinition). This model recognises organisational differences, with the view that businesses will engage in this linear process at different stages and in relation to internal structural changes and external competitive issues. However, it does not encompass other key factors of adoption, in terms of organisational size, sector, geographic location, available skill-base or available resources. Nor does it emphasise the entrepreneurial or innovative factors or the economic contexts put forward by a number of writers. For example, the importance of a strong IT capability including the specific ICT skills of small firm owner/managers, is indicated by Bharadwaj's (2000) study, showing that firms with a strong IT capability outperform others on profit and cost-based performance measures.

Whilst there are not only economic benefits which organisations can achieve from adopting and exploiting ICTs, but also the managerial knowledge, skills and experience of owner/managers of SMEs which have the potential to make a significant difference in exploiting new opportunities offered by ICTs (Matlay, 1999). Chapman *et al.* (2000) claim that most managers who lack in-depth understanding of ICTs and their potential benefits would benefit considerably from assistance on how to link new technology to specific operational aspects of their organisations.

Furthermore, Blackburn and Athayde (2000) identify not only size and sector as contributory factors to ICT adoption by SMEs, but also the imposition by larger trading partners, who tend to be more powerful due to their extensive resource base.

Figure 1 Five levels of IT-enabled business transformation



Adoption drivers are more likely to emerge from customers, suppliers, business partners and competitors. Hence, Chen and Williams (1993, p. 96) observed that "small firms are uniquely different from large organisations, and as a result, there needs to be different methodological ways of examining them which takes into consideration the vast differences which exist".

Conversely, the model promulgated by Poon and Swatman (1997) (see Figure 2) concurs with Venkatraman's model to the extent that a stage-based transformation process occurs when SMEs use ICTs to improve their strategic position. However, Poon and Swatman (1997) propose a "top down" approach, from an industry-wide perspective is more appropriate for SMEs and believe that the transformation process begins with the inter-organisational dimension, rather than with local exploitation. Integration with their business processes occurs subsequently, with full Internet-to-internal process integration providing the greatest benefit to a company. These authors recognise that these benefits could only be achieved following significant organisational process adjustment and industry-wide transformation.

However, the lack of adoption and implementation of ICTs by SMEs, preventing them from overcoming current performance deficits and exploiting new opportunities (Zmud, 1984) or fulfilling strategic goals of efficiency and effectiveness (Feher and Towell, 1997), suggests that the Poon and Swatman (1997) model is in its infancy.

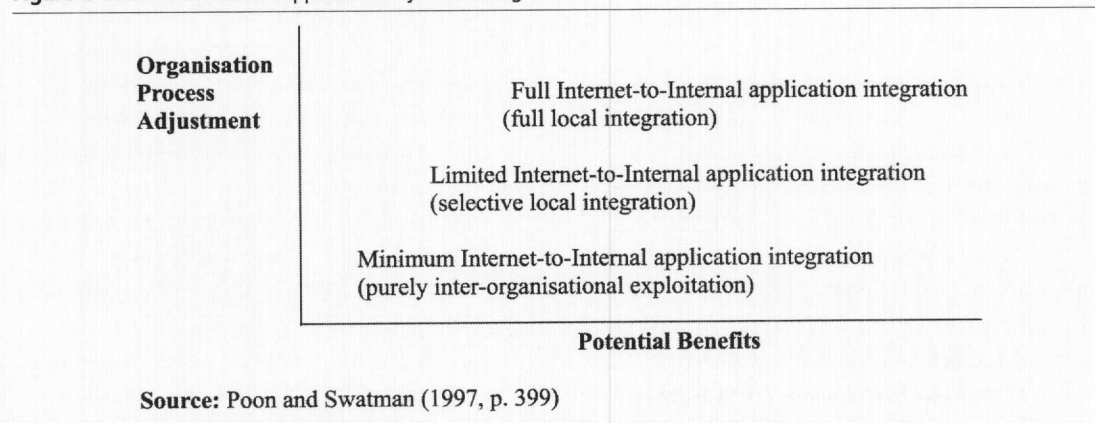
Whilst the Venkatraman (1994) model was primarily designed to study large corporations, it was felt that there are many aspects of this model which could also apply to investigations of much smaller companies.

As SMEs are the "economic engine" driving the economy in NI, it was decided that this geographic location would provide a sound basis for adapting this framework. Hence, it was felt that the Venkatraman (1994) model could be explored further to ascertain the transferability of the framework of IT-enabled transformation (or at least some aspects of it) to an industrial landscape dominated by SMEs. Small business researchers have examined factors which influence the use of IT (see, for example, Kettinger and Teng, 1998; Grover *et al.*, 1997; Damanpour, 1991), yet many of these factors are irrelevant to the successful adoption and use of ICTs in SMEs.

Whilst there have been limited studies conducted in assessing the adoption and exploitation of ICTs by SMEs (Poon and Swatman, 1997), there remains a need to develop a suitable model of SME adoption of ICTs. This study assesses current sophistication levels of adoption and exploitation of ICTs within the study sample selected, in conjunction with their integration with business processes, utilising variables adapted from the Venkatraman (1994) model. The following inter-related dimensions variables, which are aligned with those identified by Waring and Wainwright (2000) into the possible views of the nature of integration of systems and technology, have been identified to measure the sophistication of ICT adoption and exploitation by SMEs:

- *Technical integration (TI)*. Analysed by: the number of staff with Internet and e-mail access; speed of access; presence of a network and number of PCs on the network; availability of sufficient and appropriate applications; client in use; regularity and security of backups; evidence of valid anti-virus software;

Figure 2 Internet-to-internal applications systems integration



presence of a firewall. This dimension examines the company's current ICT infrastructure and forces the organisation and/or SME owner/manager to consider the importance of ICTs within their business operation.

- *Operational integration (OI)*. Analysed through the integration of ICT with internal business practices, e.g. evidence and use of Web site and relevance/effectiveness of the site to the overall business, ability to highlight most profitable part of the business, how stock management functions are controlled. This dimension investigates how ICTs interact with business processes and the importance of aligning technology with business functions in order to improve competitiveness.
- *Inter-organisational integration (II)*. Analysed by the use of technology from supplier-to-company-to-customer and the technological interaction with suppliers and customers. This dimension explores the streamlining of internal operations, but also the structuring of external relationships in order to leverage maximum benefit from exploiting ICTs.
- *Strategic integration (SI)*. Analysed through examining the role of ICT in co-ordinating and managing business processes internally and externally. This dimension incorporates the composite requirements of levels of operational integration and inter-organisational integration primarily, in order to assess the role of ICTs within the strategic operations of the business and also their extended business network.

Methodology

This study aims to analyse the sophistication of adoption and exploitation of ICTs, in a sample of 24 case study SMEs within NI and establish the drivers in developing and implementing appropriate ICTs for their business, based on the four research dimensions identified. These multiple case studies were a combination of primary research, through a series of interviews (using semi-structured questionnaires), site visits and secondary research, through investigative work in the specific industry sectors.

The research focused on 24 companies including six micro-firms employing between

zero and nine people, 11 meso-size firms employing between ten and 50 people and seven who employed more than 50 people, over a nine-month period. The companies were selected from the retail, construction, wholesale and distribution industry sectors – sectors that have traditionally fallen outside the local government-funded initiatives or supported by business development agencies. As this study attempted to investigate those companies using ICTs to support their business processes, it was imperative that the subjects were selected from companies already employing ICTs in their business processes.

An initial application form, designed to illicit relevant information of the company's current and proposed ICT plans, sought information on the company's profile, size, industry sector, current markets, and existing technologies. Based on the evaluation of this initial selection tool, companies were then selected based on their ability to fulfil the necessary selection criteria. This was composed of their ability to:

- designate a key member of staff for the duration of the study;
- allocate relevant financial resources based on their proposed ICT plans; and
- undertake and commit to completing the study.

Each of the 24 companies selected for this study were assessed on individual merit (to minimise any potential bias), using this initial information. The Appendix provides an insight into this sample of varying sized SMEs throughout NI and across the industrial sectors highlighted.

Semi-structured interviews with the selected participants, over a period of one day each, took place with the designated key personnel, to illicit an understanding of the following:

- *Expected financial outlay with regards to information technology in the forthcoming 12 months*. This was used to assess the commitment of each company in implementing the solutions suggested within this study.
- *Nature of problem(s) identified for this study*. This provided a measure of how conversant the companies were with ICTs in general and the practicality of implementing possible solutions given the timescales available and the expected financial commitment of each company.

- *Extent of current use of ICTs.* Presented an indication of how committed the company were to actually using technologies which were previously installed or how prevalent usage was.

Based upon these initial interviews and subsequent research (over a two day period) into each company, it was possible to assess and score the levels of sophistication using the four dimensions and their components identified in the literature review – technical integration; operational integration; inter-organisational integration and strategic integration. A six-point ordinal scale ranging from zero to five was employed, with zero indicating no evidence of the criteria in use, to five indicating maximum use of the specific criteria. The organisational scores on each scale were normalised and averaged to obtain a composite sophistication score on all four dimensions and an overall sophistication score.

Once this analysis was carried out, it was decided to investigate the three most and three least sophisticated companies in terms of ICT usage, as exploratory case studies. The case study approach provides richness and multiple perspectives of the many managers involved with regard to the data collected and is thus largely qualitative in nature (Yin, 1994; Bourgois and Eisenhardt, 1988). Unlike positivist research, however, the analysis of case study data is essentially interpretative and inductive. From the qualitative data, narratives or stories are developed which are examined for patterns. From these patterns inferences are drawn which yield propositions and can lead to specific hypotheses. Such hypotheses can then be tested in other situations and indeed if sufficiently specific can be tested via the more traditional survey methods of social science. Gathering the large amounts of data associated with case study research involves a great deal of interaction between the researchers and staff of the organisation being studied. The case study research with the six companies was carried out through company visits, a series of interviews and observations and analysis of company documentation. As part of this analysis the following research questions were considered:

- How effective are SMEs generally in the adoption and exploitation of ICTs?
- How does the use of ICTs impact upon the business transformation process?

- What is the level of inter-organisational integration facilitated via ICTs?
- What are the challenges confronting owner/managers of SMEs in the development of a strategic approach in the adoption and use of ICTs?

Findings

Table I illustrates by company, the initial level of ICT sophistication in descending order, as per the scale identified, using the composite results of all four measurement variables. These results reveal that there is a significant disparity between the most sophisticated and least sophisticated companies within this sample, ranging from totals of 15.00 to 0.75 respectively.

Grouping the sophistication levels of each company by industry sector presents their distribution as shown in Figure 3, which highlights that the retail and wholesale sectors are clustered around the median point of 9.5, whereas the construction and distribution sectors dominate both the high levels of and low levels of ICT adoption and sophistication.

Due to the large volume of data associated with investigating 24 companies, it was decided to analyse the findings of these dominant companies as case studies. As a result, the three most sophisticated (D1, D6, C4) and three least sophisticated (C6, C7, D7) adopters and users of ICTS, shall provide the basis for further analysis within this current paper.

The following sections discuss the findings in relation to the in-depth case study analysis of the six companies along the four dimensions developed from the literature review.

Technical integration (TI)

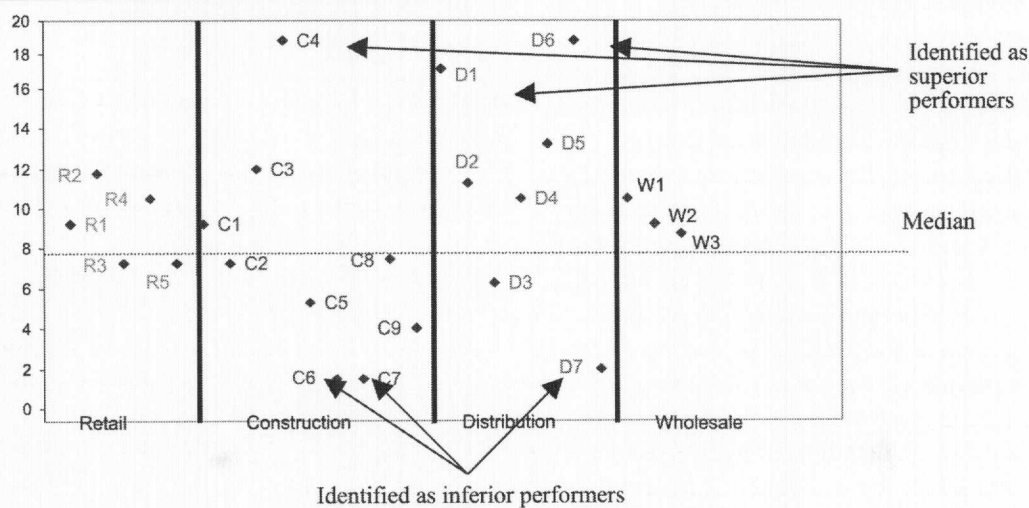
The study revealed that each of the participating companies recognised the need for e-mail and Internet penetration to employees and the benefits of asynchronous communications, in terms of overcoming time and geographic limitations and multimedia transmission. However, Figure 4 demonstrates that some of the companies appear only to have reached an introductory stage of technical functionality within this assessment criterion.

Workstations within the six selected case studies have varying levels of e-mail and Internet penetration, through a combination of ISDN, PSTN and leased lines. The

Table I Initial level of ICT sophistication by company

Company ID	Technical integration	Operational integration	Inter-organisational integration	Strategic integration	Total	Mean
C4	4.00	3	3	5	15.00	3.75
D6	4.00	4	3	4	15.00	3.75
D1	5.00	2	2	3	12.00	3.00
D5	3.13	3	2	2	10.13	2.53
C3	4.00	0	0	4	8.00	2.00
R2	1.88	3	3	2	9.88	2.47
D2	3.63	2	0	2	7.63	1.91
R4	2.75	0	3	2	7.75	1.94
D4	2.75	2	1	2	7.75	1.94
W1	2.25	2	1	3	8.25	2.06
R1	1.63	2	2	2	7.63	1.91
C1	2.63	2	0	2	6.63	1.66
W2	1.13	0	2	5	8.13	2.03
W3	1.88	0	0	5	6.88	1.72
C8	2.75	0	0	2	4.75	1.19
R3	1.63	3	1	0	5.63	1.41
R5	1.63	3	1	0	5.63	1.41
C2	2.13	1	1	1	5.13	1.28
D3	2.13	0	0	2	4.13	1.03
C5	1.63	0	0	2	3.63	0.91
C9	1.50	0	0	1	2.50	0.63
D7	1.00	0	0	0	1.00	0.25
C6	0.75	0	0	0	0.75	0.19
C7	0.75	0	0	0	0.75	0.19

Figure 3 Initial ICT sophistication levels by industry sector

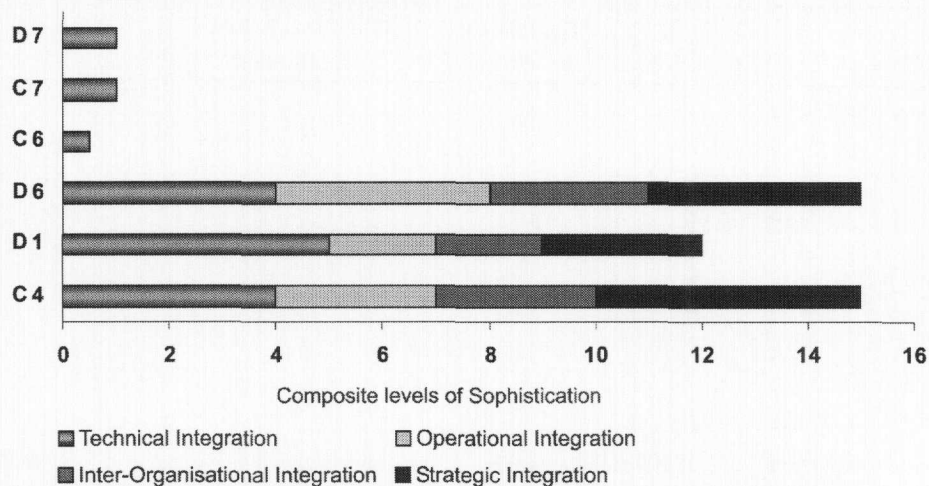


superior performers (C4, D1, D6) operate company-wide networks with designated servers and have e-mail and Internet access varying from 30 percent to 100 percent of workstations with full access, which are backed up regularly. Whereas the least sophisticated companies (C6, C7, D7) do not have designated servers, have limited peer-to-peer networks for only a minority of their

workstations, have e-mail and Internet access ranging from one percent to 50 percent and employ an *ad hoc* method of backing up information.

Specific characteristics of the distribution and construction industries necessitate that companies are in regular contact with suppliers, customers and trading partners, which would suggest that they would benefit

Figure 4 Inferior and superior performers of ICT adoption



immensely from the use of ICTs in the sharing of information and resources. For example, company C4 (a superior performer) possesses and utilizes sufficient hardware, e-mail and Web servers, yet senior management recognise the need to improve their network security and are willing to invest in this. Conversely, company C6 (an inferior performer) is not networked and relies heavily on sharing large design files internally and externally, yet senior management are not willing to embrace ICTs in a manner which would significantly enhance the efficiency of their business processes.

This stage is consistent with both the localised exploitation and internal integration levels of Venkatraman's (1994) model, which views the deployment of standard IT applications with minimal changes to business processes. It is essential that internal systems and applications are consistent throughout the business and that a seamless ICT infrastructure is embedded, regardless of the functional differences between departments and operations. However, whilst this maybe applied much more rigorously to large corporations, initial findings from this research suggests that even basic ICT infrastructure required to integrate with business processes in study, is limited.

Operational integration (OI)

Table II represents a cross-section of the most sophisticated and least sophisticated adopters of ICT. The most sophisticated performers (C4, D1, D6) who own and use a website, employ it primarily as a marketing tool to promote the company and its products/ services. Industry and product specificity have influenced these companies in the extent of

use of the Internet to support their business operations, with the distribution sector being dominant.

The work of Morton (1991) emphasises that IT functionality should not be simply overlaid on existing business processes but should be used as a lever for designing a new organisation and associated business operations – as denoted within level three (business process redesign) of the Venkatraman (1994) model. This is particularly relevant to the less sophisticated companies (C6, C7, D7) should they choose to create and use an organisational Web site.

Inter-organisational integration (II)

Table III presents the average level of sophistication within each industry sector, for each assessment criterion. Whilst none of the sample performed particularly well in this category, there are marked differences within the selected industry sectors, with the construction industry presenting the poorest results. These findings are supported by Love *et al.* (1999), who claim that this industry sector is fragmented and adversarial in nature, which has led to poor communication and inefficient information practices that have contributed to the emergence of dysfunctional supply chains. Conversely, the distribution sector, possessed a higher level of sophistication, which can be attributed to the nature of their business operations and the type of customer they target. Indeed, Acs *et al.* (2001) suggest that as economies become more interconnected with global trade, SMEs are becoming increasingly important pillars of the economies of major trading partners. For example, company D1 provides a supply

Table II Cross-section of most sophisticated and least sophisticated adopters of ICT

Company ID	Company size – employees	Technical integration	Operational integration	Inter-organisational integration	Strategic integration	Total	Mean
<i>Most sophisticated adopters of ICT</i>							
C4	100	4.00	3.00	3.00	5.00	15.00	3.75
D6	18	4.00	4.00	3.00	4.00	15.00	3.75
D1	75	5.00	2.00	2.00	3.00	12.00	3.00
<i>Least sophisticated adopters of ICT</i>							
D7	16	1.00	0.00	0.00	0.00	1.00	0.25
C6	120	0.75	0.00	0.00	0.00	0.75	0.19
C7	25	0.75	0.00	0.00	0.00	0.75	0.19

Table III Initial level of ICT sophistication by industry sector

Industry sector	Technical integration	Operational integration	Inter-organisational integration	Strategic integration	Total
Retail	1.90	2.20	2.00	1.20	11.10
Construction	2.24	0.67	0.44	1.89	9.71
Distribution	3.09	1.86	1.14	2.14	14.41
Wholesale	1.75	0.67	1.00	4.33	11.25
Average	2.24	1.35	1.15	2.39	

chain management service to a number of global industrial customers and is wholly dependant on integrated technologies between remote customer sites and their main office for the effective operation of their business. Whereas, company D7 has a target market of individual buyers and home users, which utilises stand-alone technologies, but are aiming to integrate their internal systems.

Within this sample of companies at this initial stage, it has become apparent that there are some companies that are consistently more sophisticated in their adoption and use of ICTs to improve their operational performance with the view to leverage competitive advantage. Level 4 (business network redesign) of Venkatraman's framework for IT enabled business transformation can be addressed in the context of this research by examining the structuring of relationships in the extended business network. Further research would examine the restructuring of these relationships to leverage a broader array of competencies in the delivery of improved product/service delivery.

Strategic integration (SI)

Only one company (C4 – a superior performer), was deemed to have achieved the highest level of sophistication within this variable. This was attributable to their excellent project management abilities including stock management, a highly

developed internal communications structure, a progressive-thinking management team and their effective customer relationship management practices.

From this research, the determining factor of the sophistication of the technical infrastructure within these industries, is the commitment of senior management. This concurs with the findings of Standing *et al.* (1998) which found the driving force of adoption of technology was in fact the owner-manager. Blackburn and McClure (1998) also supports the view that owner-managers attitude, knowledge and experience, in addition to the overall managerial approach to the business, is often more influential than business size and sector in understanding the use of ICT.

Evidence from the initial investigation of these companies, would suggest that there is minimal integration between the Internet and internal systems. This is consistent with the primary level of Venkatraman's model, where integration is localised to departments within the organisation. Notwithstanding, some superior performers (D1, C4), did demonstrate limited internal application integration, which is consistent with the second level of the model. However, many of the selected companies employed internal information systems such as stock control, customer and supplier management, which were operating independently of the Internet, resulting in a chasm between inter-organisational processes and internal

information systems integration. Waring and Wainwright (2000, p. 145) suggests "understanding the phenomenon of integration" is paramount to the success of implementation, which is supported by Themistocleous *et al.*'s (2001, p. 202) study reporting "82 per cent of companies face integration problems during implementation".

The ICT exploitation and business integration model

Based upon the findings within this study and review of relevant literature, including Nolan's (1979) growth model and the work of Galliers and Sutherland (1991), the following conceptual model, the ICT exploitation and business integration model (see Figure 5), which incorporates the four measurement variables identified, has been developed. The purpose of this conceptual model is to assess the level of adoption and exploitation of ICTs within SMEs. However, it must be emphasised that this model would only be suitable for organisations that currently utilise ICTs in their business processes.

Whilst this conceptual model differs from the Venkatraman (1994) model, in that it is not linear in format, it is designed to provide an incremental approach for SMEs to measure their advancement in adopting and exploiting ICTs. The purpose of this model is to provide a framework which would allow SMEs to be "plotted" onto it, to denote their current level of sophistication. Whilst Figure 5 presents the initial results for all 24

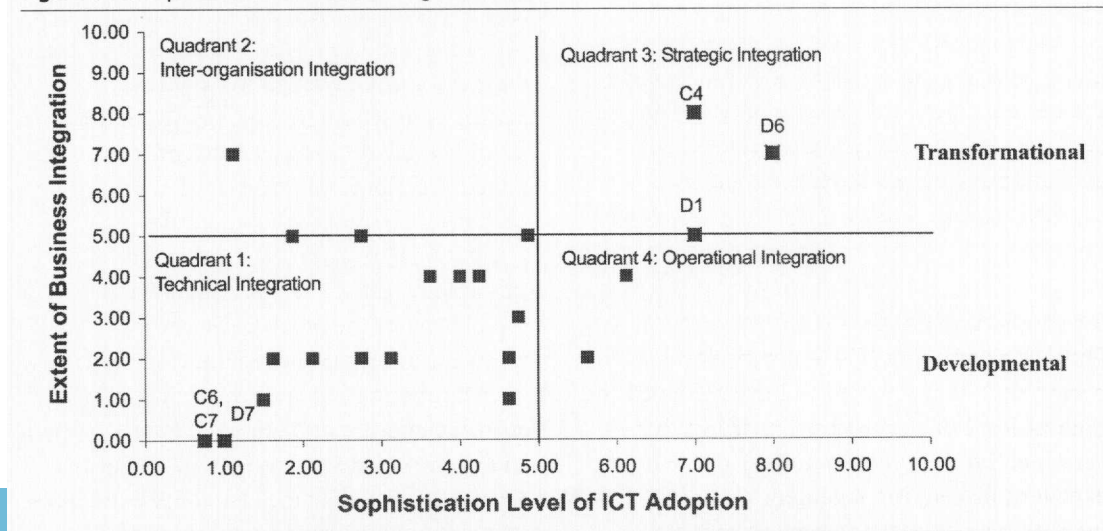
companies, the six case study companies are highlighted. This framework could then be further utilised to denote advancements made by the organisation, when they become more sophisticated in their integration of technology with business process. Analysing an SME using the criteria selected in this study presents an opportunity for business owners to define where they currently are and which quadrant they need to concentrate on immediately, to enhance their particular competitive position in the marketplace through the exploitation of ICTs.

This model comprises four quadrants. Quadrants 1 and 2 are deemed developmental to this assessment process; where developmental in the context of this model refers to how ICTs are implemented and utilised within an SME. In contrast, quadrants 3 and 4 are deemed as transformational within the organisation, whereby transformational refers to how ICTs are integrated with business processes to transfigure the operational activities within an organisation. It must be emphasised that SMEs will not necessarily progress through each stage in sequential order. Rather companies can be plotted onto this model by combining the net results of their developmental status (using the technical integration and operational integration dimensions), against their transformational status (using the inter-organisational integration and strategic integration dimensions).

Quadrant 1: technical integration

Companies in this quadrant need to compare current internal ICT infrastructure with

Figure 5 ICT exploitation and business integration model



industry ICT infrastructure benchmarks. The commitment of senior management needs to be secured in order to conduct a review of current and future infrastructures for performance, flexibility and projected growth. Whilst technology does not automatically lead to business growth, it has the potential to improve business performance when aligned with business strategy.

Within this initial study, the three least sophisticated companies fall within this quadrant. This suggests that they need to immediately implement the measures above in order to redress their current position and aim for a position, which denotes a higher degree of ICT sophistication. Companies within quadrant 1 will normally move to either quadrant 2 or quadrant 3, depending upon the emphasis placed on the organisation to concentrate more on improving their technical infrastructure (resulting in quadrant 2) or improving ICT integration with business processes (resulting in quadrant 3).

Quadrant 2: operational integration

This quadrant is still considered to be developmental with regard business integration, as companies are characterised as having taken a technological lead in implementing isolated hardware developments or software applications, which are not necessarily bound to business strategy. Rather than automating outdated or inefficient business processes, companies classified in this quadrant, need to achieve internal integration, whether through an incremental/staged approach across various departments, or through a fundamental redesign of existing business processes.

Whilst securing a position within this quadrant, especially in the top right-hand corner, suggests that a company possesses a highly sophisticated technical infrastructure, the benefits from IT functionality cannot be fully realised if merely superimposed upon existing business processes. However, a sophisticated technical infrastructure could provide the basis for redefining existing business processes (resulting in a move to quadrant 3) or designing new business processes (resulting in a move to quadrant 4).

Quadrant 3: inter-organisational integration

Whilst there remains scope for the streamlining of internal operations, this

quadrant requires companies to integrate their technical infrastructure internally (across functional areas), in order to achieve external linkages (with customers and suppliers).

Companies, which secure a position in this quadrant, especially in the top half, would possess and utilise an effective business strategy, yet their technical infrastructure would not be particularly sophisticated. This could be due to the nature of their business operations or industry sector, which may not necessitate a highly sophisticated technical infrastructure. Conversely, it could also suggest that there is a need to improve the technical infrastructure throughout the company (by aiming towards and securing a position in quadrant 4).

Quadrant 4: strategic integration

The final quadrant builds upon the strengths of quadrant 2 (in terms of ICT adoption) and quadrant 3 (in terms of business integration) through embedding technical infrastructure with the operational activities of the organisation. In order for companies to move into this quadrant from any of the other three quadrants, it is essential that an ICT strategy is developed and designed in conjunction with the business strategy to ensure that existing processes and technology are aligned and monitored.

Within this study, the most sophisticated performers (D1, D6 and C4) all achieved a place within this quadrant. Whilst each of these companies were plotted on the bottom left-hand corner of the quadrant there remains substantial growth opportunities within each of these companies, in terms of improving their integration of business processes and technology. It is unlikely that a company will ever be able to maintain a position in the top right-hand corner of this quadrant, due mainly to the dynamic environment which businesses operate within and the constant advancement of technology and technological solutions.

Conclusion

The findings in this research have highlighted how ICTs are being employed to support business processes. Characteristics of the firm and industry sector have had an effect on the adoption and use of ICTs to support business processes, which suggests that the findings

have the potential for transferability to other industrial sectors and beyond the geographic restrictions investigated initially.

This research set out to determine the level of sophistication in key areas of ICT adoption and use within a sample of SMEs in NI. The impact on business performance resulting from implementation of the solutions suggested within this project, could be used to determine the types and levels of efficiency gains achievable through further exploitation of ICTs, which is consistent with the findings of Cragg *et al.* (2002). Many SMEs do not have quantifiable data demonstrating how they have achieved performance improvement by employing ICTs. In fact, some SMEs continue to base their beliefs of success in this area on subjective benefits. This initial research has demonstrated that there is minimal evidence either of ICTs being adopted rapidly or with any high level of sophistication. Yet the issue of exploiting competencies directly linked to ICTs is seen as central to growing the smaller firm (Durkin and McGowan, 2001). Understanding the benefits and drawbacks of implementing these solutions has the potential to increase the competitiveness of local SMEs in wider geographic markets.

The ICT Exploitation and Integration Model designed and utilised in this project, has the potential to offer a structured approach to performance improvement through the further adoption and use of ICTs by SMEs. This potential will be further investigated to determine whether it could be established as a tool for mapping performance improvement through the exploitation of ICT. In essence, further work is required in determining the importance of alignment or "fit" between the internal (organisational) and external (environmental) contexts in which ICTs are implemented and utilised, from both an operational and strategic perspective. The widespread potential of ICT adoption and use, especially in SMEs offers significant potential for future research. The case-study approach of this exploratory study provides a basis for building more comprehensive, prescriptive models. The ICT Exploitation and Integration model developed here requires further investigation. Hence, the research questions proposed suggest specific hypotheses can be tested using larger sample sizes, a broader range of industry sectors and in a wider number of geographic locations, thus addressing three of this study's main limitations.

References

- Acs, Z., Morck, R. and Yeung, B. (2001), "Entrepreneurship, globalisation and public policy", *Journal of International Management*, Vol. 7, pp. 235-51.
- Alhadeff, J. and Cohen, R. (1997), "Assembling the right Internet business model", *DB2 Magazine*, Winter, pp. 11-16.
- Bharadwaj, A.S. (2000), "A resource based perspective on information technology capability and firm performance: an empirical investigation", *Management Information Systems Quarterly*, Vol. 24 No. 1.
- Blackburn, R. and Athayde, R. (2000), "Making the connection: the effectiveness of Internet training on small businesses", *Education + Training*, Vol. 42 No. 4/5.
- Blackburn, R. and McClure, R. (1998), *The Rise of Information and Communication Technologies (ICTs) in small business service firms*, Small Business Research Centre, Kingston Business School.
- Bouchard, L. (1993), "Decision criteria in the adoption of EDI", *Proceedings of the 4th International Conference on Information Systems, Orlando, FL*, pp. 365-76.
- Bourgois, L. and Eisenhardt, K. (1988), "Strategic decision processes in high velocity environments: four cases in the micro-computer industry", *Management Science*, Vol. 34 No. 7, pp. 816-35.
- Chapman, P., James-Moore, M., Szczygiel, M. and Thompson, D. (2000), "Building Internet capabilities in SMEs", *Logistics Information Management*, Vol. 13 No. 6, pp. 353-60.
- Chen, J.C. and Williams, B.C. (1993), "The impact of microcomputer systems on small businesses: England 10 years later", in *Technological Innovation*, Lexington Books, Lexington, MA, pp. 117-48.
- Cragg, P., King, M. and Hussin, H. (2002), "IT alignment and firm performance in small manufacturing firms", *Journal of Strategic Information Systems*, Vol. 11, pp. 109-32.
- Damanpour, F. (1991), "Organizational innovation: a meta-analysis of effects of determinants and moderators", *Academy of Management Journal*, Vol. 34 No. 3, pp. 555-90.
- Durkin, M. and McGowan, P. (2001), "Net effect – views from the periphery: exploring the role and importance of the Internet on marketing activity in entrepreneurial firms", *Irish Marketing Review*, Vol. 14, pp. 15-25.
- European Commission (1995), *Telework and Small Business Networking*, Directorate-General XIII-B, European Commission, Luxembourg.
- Evans, P. and Wurster, T.S. (1999), "Getting real about virtual commerce", *Harvard Business Review*, November/December.
- Eveland, J.D. and Tornatzky, L.G. (1990), "The deployment of technology", in Tornatzky, L.G. and Fleischer, M. (Eds), *The Processes of Technological Innovation*, Lexington Books, Lexington, MA, pp. 117-48.
- Fallon, M. and Moran, P. (2000), "Information communication technology (ICT) and manufacturing SMEs", *2000 Small Business and Enterprise Development Conference, 10-11 April*, Manchester University, Manchester, pp. 100-9.

- Feher, A. and Towell, E. (1997), "Business use of the Internet", *Internet Research: Electronic Networking Applications and Policy*, Vol. 7 No. 3.
- Fichman, R.G. (2000), "The diffusion and assimilation of information technology innovations", in Zmud, R.W. (Ed.), *Framing the Domain of IT Management*, Pinnaflex Educational Resources, Cincinnati, OH, pp. 105-27.
- Gallaugher, J. and Auger, P. (1997), "Factors affecting the adoption of an Internet-based sales presence for small businesses", *The Information Society*, Vol. 13 No. 1, pp. 55-74.
- Galliers, R.D. and Sutherland, A.R. (1991), "Information systems management and strategy formulation – the stages of growth model revisited", *Journal of Information Systems*, Vol. 1 No. 2, pp. 89-114.
- Grover, V., Fiedler, K. and Teng, J. (1997), "Empirical evidence on Swanson's tri-core model of information systems innovation", *Information Systems Research*, Vol. 8 No. 3, pp. 273-87.
- Gunasekaran, A., Okko, P., Martikainen, T. and Yli-Olli, P. (1996), "Improving productivity and quality in small and medium enterprises: cases and analysis", *International Small Business Journal*, Vol. 15 No. 1, pp. 59-72.
- Harrington, L. and Reed, G. (1996), "Electronic commerce finally comes of age", *The McKinsey Quarterly*, No. 2.
- Hoffman, D., Novak, T. and Chatterjee (1995), "Commercial scenarios for the Web: opportunities and challenges", available at: www.usc.edu/dept/annenbergl/issue3/hoffman.html
- Hoffman, D.I. and Novak, T.P. (1996), "A new marketing paradigm for electronic commerce", *The Information Society*.
- Hsieh, C. and Lin, B. (1998), "Internet commerce for small businesses", *Industrial Management & Data Systems*, No. 3, pp. 113-9.
- IAI (2000), *Northern Ireland Business in the Information Age: ICT Benchmarking Report*, Information Age Initiative.
- Iacovou, C.L., Benbasat, I. and Dexter, A.S. (1995), "Electronic data interchange and small organisations: adoption and impact of technology", *MIS Quarterly*, December, pp. 465-85.
- Indermaur, K. (1997), "Behind the lines", *Internet Systems*, July, pp. 54-8.
- Industrial Development Board (IDB) and the Local Economic Development Unit (LEDU) (2001), *Financing for Growth*, June.
- Julien, P-A. and Raymond, L. (1994), "Factors of new technology adoption in the retail sector", *Entrepreneurship Theory and Practice*, Vol. 18 No. 4, pp. 79-90.
- Kassaye, W.W. (1999), "Sorting out the practical concerns in World Wide Web advertising", *International Journal of Advertising*, Vol. 18, pp. 339-61.
- Kettinger, W.J. and Teng, J.T.C. (1998), "Aligning business process change to strategy: a framework for analysis", *Long Range Planning*, Vol. 31 No. 1, pp. 93-107.
- Lauder, G. and Westall, A. (1997), "Small firms on-line", *Commission on Public Policy and British Business: Issue Article No. 6*, Institute for Public Policy Research, London.
- Lee, M.K.O. (1998), "Internet-based financial EDI: towards a theory of its organisational adoption", *Computer Networks and ISDN Systems*, Vol. 30, pp. 1579-88.
- Levy, M., Powell, P. and Yetton, P. (1998), "SMEs and the gains from IS: from cost reduction to value added", paper presented at the IFIP 8.2 Conference, Finland.
- Love, P.E.D., Li, H. and Mandal, P. (1999), "Rework: a symptom of a dysfunctional supply-chain", *European Journal of Purchasing and Supply Management*, Vol. 5, pp. 1-11.
- Martin, L.M. and Matlay, H. (2001), "Blanket approaches to promoting ICT in small firms: some lessons from the DTI ladder adoption model in the UK", *Internet Research: Electronic Networking Applications and Policy*, Vol. 11 No. 5, pp. 399-410.
- Matlay, H. (1999), "Vocational education and training in Britain: a small business perspective", *Education + Training*, Vol. 41 No. 1.
- Morton, S. (1991), *The Corporation of the 1990s*, Oxford University Press, New York, NY.
- Nolan, R.L. (1979), "Managing the crisis in data processing", *Harvard Business Review*, March/April, pp. 115-26.
- O'Farrell, P.N. and Hitchens, D.M.W.N. (1988), "Alternative theories of small firm growth: a critical perspective", *Environment and Planning*, Vol. 20, pp. 1365-83.
- Poon, S. and Swatman, P.M.C. (1997), "Small business use of the Internet: findings from the Australian case studies", *International Marketing Review*, Vol. 14 No. 5, pp. 385-402.
- Rodgers, E.M. (1995), *Diffusion of Innovations*, Free Press, New York, NY.
- Seeley, R. (1997), "Internet commerce emerges", *Application Development Trends*, June, pp. 38-48.
- Senn, J. (1996), "Capitalizing on electronic commerce: the role of the Internet in electronic marketing", *Information Systems Management*, Summer, pp. 15-24.
- Standing, C., Vasudavan, T. and Borbely, S. (1998), "Re-engineering travel agencies with the world wide web", *Electronic Markets*, Vol. 8 No. 4, pp. 40-3.
- Themistocleous, M., Irani, Z. and O'Keefe, R.M. (2001), "ERP and application integration: exploratory study", *Business Process Management Journal*, Vol. 7 No. 3, pp. 195-204.
- Tidd, J., Bessant, J. and Pavitt, K.I. (1997), *Integrating Technological, Market and Organisational Change*, J. Wiley & Sons, Chichester.
- Umar, A. (1997), "E-commerce bedrock", *Database Programming & Design*, November, pp. 32-9.
- Venkatraman, N. (1994), "IT-enabled business transformation: from automation to business scope redefinition", *Sloan Management Review*, Winter, pp. 73-87.
- Waring, T. and Wainwright, D. (2000), "Interpreting integration with respect to information systems in organizations – image, theory and reality", *Journal of Information Technology*, Vol. 15, pp. 131-48.
- Whitley, R. (1986), "The revival of the small business in Europe", in Greenfield, S.M. and Stricken, A. (Eds), *Entrepreneurship and Social Change*, Monographs in Economic Anthropology, No. 8, Economic Anthropology Press of America, Lanham, MD.
- Yin, R. (1994), *Case Study Research – Design and Methods*, Sage, Beverly Hills, CA.
- Zmud, R.W. (1984), "An examination of push-pull theory applied to process innovation in knowledge work", *Management Science*, Vol. 30 No. 6, pp. 727-38.

Appendix

Table A1 Company profiles

Company identifier	Products/services	No. of staff	Turnover p.a. (£stg)
Retail 1	Jewellery and giftware retailers, in three locations	15	750k
Retail 2	Provide promotional printing services/products to general public	2	80k
Retail 3	Trade in fine arts, framing and contract work with interior designers	7	300k
Retail 4	Grocery and non-food retail in three locations	245	10m-12m
Retail 5	Supply of specialist postcards and printing materials	22	1m
Construction 1	Building service engineering consultants with six offices nationwide	64	N/k
Construction 2	Design and fabrication specialist of commercial glazing applications	33	4m
Construction 3	Architectural practice with expertise in architecture, master planning and town planning. Second office in England	20	850k
Construction 4	Providers of design, construction, project management and maintenance services	100	5m
Construction 5	Construction of natural and artificial surfaces; providers of specialised drainage and renovation of exterior pitches; specialist equipment hire	18	1.3m
Construction 6	Consultancy firm engaged in civil, structural and environmental engineering, architecture, town planning and project management	120	80m-100m
Construction 7	Building contractor specialising in house renovations and sale of refurbished dwellings	25	N/k
Construction 8	Provider of facilities management services and contract labour for industrial cleaning, with four office locations	15	4.3m
Construction 9	Chartered architects specialising in private housing sector	4	70k
Distribution 1	Provider of supply chain management services, safety, electrostatic and vision equipment and office supplies	75	20m
Distribution 2	Customised supply chain management facility to specialised industries	27	N/k
Distribution 3	Developer and distributor of educational learning tool	5	N/k
Distribution 4	Distributor of products from a number of core customers	110	N/k
Distribution 5	Proprietor of four local newspapers in four locations and distributor of media products	75	2m-2.5m

(continued)

Table A1

Company identifier	Products/services	No. of staff	Turnover p.a. (£stg)
Distribution 6	Design, manufacture and supply printed fabric and self-adhesive labels to clothing manufacturers	18	820k
Distribution 7	Provider of warehouse facilities for UK company and interior design facilities	16	350k
Wholesale 1	Supplier of health and safety products and services and specialist recycling.	82	N/k
Wholesale 2	Supplier of domestic appliance spare parts	5	N/k
Wholesale 3	Supplier of stationery, office equipment and office furniture	6	N/k