Impact of e-business on perceived supply chain risks

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Abstract

Purpose – The purpose of this paper is to understand the risks managers and individual supply chains perceive from e-business.

Design/methodology/approach – This research takes a long-term, staged view of the risks managers and individual supply chains perceive from e-business. By taking a two-stage approach, investigating four supply chains at a three year interval, the research considers perceived risks from e-business and the extent to which these risks obtained.

Findings – E-business has the potential to deliver substantial benefits, but it also involves new and different risks. This research finds that small firms (SMEs) adopted a "watching brief" rather than implemented e-business. Between the two studies it emerges that e-business can support rather than detract from inter-organisational relationships. Global forces are in evidence in terms of low cost competition, but low cost competitors are not e-enabled.

Research limitations/implications – Limitations, pragmatism and opportunism in the sampling is acknowledged. For example, the work and concepts that led to the expectation of e-business dominating and decimating industrial supply chains may have been based in chains more open to external forces than the ones examined here. Further research is required that identifies the minimum critical mass necessary to retain national manufacturing capacity at a chain or sector level, and empirical work is needed on the suggested link between supply chain stability and certainty of payment. The cases here are based on four UK supply chains, so various chain forms are likely to have been excluded.

Originality/value – This research, by taking a staged approach and going back to the same chain and reviewing perceived risks, identifies how the build up of numerous – but small – events, for example factory closures, can aggregate over time to be just as significant as high profile, headline-worthy risks. Methods that produce a snapshot such as a one-off survey may be inadequate for fully exploring an area such as risk. Especially if the risks are hard to assess and are biased toward high profile events – catastrophic risks rather than accumulations of smaller, less noticeable risks.

Keywords Risk, Small to medium sized enterprises, Supply chains, B2B, E-business, Electronic commerce, United Kingdom

Paper type Research paper

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Introduction

This research investigates the risks perceived by firms from engaging in e-business. The focus is on perceived risks, rather than expert-calculated risks, as risk perception is more likely to drive change. However, this work goes one stage further than simply assessing perceived risks. By taking a staged approach, involving two interventions

three years apart with a set of four supply chains, e-business risk perceptions and the subsequent manifestations of the risks are revealed. The research identifies that, rather than e-business destabilising existing supply structures, there is substantial stability. Yet other risks, not engendered by e-business, do manifest and impact on the supply networks.

Firms face increasing risks to their ability to supply customers cost-effectively, yet few are confident that they can manage these risks successfully (McKinsey, 2006). One of the key risks to supply chain management may be e-business. While, e-business offers firms enhanced selling and interaction opportunities, such opportunities involve new types of risks. Some of these risks are specific to the technologies used, some to the individual firm, and some to interactions with other firms. However, as business is conducted in increasingly complex networks of organisations, different types of risk in supply chains and networks arise. Although business networks have always existed, Halinen and Törnroos (2005) point to an increase in the importance of knowledge, technological innovations, competitive forces, globalization and the availability of information technology (IT) as driving this increase in complexity. Business-to-business (B2B) technologies connect the business activities of trading partners, and the increased dependency and inter-linking of information systems (IS) may magnify existing inter-firm risks and create new risks.

The paper is organized as follows: the next section provides the theoretical background to the study via a review of the literature on risk perceptions, risk and supply chains, and on risk and e-business. The third section discusses the research method while the fourth presents major findings from the case analysis. Section five is the discussion, with conclusions, limitations and areas for further research forming the final section.

Theoretical background

This section reviews the literature on risks perceptions, risk and supply chains, and on risk and e-business. A replication of the work of Finch (2004) in identifying relevant research to form the theoretical basis of this paper reveals surprisingly few recently published pieces. Keyword searches on risk and e-business terms uncover much business-to-consumer work and lots of material investigating trust and related aspects. However, there is almost no published research that looks at risk and business-to-business activities since the mid-2000s.

Risk perception

The notion of risk perception and its implication has been researched for some decades. Slovic *et al.* (1982) were among the first to discuss the importance and determinants of perceived risk and investigate how people perceive the benefits of risky technologies. Renn (1998) also investigates risk perceptions and argues that both a constructivist and the realist perspective on risk perceptions are amiss as risks are always mental representations of threats that are capable of claiming real losses. He claims that risk is a social construction rather than a representation of real hazards and argues that public perceptions of risk may be misguided by sensational press coverage and intuitive biases. Hence, the perceived seriousness of risks do not match expert-calculated risks and people tend to over-estimate highly publicised,

large-scale technological risks and underestimate routine risks with low catastrophic potentials.

Firms, particularly small firms that are often dominated by their owner-managers, have little in-house or bought-in risk expertise and are less able to influence their environment, act on, and react to, the risks they perceive. While formal definitions of risk consider probability and significance of loss (Mitchel, 1995; Royal Society, 1992), such detachment is seldom reflected in management practice (Cousins *et al.*, 2004, Mitchell *et al.*, 2003, Pablo, 1999). March and Shapira (1987) propose that managers see risk not as probability, but in terms of the gravity of the outcome. Ruefli *et al.*(1999) comment that, in examining risk, borrowed (i.e. deductively derived) measures lack face validity. They argue it is necessary to capture the actual concepts of risks as employed by managers and investors.

Reviewing managers' attitude towards risks, Tang (2006) argues that managers are insensitive to estimates of the probabilities of possible outcomes, that they tend to focus on critical performance targets, which affect the way they manage risk, and that managers make a sharp distinction between taking risks and gambling. In addition, managers do not trust, do not understand, and do not much use, precise probability estimates. Tang sees that most firms invest little in mitigating supply chain risks and that probability estimates of any disruption and accurate measure of potential impacts are difficult to obtain. He suggests that firms tend to under-estimate disruption risk in the absence of accurate supply chain risk assessment.

Acknowledging this need to adopt managers' own perspectives on risks rather than to impose external measures, this paper explores managers' perceptions of e-business supply chain risks and compares these with their outcome using a two stage approach involving "interventions" three years apart with the same supply networks. This paper proposes that supply chain risk can be thought of as the probability of loss through disruption to existing interfaces, i.e. to incumbent supply chain interfaces.

Risk and supply chains

Risk is multi-faceted (Zsidisin, 2003) and risk definitions tend to be industry-dependent (Pablo, 1999). Supply chains cannot exist without interfaces connecting diverse parties. Given that risk needs to be defined in participant/industry terms, examining risk at the level of the whole supply chain requires simplicity and universality. These requirements are met by viewing supply chains as series of existing connections, rather than potentialities.

Most supply chain risk research has been conducted at the level of the buyer/supplier relationship (Paulsson, 2004; Harland *et al.*, 2003). Little has investigated the systems level of the supply chain or network. For example, Norrman and Lindroth (2002) identify conflicting objectives between automotive original equipment manufacturers (OEMs) and upstream firms regarding risk and its distribution in a supply chain; OEMs closer to ultimate demand want to adjust capacity to meet peaks in demand, whereas asset-intensive, upstream businesses tend to be more risk averse as capacity increases require substantial investment. Increasing outsourcing and globalization is escalating complexity in supply structures, which means the sources and types of supply risk increase. Recent supply risk approaches focus on identifying system level risk, while noting the lack of higher systems levels (networks and chain) studies.

Initiatives such as outsourced manufacturing and product variety are effective in a stable environment, but they make supply chains more vulnerable to disruptions caused by uncertain economic cycles, consumer demands, and natural and man-made disasters (Tang, 2006). Tang assesses operational risks as inherent uncertainties such as uncertain customer demand, uncertain supply, and uncertain cost while disruption risks are those caused by natural and man-made disasters, or economic crises. He argues that the business impact of disruption risks is much greater than that of operational risks and suggests that most quantitative models are designed for managing operational risks, they do not address disruption risks.

The potential benefits of supply chain management include product and delivery process quality such as shorter delivery times, more reliable delivery promises, fewer schedule disruptions, cost savings and risk reductions (Vaaland and Heide, 2007). Vaaland and Heide feel few firms have a strategic plan or vision for their e-strategy. In their review of past research, they suggest that there is a little work on technology-based supply chain management methods. For instance, small and medium-sized firms (SMEs) lack focus on issues such as new technology, research and development, and e-commerce, and often adopt a wait and see attitude towards e-based supply chain management methods, especially if there is no pressure from customers.

This paper explores risk in terms of managerial perceptions. Risks may be endogenous (inherent within the situation itself) or exogenous (impinging on the situation from outside) (Ritchie and Brindley, 2004, Ritchie and Marshall, 1993), and systematic or unsystematic. Andersen (1990, p.117) suggests endogenous risks reflect "uncertainty about the decision taken by other agents (compared to uncertainty about the environment [exogenous])". Thus, supply chain risks may be categorized as those endogenous to the chain (and the incumbent supply actors), and those exogenous to the chains (and the actions of incumbent supply actors). For example, a new technology risk can be both endogenous and exogenous; there is a risk a firm could suffer from adopting a new technology causing damage to its existing supply chain interfaces (endogenous), and the wider or environmental risk of its market place and national/international reputation being damaged (exogenous). This distinction is useful as, in the wider media, it is exogenous risks that attract high profile coverage, such as the threat of avian flu or national security.

For example, at a supply level, the 2001 UK outbreak of Foot and Mouth disease in cattle (a formerly endogenous and containable risk) exploded into a national risk because formerly local and regional supply networks had become national and international (Norrman and Lindroth, 2004). These exogenous risks impacted on other industries; for example, Volvo and Jaguar in the automotive industry ceased deliveries of luxury cars due to a lack of high quality leather. The foot and mouth outbreak illustrates connectivity between supply chains, and the kind of high profile exogenous risk that is increasingly being seen as supply chain risk (Ritchie and Brindley, 2000; Johnsen, 2001; Norrman and Lindroth, 2004; Van de Vijver *et al.*, 2005). More recently, the volcanic ash from an eruption in Iceland is reported to have caused Nissan car factories in Japan to cease production of three models despite the ash only affecting Western Europe. The car maker was unable to import air pressure sensors from the Irish Republic (BBC, 2010). Yet, exogenous risks with a high media profile may receive too much attention (e.g. the low outcome risk of the millennium bug). Harland *et al.* (2003) highlight that losses can range from minor to catastrophic, and that more

managerial and academic attention is often paid to the potential scale of catastrophic loss, rather than the probability it will be realized. Little attention is paid in the literature to relatively minor losses that, if repeatedly incurred, may aggregate into a significant risk.

However, there are four basic approaches to mitigate the impact of supply chain risks (Tang, 2006): supply management, demand management, product management, and information management. Each improves supply chain operations via coordination or collaboration. First, a firm can coordinate or collaborate with upstream partners to ensure efficient supply. Second, a firm can coordinate or collaborate with downstream partners to influence demand. Third, a firm can modify product or process design so that supply meets demand. Finally, supply chain partners can improve their coordinated or collaborative effort if they can access various types of private information that is available to individual supply chain partners.

Combining the definition of supply chain risk as essentially disruptive to existing chain interfaces with endogenous risks, focuses attention on those risks managers have (or perceive that they have) agency over. This paper does not seek to quantify supply chain risks, rather the concern is to compare managers' perceptions of chain risk with how these perceived risks play out, over time, as outcomes.

Risk and e-business

Any new mechanism of communication, co-ordination or control will disturb the risk equilibrium in a network. E-business is a potentially disruptive technology in supply chains, and therefore fits the definition of a supply chain risk as primarily a disruption to existing interfaces, i.e. to incumbent, supply chain interfaces.

Scott (2004) argues that research has paid little attention to some important e-business risks. While past work has addressed many aspects of the business risks associated with strategy, leadership reputation, culture, security, privacy and technology, there is a gap in an overall theory and empirical research is needed to categorise the risks. He states that research on perceived e-business risk is important because of the severe consequences of neglecting risk.

E-business radically alters not only the general shape of the supply chain but also the relationships within, and therefore risks and benefits will alter (Ritchie and Brindley, 2004). Inter-organisational systems involve issues of control and trust between supplier and customer (Chinn and Unkle, 2006). Despite optimistic projections, businesses have been cautious in embracing business-to-business technologies. Typically, B2B models have three fundamental flaws – they are concerned with economics not quality, sellers respond to price and hence focus on profitability and customers, and customer priorities are not considered (Vaidyanathan and Devaraj, 2003). Vaidyanathan and Devaraj maintain that the risks associated with e-business include weak software development processes, deficiencies in e-business protocols, accidental and erroneous processing of transactions and that, by introducing new processes, new business models and new technologies, participants introduce new risks. These new on-line risks are identified by Vaidyanathan and Devaraj's (2003) review as:

- New services. E-business integrates systems that would otherwise be independent. Internal risks include a lack of standards, regulations and rules, a lack of systems support, while external factors include legal, environmental and political issues.

- New business models may involve dynamic pricing, free products, and demand-sensitive pricing that add new risks as issues such as trust and confidence emerge.
- New processes, involving integration with external partners and outsourcing.
- New technologies – emerging technologies may not be scaleable, secure or available.;
- New fulfillment, expectations of service level and speed have changed. Integration of real-time sales orders with existing supply chains may expose risks.

Strategic risks are the concern of top management who need to articulate the vision and monitor e-business compliance with the vision (Scott, 2004). Organisational risks are associated with leadership, reputation, culture, currency, reliability, expertise, legal issues and profitability. On the other hand, policy risks involve security, privacy, intellectual property, identity and identification. Expertise risks arise from a lack of experience in doing e-business. Dependence risks involve management perceptions of uncertainty and a lack control over external risks. Scott points to the reliability of technology risk to the business. He argues that e-business is especially vulnerable to inadequate infrastructure due to its reliance on IT for transactions. Further, security needs to be robust enough to prevent data theft and denial of service attacks.

Scott's (2004) survey reveals that the most concerning e-business risks for management are profitability privacy and security. He concludes that while e-business risks associated with security privacy and other policies have garnered most attention, traditional organisational and strategic risks are critical and should not be ignored.

Risk-mitigating buyer behaviours, such as long-term relationship-building, Hunter *et al.* (2004) argue, have far reaching implications for the supplier selection process and the value of e-business. They maintain that a significant implication for e-business is that applications promising price minimisation such as on-line reverse auctions offer little value to buyers in high risk situations. Buyers are willing to pay more for a known supplier who will surely deliver in an effort to minimise risk (Hunter *et al.*, 2004). The overall value provided by a supplier is determined more by factors such as quality, customisation, process integration, long-term joint cost reduction programmes and after-sales service than price.

Extensive face-to-face contact is required to build trust. Hunter *et al.* (2004) argue that the nature of e-business is not the same for all firms. They maintain that risk perception is the classification of different buying situations and predictions about e-business benefits that will offer value. Their first component of risk perception, risk importance, is the perceived importance in the buyer's mind of potential negative consequences of poor product choice. It derives from personal and organisational risks. Risk probability, the perceived probability of making a poor choice, is the second component. When high risk importance and risk probability are perceived, industrial buyers often turn to relationship building to reduce decision risk.

Sutton *et al.* (2008) focus on technical risks, application-user risks and business risks. They identify risks involve of being exploited within the relationship and include transaction-specific capital, information asymmetries, and loss of resource control. Sutton et al. find 49 critical risk factors across three dimensions – technical risk, application users risk and business risk. Technical risks address whether technical

B2B elements are in place, and internal and external integration works. Application user risks relate to ensuring rationale for B2B implementation is appropriate. These risks include understanding the benefits of B2B linkages, assessing readiness, and dealing with the impersonal nature of B2B transactions. Business level risks relate to an organisation's ability to re-engineer traditional business processes for e-commerce and include the appropriateness of e-commerce, legal, auditing, security issues. Sutton et al. argue that benefits arise from tight collaboration with trading partners, but that the dependence on a small set of trading partners increases risk.

The classical approach to risk management between firms is to maintain slack, usually stock. However, initiatives such as lean and agile supply and just-in-time reduce the commercial viability of decoupling risks by tying resources up in inter-organisational buffer stocks. Tighter integration of customers and suppliers in supply chains and networks spreads risk from such internal, inter-firm issues, to external, multiple inter-organisational issues. Thus, co-ordination mechanisms between firms such as business-to-business technologies become potential conduits for risk (Garcia-Dastugue and Lambert, 2002). Chain level risks from IT developments such as B2B reduce entry and exit barriers in many markets and "may change the methods of communicating with the final customer … ordering and purchasing methods, product/service delivery channels and the process of sustaining customer relationships" (Ritchie and Brindley, 2004).

Beyond loss of contract or tender opportunities, B2B raises the prospect of radical revision of supply chains - intermediation, disintermediation (the process of bypassing traditional linkages in the distribution channel) and remediation (introducing new intermediaries into the value chain) (McIvor and Humphrey, 2004, Ritchie and Brindley, 2000); inevitably resulting in winners and losers with losing firms being de-selected or replaced in the chain or network. Harland *et al.* (2005) explore the risks to organisations, sectors and nations of firms being deselected from supply networks through out-sourcing; raising the issue for how the sustainability of national economies can be affected by network decisions.

Initial speculation was that the greatest benefits of e-business occur under full supply chain integration (Currie, 2000). Later, Garcia-Dastugue and Lambert (2002) and van Weele (2002) note the need for contingent approaches to e-business; that managers need to choose the appropriate level of e-integration for a particular relationship in the supply chain. Nonetheless, there is an assumption in much of the literature that e-business adoption moves through some form of stages of increasing integration with other operations and systems (Venkatraman, 1991; Costello and Tuchen, 1997, Willcocks and Sauer, 2000, Froehlich and Westbrook, 2001). Ritchie and Brindley (2004) argue that most small firms see Internet risks as pertaining to marketing communications and sales.

Viewing e-business as a disruptive technology raises risks of substantial changes in supply chains and, under conditions of increasing integration, greater likelihood of entire chains losing out to nimbler rivals. However, behaviours are conditioned by risk perception as much as by risks that obtain. This paper contributes to knowledge of how managers construct, interpret and manage such risks in supply chains by assessing the risks managers perceived from e-business, the impacts these have on their supply chains and how the perceived risks unfolded over time.

Method

This research reports on perceptions of risk against reported outcomes. The epistemological stance of the research is to value reported verbal perceptions and attitudes from interviewees, rather than seeking unreliable quantitative data. The research is conducted in two phases, at a three year interval. This elapsed time allows for the risks perceived in the first intervention to become manifest or mitigated or for new, previously unperceived risks to arise.

Research design

The approach in the first phase of the research consisted of exploratory semi-structured interviews and case studies of four supply chains (comprising 29 firms) in different sectors (Table I). Eight exploratory interviews were conducted with managers familiar with e-business, to capture a broad range of issues relevant to e-risk in supply chains. The issues raised in these interviews, in conjunction with the literature review, allowed development of a semi-structured interview format for the cases. Case research is recommended for situations where little is know about the research topic and where current theories are not well developed (Easton, 1995, Eisenhardt, 1989, Yin, 1994). Halinen and Törnroos (2005, p. 1286) suggest: "case strategy can be defined as an intensive study of one or a small number of business networks, where multiple sources of evidence are used to develop a holistic description of the network and where the network refers to a set of companies (and potentially other organisations) connected to each other for the purpose of doing business".

Case studies are performed in four sectors: construction, assistive technology, apparel and computer consumables. Gaining co-operation from firms identified as linked in a supply chain is not simple; agreement has to be established and maintained across multiple organisational boundaries. Therefore, in setting up the case studies, convenience samples of chains involve focal firms where prior links had been established. Commitment is needed from the focal firm as they are involved in facilitating access to one of their first tier suppliers, and again in persuading that supplier not only to participate, but to facilitate gaining access to a set of their SME suppliers, for example, who also need to be persuaded to co-operate.

Figure 1, Figure 2, Figure 3 and Figure 4 represent the four case chains and illustrate the limitations of linear portrayals of supply chains. The industries and the chains were purposive selections to uncover and explain difference. The key players of the construction industry tend to be professionals, such as architects, surveyors, project managers, and site managers. Each is involved in supply procurement and is concerned with managing their individual supply chain. SMEs tend to be small-scale and owner-run. A feature of the SMEs in the assistive technology chain is that they face fierce global competition. Supplies sourced from China, Malaysia and India are cheaper and often faster than local suppliers. The apparel industry features a diverse chain, with two mainly public sector-oriented firms, in somewhat protected markets, a low value manufacturer dealing in the mass and retail market, and a packaging manufacturer dealing in low volume boxes. The apparel chain is in a relatively transparent industry (in that manufacturing costs are easy to estimate), providing customers and competition with readily accessible information. The machinery used is standard and the tender process is public, although testing and tendering processes may protect domestic suppliers. The apparel industry is close-knit in terms of

Chain	Construction	Assistive technology	Apparel chain	Computer consumable
Product	Elevators	Wheelchairs	Uniforms	Computer consumables
Face to face large firm interviews	1 customer, 1 supplier	1 customer, 1 supplier	1 customer	3 suppliers, 2 customers
Telephone interviews – large firms	2	2	1	4
Face to face SME interviews	5 suppliers	4 suppliers	4 suppliers	4 suppliers and 2 customers
Telephone SMEs interviews	4	3	4	4
Firms no longer in business (SMEs)	1	1 no longer in sector	1 no longer in sector	2 and 1 no longer in chain

Table I.
Supply chain case studies and interview schedules

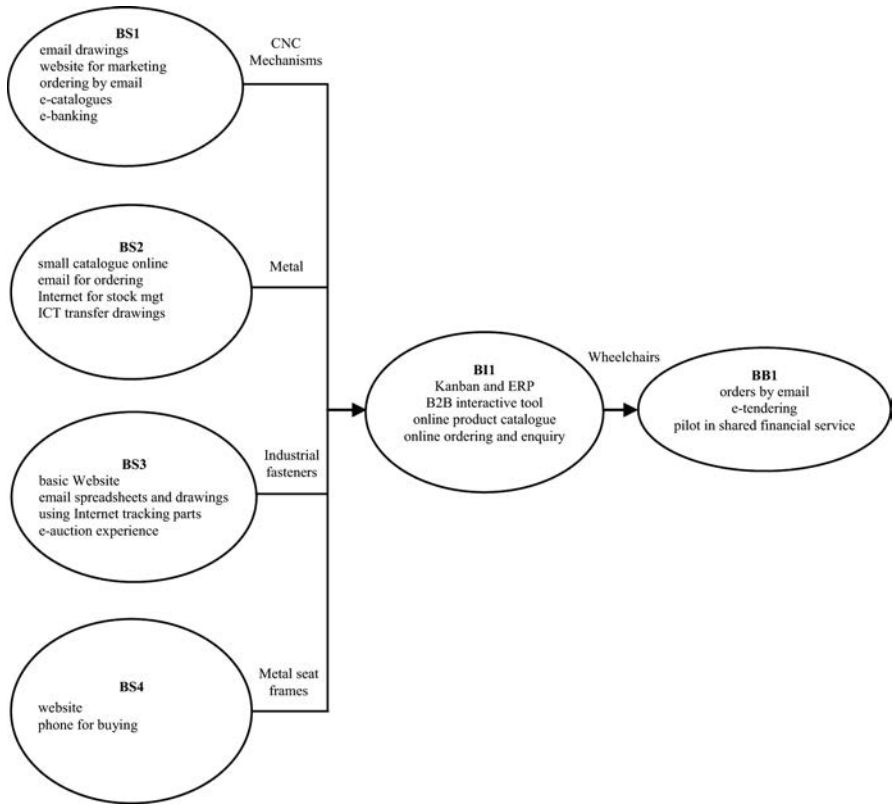

Figure 1.
Assistive technology supply chain map

associates and business relationships, with members remaining loyal and proprietary traditional knowledge about market requirements communicated by word of mouth.

The computer consumables chain takes an iterative form, the supply chain archetype of a large focal firm supplied by an intermediate, smaller supplier that, in turn, receives supplies from much smaller firms, is not supported. The emphasis on inter-firm interfaces in supply chain management enables examination of how far initiatives penetrated each chain. Examining only of dyadic relationships would not have captured the scale of any chain-wide impacts. The diversity inherent in small firms made it appropriate to conduct interviews with a number of SMEs in each of the four chains.

In order to investigate the use of e-business through a chain of organisations, the case approach involved interviews at three levels of each chain, engaging customers, suppliers and suppliers' suppliers. Supply chains are invariably conceived as centered around a large powerful "focal" firm, so that benefits and losses would only be recognised in terms of how they impact the focal firm. Here, the research design uses a focal firm as the access point to the chain, not as the unit of analysis. This design choice reflects two aspects of the research focus, first a concern to capture risk perceptions throughout part of a chain rather than solely with regard to a focal firm. Second, there

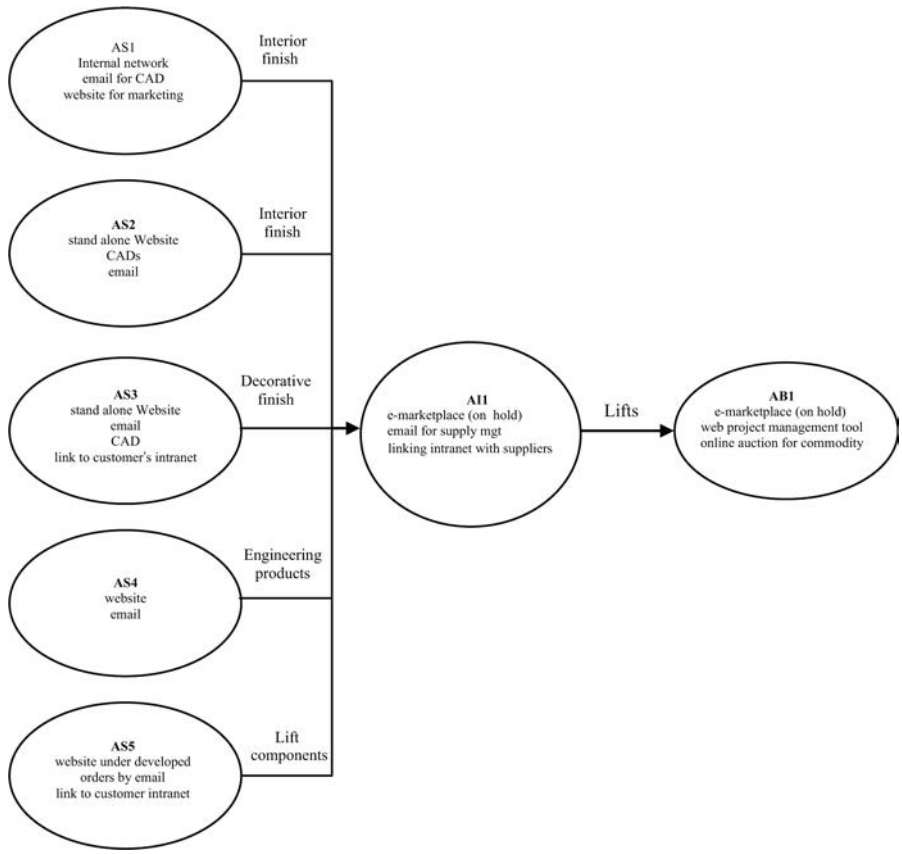

Figure 2.
Construction supply chain map

is skepticism about the generalisability of the focal firm view; prior research shows it is common for many customers and suppliers to be in many chains.

The research here only employs complete chains - in at least two other chains the same process resulted in broken, unstable chains. Thus, although initial access was a major issue, the commitment of chain members was crucial in enabling the second phase research. A sample of four supply chain studies is in line with Eisenhardt (1989) guideline that a number of cases somewhere between four and ten works well. In summary, the research reports on supply chains' participants that include 20 SMEs and ten larger firms. Table I provides details of each supply chain and the overall interview schedule while Table II summarises, by supply chain, the organisations that participated.

Interviews were conducted with a senior purchasing manager and/or IT manager in focal firms and large suppliers, and with owner/managers in the SMEs. All the interviews were recorded and documented and confidentiality was assured. All data was manually coded using emergent themes. The use of single respondent case interviews minimized potential multi-respondent bias. The final outcome was sent to all participants for factual checking.

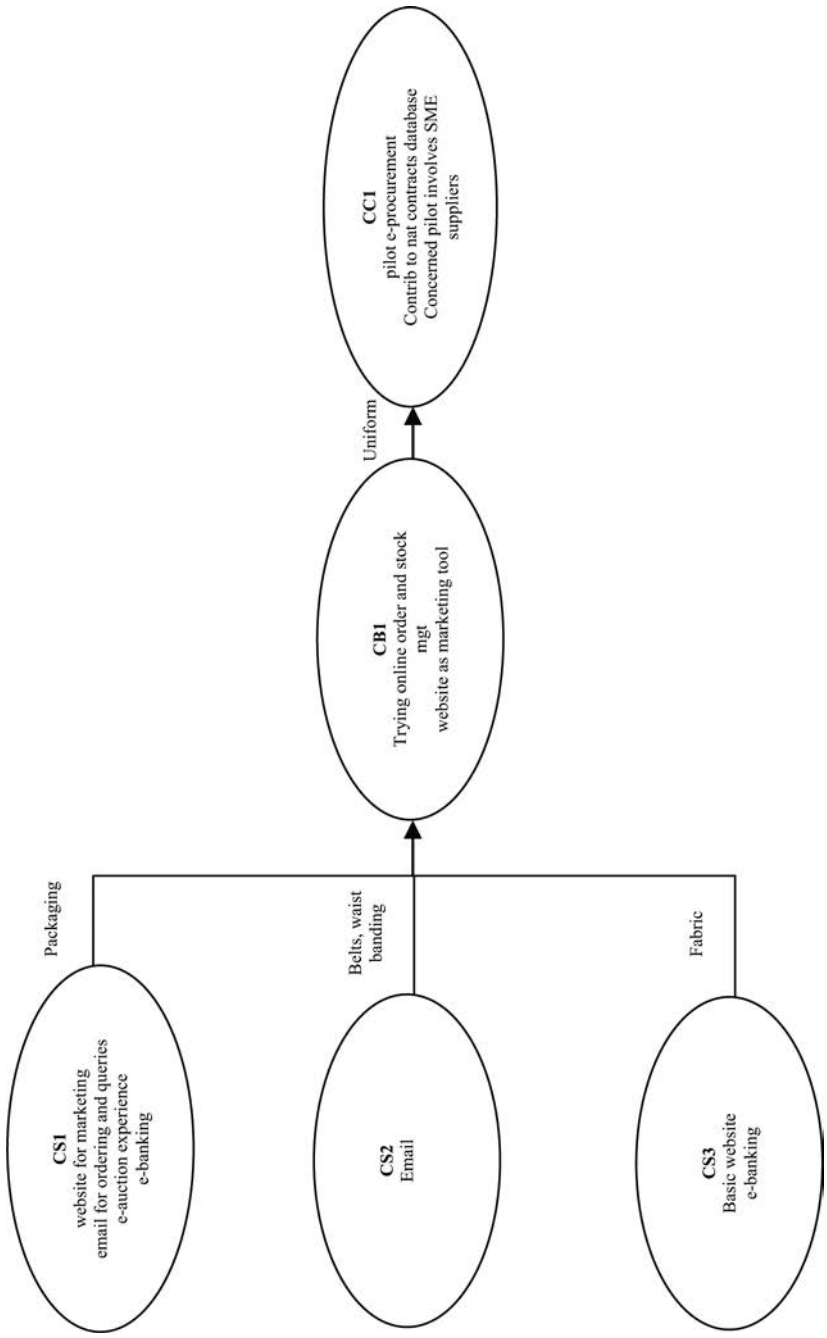

Figure 3.
Apparel supply chain map

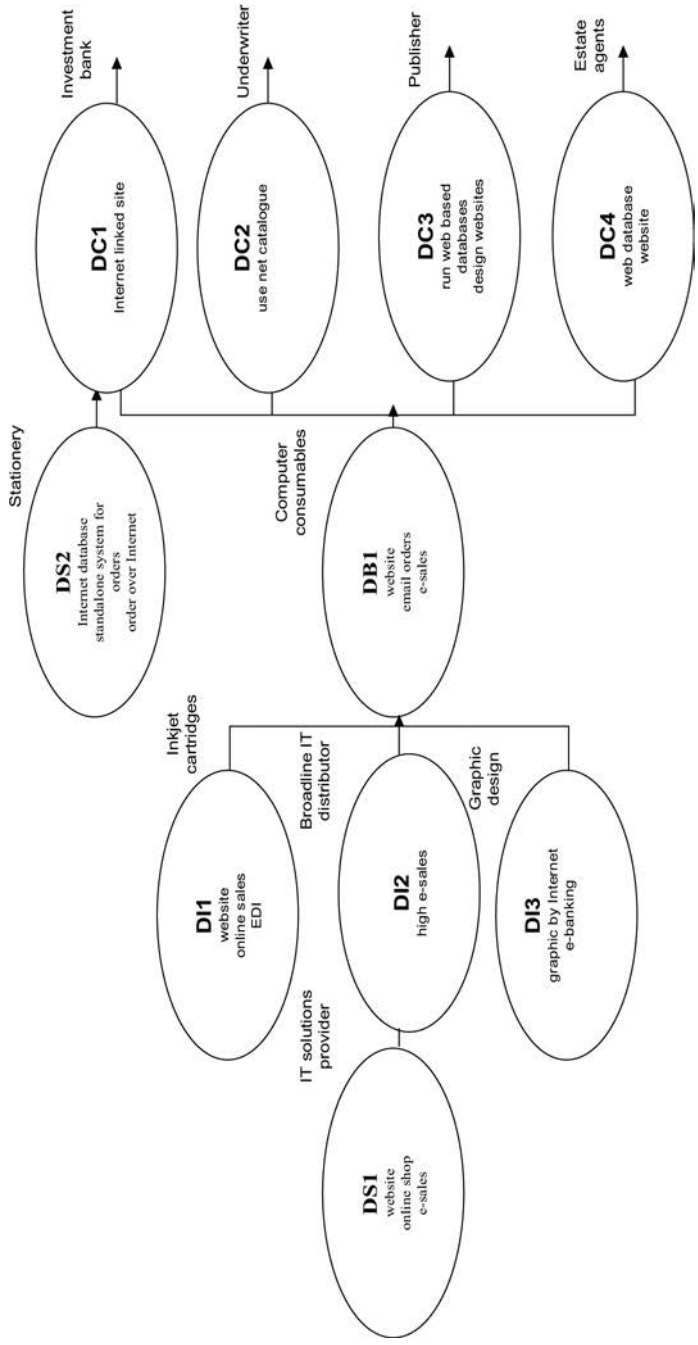

Figure 4.
Computer consumables supply chain map

Chain	Firm	Business	Ownership	Turnover (€s)	Employees
Construction	AB1	Construction: mechanical, electrical and maintenance	Large focal firm: UK listed	5.4bn	50,000
	AI1	Lift manufacturer	Large immediate suppliers	313m	2,800
	AS1	Interior finishing	Owner managed	3.1m	45
	AS2	Interior finishing	Owned/managed: 2 directors	3m	50
	AS3	Decorative finishes	Partnership of 3	1.3m	20
	AS4	Manufacturer of engineering products	Family owned since 1851	0.88m	13
	AS5	Distributor of lift component parts	Part of a lift manufacturer	3.1m	7
Assistive technology	BB1	NHS Trust Disablement Centre	Large Focal Firm	Budget 6.9m	70
	BI1	Wheelchair manufacturer	Large immediate supplier: UK listed	65m	N/A
	BS1	Subcontracting CNC mechanisms	Private limited co, family owned since 1992	1.3m	16
	BS2	Metal stockholder	Private limited co, family owned	7.5m	22
	BS3	Distributor of industrial fasteners	Private limited co and family owned	2.25m	16
	BS4	Subcontracting wheelchair parts	Owner semi-retired	5m	60
Apparel	CB1	Uniform manufacturer	Large Focal Firm	n/a	n/a
	CB1	Distributor of quality uniform	Private limited co	11.25m	100
	CS1	Distribution of packaging	Limited co -(was family business, family CEO)	15m	100
	CS2	Manufacturer: belts, waist banding, bindings	Family owned (50 yrs)	3.1m	32
	CS3	Fabric manufacturer	Private	10m	53
Computer consumables	DC1	Private investment bank	Large customer	n/a	160-170
	DC2	Underwriter	Large customer	1.88bn	200
	DB1	Distributor of computer consumables	Large supplier	18m	80
	DI1	Manufacturer of inkjet cartridges	Large immediate supplier	Globally, 5.1bn	200
	DI2	Broad line IT distributor	Large immediate Supplier	1.25bn	600
	DC3	Publisher – websites/e- brochures	One person	375,000	13
	DC4	Estate agents	Owner entrepreneur	88k	2 FT + associates
	DS3	IT solutions	Private limited company	38m	120
	DS2	Stationery supplier	Private	3.1m	12
	DI3	Graphic design	one and contacts network	38,000	1 plus casuals
	DS1	IT solutions provider	Two partners	3.8m	13

Table II.
Summary by supply chain of participating organisations

Longitudinal research, in the form of follow-up or staged studies, are one of the data gathering methods recommended in Easton (1995). George and Jones (2000) argue that time should play an important role in theory and in theory building, while Zaheer *et al.* (1999) maintains that the choice of time scale has a major impact on the development of theory. In order to capture a longitudinal perspective on the perceptions of risk, this research employs a follow up set of telephone interviews was carried out three years later. Telephone surveying has been used as a method by other researchers (Rosenthal, 1984, Lindsley and Blackburn, 1991). Walton (1997) lists the advantages of telephone surveys in logistics research as more control over data quality, collection speed, cost efficiencies, higher data integrity through mitigation of non-response bias and higher response rates than mail survey. These advantages of telephone-based survey were all the more relevant due to the high percentage of original respondents, rather than role substitutes, who were re-interviewed (construction 67 per cent, assistive technology 67 per cent, apparel 100 per cent, computer consumables 50 per cent).

Two firms were unavailable/unwilling to participate in the second phase of the research, three had changed their business and were no longer involved in the same chain and four businesses had ceased trading, leaving 20 of the original chain case firms as active participants. For the follow-up survey participants were first read a one page summary of their first phase interview. Then the second phase research was conducted under five headings: e-business development in the last three years, the forces (or lack of) for e-business change, the importance of the use of e-business, the impact of any lack of e-business capability and the future role of e-business.

Analysis

Table III reports the risks the four chains identified in the first research phase. Two features are apparent, the first is the low level of perceived external risk posed by B2B. Second, the pragmatic nature of risk perception, with "getting paid" featuring in all the chains. Getting paid, along with over-dependence on a single customer dominated SME responses. Only in the computer consumable chain were e-related issues taken seriously as a perceived risk. Across the supply chains the SMEs adopted a "watching brief" with regard to e-business adoption, based on caution, contingency and the need for hard and quantifiable cost benefits (Zheng *et al.*, 2004). As one interviewee put it:

> When we first heard of TQM and all that, we were horrified, how would we ever afford the time let alone the money to do that. Now everybody, every small company does it. It'll be the same with e-business, when we have to we will do something, everyone will, but not 'till then.

Across the 29 organisations it was apparent that firms, large and small, did not shape their perception of risk in e-business terms; this finding supports Ruefli *et al.* (1999) comment that borrowed measures lack validity. In both construction and computer consumables, e-business was perceived as a threat to the strong communication ties within existing personal relationships, these personal relationships being assets that might be negated by electronic communication. Thus, rather than see e-business as a global threat – able to reconfigure entire chains through giving customers reach to new, distant e-enabled suppliers - the risk of e-business was perceived more pragmatically as an adjustment to existing practices.

Compared to the set of risks identified by Scott (2004), by Vaidyanathan and Devaraj (2003), and by Sutton *et al.* (2008), five of these risks feature in the first phase

	SME risk	Large firm risk
Construction	Not getting paid	Competitive
	Risk	Human interaction
	Loss brand name	Supply risk related to e-marketplace
	Quality standard from overseas supplier	
	Supplier selection	Supplier selection
Assistive technology	Over-reliance on one big customer	Over-reliance on IT expertise
	Foreign competition	
	Government (red tape)	
	Not getting paid	
	Quality standard from overseas suppliers	
	Supply due to shipment problem	
	Losing sensitive information	
	Losing personal touch	
Apparel	Over-reliance on one big customer	Raw material price
	Not getting paid	Dependence on IT
	Customer sourcing overseas	Security
	Quality standard from overseas supplier	Losing personal touch/investment
	Shrinkage of UK textile sector	
	Foreign competition	
Computer consumable	Employee mistake shutting out customer	Lose uniqueness, become price-based supplier
	Owner's ill health	Quantity of business more important than quality
	Slow loss of an e-based customer through not talking and sorting out problem	Security
		Jeopardise supply relationships
		Competitors can do same better/cheaper
		Destroying margins

Table III.
First phase-adoption risks perceived by SMEs and large firms

research. These risks are competitive, technology reliability and over-dependency, expertise and security. However, this research's outcomes centre around the risks identified by participants - primarily over-dependence on one customer, not being paid, loss of critical mass, cannibalisation of existing sales, loss of personal contacts, and transparency. These are largely non-e-business risks and they appear to dominate e-business risks. These are now explored in more detail and the manifestation of these risks in the second research phase are discussed.

Risk of over-dependence

In the first research phase e-business development was more advanced between large firms downstream in the supply network and their customers; with only limited development with immediate suppliers. This pattern was confirmed in the second phase, even in the most e-enabled chain, "computer consumables". However, in this chain upstream suppliers reported no pressure to supply electronically to downstream customers, an observation repeated throughout the later research.

In the first research phase the focal firm of the construction chain [AI1] had major plans for a B2B exchange with full back-office integration and e-procurement with approved suppliers. This was abandoned one year later and was still mothballed at the time of the second phase. This pattern was replicated in the assistive technology chain

where the focal firm BB1 was planning to have full Internet procurement and electronic inventory management, which was still "in planning" three years later.

Many of the smaller firms in all the chains (except computer consumables) reported difficulties from being too dependent on a single customer and actively trying to remedy this. The apparel and assistive technology chains were vulnerable to large (downward) variations in demand at short notice by public sector customers. However, developing technologies before customers might induce a different sort of over-dependence – on inappropriate technologies:

> Before we invested in IT, we didn't have a customer who had that demand and if a customer suddenly came out and said, "We need that type of technology and service from you" we would have been stuck and he might have gone to another supplier. We weighed that risk up and decided to invest in the technology without already having the customer making that demand on us.

By the second phase, a variant of the over-dependence theme emerged, whereby small public bodies such as local government authorities, or local fire services are demanding e-supply as a qualifying criterion. This demand was not uniform across the public sector as CB1 and CS1 had large public sector customers, such as defence, and report no demand for e-business. DB1 and DS1 identified that the biggest change since the first phase is that these smaller public bodies then led e-adoption, perhaps rather "frantically", to meet targets imposed by central government. However, each public body adopted a unique e-system and the costs to suppliers of supporting multiple systems are large. DB1 turned away business that is not obtained via one of the 12 systems they had decided to support.

Risk of not getting paid

In the first phase, respondents made no link between the most cited risk, that of not getting paid, and e-business. In contrast, the literature predicted seamless e-integration (Currie, 2000), with paperless invoicing and tightly coupled backroom financial operations. One finding from the second phase research is that the predicted cross-organisational integration of financial systems has simply not happened:

> A lot of tenders for three to five year frameworks agreements now require an electronic system to obtain quotations … but we still find these are manually passed to finance or purchasing and come through traditional means (Commercial Director, DS3).

Risk of the industry losing critical mass

That an entire industry could fall below the critical mass necessary internationally to compete effectively was raised in the apparel chain and the assistive technology chain. The apparel chain has been contracting in volume of activity for many years due to lower order volumes by the armed forces and increasing competition from low cost countries. The case firms were surviving by becoming ever more niche suppliers (although a success story, CB1, is reported later). A similar story was reported with regard to the assistive technology chain; volumes ordered have fallen and, increasingly, the mass market was being supplied by low cost countries, with domestic suppliers occupying niches for specialist or bespoke wheelchairs.

By the second phase two manufacturing firms supplying the assistive technology chain had left the industry: BS1 has gone out of business whilst BS4 has left the wheel

chair industry entirely and manufactured bus and coach seating. However, it is striking here that respondents did not see e-business as a cause; in fact, e-business was not seen as a factor. Competition from countries with low cost bases was the reported issue, and these low cost producers were not supplying electronically (except through email). Cost, not e-technology, was the decider; the assistive technology chain reflects the loss of domestic manufacturing to overseas suppliers but does not support "e-globalisation" as the cause.

Risk of cannibalising existing sales

E-business-based sales cannibalising existing business (i.e. the subdivision of existing revenue between lines of business supplied through e-business and those not, without generating new revenue) was raised as a risk in the computer consumables chain. However, of the 11 firms in the first phase research, seven are reported on here, although all are the original respondents.

In the first phase research, DB1 reported that, under threat of losing the business, they had been forced to adopt the e-business system of a major consultancy. At that time they saw no advantage of such an adoption. However, in the global supplier, DI2, the problem was most pressing. DI2 reported that, while electronic supply had advantages, some customers were taking the e-business price as a starting point for negotiating further reductions, rather than as a best – and electronically mediated – final offer price. The respondent contrasted this situation with that of the Belgian office that "turned off the phones" so that customers take the e-business price or go elsewhere. Three years later, DI2 reported a sustained increase in e-business, up from 32 per cent to 42 per cent of turnover. However, the mix of the e-business evolved:

> The big change is that the number of orders taken has gone up hugely, from say 40 to 70, but the average order value is dropping. This is exactly what you want, higher value orders are still done with negotiation, people talking, but the lower more routine things are done electronically (General Manager, e-commerce, DI2).

According to DI2 the risk of cannibalizing existing sales did not transpire. E-transactions increased, with customers using e-platforms for standard but perhaps otherwise time-consuming orders, while still dealing person-to-person on more complex orders. For another computer chain supplier:

> The big change is the use of on-line configurators, customers will use a web-based configurator to set up exactly what they want (quote and build) – but then fax or phone through the order, quite a few have purchasing systems that email us the purchase orders (Commercial Director, DS3).

The use of e-business tools such as configurators for assembling complex orders, e.g. the precise specification of computers was reported in DS1. In the assistive technologies chain, BB1 trialed an e-tool for suppliers. Customer use of configurators was also reported by AI1, a rare instance of e-development in the construction chain. However, this was a customer-facing link only, and not upstream to suppliers:

> The NHS is driven by this desire to reduce costs all the time and to do this we have to find ways of doing things differently and that involves streamlining and better use of IT.

In the apparel network all the firms reported the need to diversify their business as the UK textile sector shrinks. By the second phase of research, CS3 stopped supplying this

apparel chain; after 50 years as a manufacturer it became a distributor with three employees whereas it previously employed 32 staff. CB1 presented a different and more positive response to shrinking markets. This uniform manufacturer exited in-house manufacturing to become a one-stop distributor of uniforms, with on-line ordering. It introduced a suite of e-business modules with a major UK government service, and taken over national ordering, stock control and warehousing for that service. Their plan was to roll out this business model with other customers.

Risk of losing personal contacts

While "getting paid" was the most serious generic risk identified in the first phase research, in terms of the risks of e-business, losing key personal contacts was reported as the dominant risk. Especially for SMEs, relationships with customers, developed and nurtured over time, were seen as key resources that electronic supply would degrade their inimical personal qualities:

> The business just grows by word of mouth. Brochures are great but I prefer someone giving my name to someone. They'll find us because we are who they want. Word of mouth is the biggest factor.

In the construction sector the sense of personal relationships as perhaps the core asset of the firm was stronger in smaller firms (AS1, AS2, and AS3). DB1 reported that their whole business, run by a call-centre of around 40 employees, was based on the personal relationships their employees built up with customers. These relationships were cemented by personalised activities such as remembering customers' birthdays. The aim was for call centre operatives to create a bond with customers. In the first stage research, DB1 felt e-business was such a threat to their relationship-based business model that, although they had in place the systems to supply electronically, they did not promote e-business. They were adamant that their customers liked the personal approach, and would not want the impersonality of e-business trading:

> Our customer base is mostly repeat. We visit customers to see what enquiries they have. The marketing doesn't have to be that fancy – it's down to straight forward personal contact and relationships.

This feeling was echoed in the assistive technologies chain:

> There is no pressure to use more e-. It's still very much a people business, face-to-face.

And in another SME:

> It's only when you meet people that you know what they are about. If they seem like they really know their stuff, if what they say – a delivery, say – actually happens, then you build up confidence and they will buy from you. You can't portray confidence over the Internet.

By the second phase of research, the risk of loss of personal relationships through e-business was the most discounted of all the identified risks. In the construction sector, little progress towards e-business was reported, which might be tentatively attributed to the strength and depth of personal relationships reported in that sector. However DB1, in the computer consumables chain, whose relationship-centred call centre business model seemed most at threat, was now enthusiastic about e-business:

> [We have] come away from seeing e- as a threat, now think e- can enhance the relationship, freeing [the] sales person up from administrative tasks such as inputting orders so that they can spend more time building the relationship with the customer, so our business plan is trying to grow the business but stay the same size [i.e. grow in turnover but without increasing employee numbers due to e- taking over manual or clerical tasks] but use e- to help us personalise our offering" (IT Manager, DB1).

Transparency

One of the key features of an e-enabled market is greater "transparency". In the first phase research, for the SMEs studied here, transparency was a huge risk. Transparency was often described as being all about price. Many buyers were aware that SMEs are not always the cheapest and transparency was a huge risk for the SMEs studied here. Larger firms have more complex business models, and a portfolio of products and businesses to make transparency less transparent. SMEs are in a more vulnerable position than large firms if sensitive information is lost.

In the second phase research the transparency risks manager/owners identify as supposedly inherent in Internet-based business had not materialised (except in DI1). In the first phase DI1, a manufacturer of inkjet cartridges reported that they viewed selling direct through e-business as a threat to their existing relationships with dealers and intermediaries. They, therefore, had a conscious strategy of making their sales direct to consumers on their website hard to find, offering a limited range, and charging higher prices than consumers could obtain in the high street. In the second phase research they reported the same basic strategy, that they were still reluctant to upset distributors/resellers, there was little e-business activity with consumers, and their website for intermediaries/resellers was still informational not transactional. One year later, DI1 had closed their UK manufacturing plant, switching production to low cost countries. The sales director for a small subcontractor in the assistive technology chain commented on potential problems in making stockholdings transparent to customers "It takes a long time to build a reputation and just one mistake to kill it".

For all respondent firms, except DI1, to the extent that this transparency risk was negated by the lack of e-business integration across internal and external systems, it cannot be discounted as a future risk. However, in the first phase research the starkest risk of e-business causing transparency both of firms' business models and of prices was reported as e-auctions:

> We've had offers to take part in e-auctions but we're not interested because there's not enough information. We would be going in blind on the details of a job . . . We need to be able to talk about the job. We need to know the whole way to treat the job.

And again:

> If we were bidding over the Internet it would be a lot harder in the respect that you wouldn't have as much time to sit down and make a commercial judgement on it. It's easier now because you have time to study the terms – you can look at it, you can weigh up what the odds are and you can make a logical commercial decision.

This was echoed by a further respondent:

> We used an e-auction . . . to tender for a contract to supply 11 different stock items. We found it difficult and laborious.

By the second phase research, in the four chains researched here, e-auctions were still not used by customers.

In terms of transparency of business models (a problem for smaller firms with less diversified, or even single product, offerings), the transparency risk was not confirmed. DC4 is an Internet estate agency, specialising in selling Italian properties to UK buyers. In the first phase research they reported that Internet growth would threaten their business, as big players would move in and take over the market. Three years later they reported this had not happened, and that they were investing heavily in their web-site to give more functionality to customers and collect more information on customers.

Discussion

In the first stage research the respondents perceived competition from low cost countries and general competitive pressures as the key environmental or exogenous risks; notably construction perceived no environmental risks. The endogenous risks were perceived as not getting paid, loss of critical mass to support UK manufacturing, cannibalising existing business, dependency, loss of sensitive commercial information through transparency and the loss of vital personal relationships. Of all these risks only the last four are related to e-business in supply chains. A first finding is, therefore, that e-business was not perceived as high risk by most managers.

Of the four e-business related risks identified by managers in the first phase research, the potential loss of critical face-to-face contact generated concern in nearly all of the construction chain and in the computer chain call-centre firm. Three years on, the responses to the risk of loss of personal contact as an asset were positive. DB1 and DI2 reported that personal relationships could be enhanced by having repetitive tasks handled by e-business, leaving more time for the social relationship and cross-selling, with customers. One plausible implication is that e-business may cement, or ossify, existing trading relationships and reduce the incentive to search for alternatives. This is consistent with research in the wider information systems domain in small firms (Levy and Powell, 2005). In essence, e-business may encourage firms to arrest development of new relationships and stick with their current supply chain relationships; the flexibility enabled by e-business may remain dormant. E-procurement systems then may be seen to benefit incumbent suppliers through the advantages of an installed base and general embeddedness whilst disadvantaging new suppliers; a new potential risk.

Since e-business was reported as having made virtually no inroads into the construction industry sample, it is not possible to comment upon the impact e-business had on the highly personalised business practices in this sector. It was not a clear cut issue, since in the construction chain, personal contact was not discussed as direct marketing contact but as business retention. Their time was spent not in seeking to sell new business, but in attempting to remain in the customer's frame of reference when further business emerged. Within the risk of loss of personal contact was also the risk of losing "share of mind" of the customer.

The other three e-business-related risks perceived in the first phase research by managers did not transpire. With regard to over dependency on one or more customers, e-business was not perceived to have made any difference. Three years later, however, a new, related risk arose, in terms of supporting systems unique to many customers.

The risk was that suppliers become overstretched, or ended up choosing to support proprietary systems that did not achieve an economic scale (a finding that echoes the negatives associated with electronic data interchange adoption (Mackay, 1993)). It is ironic that the public sector should be responsible for this. Also, these hastily assembled e-procurement systems were reported as not integrated with other operations. It seems behind the e-business façade personal relationships retained their existing role in dealing with such public bodies.

Conceptually, some of the risk raised by the threat of cannibalisation could be interpreted to cross over into other risks, particularly the loss of personal relationships and transparency. By interviewing only "survivors", this data, particularly in computer consumables, may be biased towards those who made a success of e-business, or at least those who were not terminally damaged by it. By the second phase research, of the surviving firms, the risk of e-business supply mechanisms segmenting existing sales was not apparent. Finally, transparency was deemed a risk by SMEs, but the later research revealed no evidence of transparency, particularly of margins or "trade secrets" being exposed by e-business adoption.

Avoiding the risk of not getting paid was a major influence on supply strategy with smaller upstream suppliers. Whereas larger firms diversify their business across a range of customers and product lines, smaller suppliers do not have the scope for such diversification (without facing huge transaction costs on a low volume of orders with a high volume of customers). Therefore, decisions such as from whom to buy and to whom to sell become implicit risk management decisions. Management of this risk was taken extremely seriously. In fact, it dictates, to some extent, customer and (supplier) attractiveness for SMEs. Repeatedly, SMEs voiced their commitment to known sources of supply, usually local, and known customers. Part of this commitment related to perceiving their business as being seen as more of a priority with existing suppliers. However, it also reflected their confidence in customers who had "paid up" before as being likely to do so again. Other SMEs were perceived as the most likely to default on payment.

This research suggests that previous work on supply chain risk, by under-estimating the importance to firms of getting paid, has missed a key driver for stability in supply chains. The research suggests a higher propensity for upstream firms to stick with the supply chain partners they know, as a risk management strategy for avoiding bad debts. The implication for e-business adoption is that the offer of a wider supply base (even global) does little to counter SME fears that their (low volume) business will not be given priority by "new players" and that new players are more likely to default on payment than known customers.

The research suggests that supply chains were not materially adversely affected by e-business growth. The endogenous risks managers identified did not materialise. This is not to suggest the managers were in error to voice these concerns as a common step in all risk management or minimisation is to identify the risks.

A snapshot approach only tells the story of a moment in time; "with 'snapshot' data one's attention is drawn to the more high profile turning points which are well documented or much talked about" (Knight, 2002, p. 168). The value of a staged study of risk is the ability to analyse whether risks are significant due to being temporarily high profile, literally "in the news", or genuine strategic concerns. Examining the

exogenous risks managers identified enables contributions to the understanding of supply chains and risk.

The two exogenous risks identified in the first phase research (excluding general "competitive pressures" which is too generic to be considered in relation to e-business) were the risk of competition from low cost countries and the risk of industries losing the critical mass necessary to survive. There are obvious overlaps between the two; the link being manufacturing. In the first phase research the apparel and assistive technology chain were predominantly manufacturers.

With regard to the globalizing effects of e-business, i.e. competition from across the globe being increasingly price-based, this research does reveal low cost competition in manufacturing – but from non-e-business enabled suppliers. Across the four chains this research found no support for firms either using the Internet to access new and "foreign" suppliers, or of "global" competition from e-business sources. There is evidence of globalization, but it is not being driven by integrated information technologies.

In the assistive technology chain the leading firm involved in manufacturing in the first stage research (BI1), had ceased volume production in the UK three years later. Although BI1 had outsourced standard manual wheelchair production to China, they reported that higher value chairs (e.g. motorised) were still manufactured in the UK, and that for non-standard chairs, the myriad combinations of complexity and specifications available made it unlikely that UK production would cease completely. BS1, a small family-owned precision machining firm was still operating as they pursued an active strategy of avoiding dependence on any one customer or sector. With regard to e-business, as in the first phase research BS1 reported no demand for e-enablement three years later from customers or suppliers. The third manufacturing firm (BS4), had left the chain, unable to compete with low cost countries and was still manufacturing but in another niche sector.

In the apparel chain in the first phase research three of the four firms were manufacturers. Three years on one had successfully ceased manufacturing to become a one-stop distributor (CB1). A similar, but less successful, story was told by CS2, which had contracted to three staff. The fabric manufacturer was still manufacturing but had downsized, after also downsizing three years earlier. The only firm with any UK manufacturing in the computer consumables chain shut its UK manufacturing facility four years after the first phase research. This significant loss of manufacturing jobs was not made any more palatable by DB1's comment that e-business was perceived as the major way to grow business without increasing the number of office-based employees. The other service success story, the Italian Internet estate agency DC4, was unlikely to create many jobs.

This research, by taking a staged approach and going back to the same chain and reviewing perceived risks, identifies how the build up of numerous – but small – events for example factory closures, can aggregate over time to be just as significant as high profile, headline-worthy risks. Methods that produce a snapshot such as a one-off survey may be inadequate for fully exploring an area such as risk. Especially if the risks are hard to assess and are biased toward high profile events – catastrophic risks rather than accumulations of smaller, less noticeable risks. For example, the data suggests that the UK uniform apparel industry was kept competitive by the integrity and thoroughness of the standards set in UK textile education. These standards,

translated into tenders, were so comprehensive, so detailed, and so specific to the UK (including especially testing standards) that lower cost competitors struggle even to tender. By implication the loss of one UK institute of higher education might imperil the entire industry by no longer having the critical mass to offer the careers and standards that maintain a national industry.

The interviewees accurately identified the exogenous risks they faced. They were aware of the increasing role of services in the economy, the lack of interest in UK manufacturing, and were aware of their impending fate. The research method could not address is the accumulation of risk (for example, loss of national manufacturing expertise) that comes from many small, and even unrelated decisions. Such analysis is a challenge for e-business and supply chain research.

In terms of the endogenous risks, the managers demonstrated foresight and accuracy. One finding validates SMEs' overall caution toward adopting e-business. Their apparently successful evaluation of its likely impact (low) and penetration (low) leads to this cautious behaviour. Such accuracy contrasts sharply with the ambitious but unfulfilled plans of the larger, focal firms.

Conclusions

This paper proffers supply chain risk as the probability of loss through disruption to existing interfaces, i.e. to incumbent supply chain interfaces. The research surfaced perceived risks at two stages. There was little impact of disintermediation in the four supply chains studied here; e-business was not seen as a component of the success of foreign manufacturing competitors.

A collapse of e-business leadership can be traced between the two research events. Where there were individual e-business strategies they focused mainly on downstream customers; there was little evidence of progress with upstream suppliers. In terms of the SMEs who might be led, by the second research there was little enthusiasm for further e-business adoption and integration. Their cautious, "watching brief" (Zheng *et al.*, 2004) appears to be validated. Hindsight of a longitudinal perspective suggests that earlier the biggest risk from e-business was SMEs (and their larger counter-parts) being misled by the hype and over-investing.

Surprisingly, the e-business leaders that emerged by the second research phase are smaller public sector bodies, focussed on meeting central government targets. For example, in the apparel chain, CS3 had many major public sector customers, including defence and police, and these were not promoting e-business. Whilst the public sector was observed to be leading demand for e-business, it was only parts of the public sector, and only smaller organisations, not the major elements of UK central government.

If supply chain integration is central to success, there were few signs of integration, few with upstream suppliers and even the local government adopters were localised adoptions. Apparently, these networks could function adequately without the integration that some of the literature suggests is necessary (Froehlich and Westbrook, 2001) and, indeed, appear content to progress without the greater benefits from information systems that can be achieved with higher levels of IS integration (Venkatraman, 1991).

A theme of the e-business literature was the looming risk of structural change – caused by e-business enablement – of the shape of supply chains or networks. Change

was predicted in who was in and who was out of the chain, of unheralded new entrants redefining the competitive landscape, and of intermediation and disintermediation. That follow up research could interview so many not only of the original firms but the original respondents indicated the robustness of the supply chains studied. Pragmatic selection of the four case chains hinders generalisability, but the literature – and earlier ethos – emphasised change and changes, whereas the findings here highlight that chains had remained highly similar. What comes through more strongly than the risk of e-business destabilising existing structures was the stability over time of those structures.

The contribution from this observation of stability is the need for understanding the specific contexts of individual chains or networks before assessing their "vulnerability" to change risks. This finding builds upon Pablo's (1999) observation that risks can only be defined in industry-specific terms. Perhaps it is managers' far greater awareness of their supply chain contingencies that makes their assessments of risk appear so accurate. In tandem, it also appeared that, with regard to future risks, accuracy (and perhaps familiarity) lose out in policy makers' eyes to newness and media profile. For example, it is unlikely that any particular manufacturing industry will suddenly cease. Instead, the industry might be undermined by a series of low profile closures until the sector is fatally below an internationally competitive threshold; also such closures need not be manufacturing sites, they could be training institutions, standards institutions, even journal publishers.

Compared to the literature, for instance the risks identified by Scott (2004), Vaidyanathan and Devaraj (2003), and Sutton *et al.* (2008), five of these risks featured in the first phase research: competitive, technology reliability and over-dependency, expertise and security. The first phase outcomes were largely non-e-business risks and they appeared to dominate e-business risks. The second phase research risks – as perceived by participants – were over-dependence on one customer, not being paid, loss of critical mass, cannibalisation of existing sales, loss of personal contacts, and transparency.

The method employed here offers alterative perspectives on supply chain risk and e-business, including how it can accumulate from individually insignificant risks. Limitations, pragmatism and opportunism in the sampling is acknowledged. For example, the work and concepts that led to the expectation of e-business dominating industrial supply chains may have been based in chains more open to external forces than the ones examined here. Further research might identify the minimum critical mass necessary to retain national manufacturing capacity at a chain or sector level, and empirical work is needed on the suggested link between supply chain stability and certainty of payment. The cases here were based on four UK supply chains, so various chain forms were likely to have been excluded. Follow up research could only be conducted with surviving firms.

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