

Adoption of Supply Chain Management Enabling Technologies: Comparing Small, Medium and Larger Organizations

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Abstract

This paper aims to extend understanding of adoption drivers and outcomes for supply chain management enabling technologies. In order to achieve this data has been collected from two surveys within the Australian Fast Moving Consumer Goods (FMCG) sector two years apart. The focus of this study is to understand how adoption differs for large, medium and small organizations within this sector. Although use of these technologies has been previously researched in FMCG supply chains, few of these studies have focused on why organization size appears to moderate adoption, particularly for Internet based technologies. This study also aims to broaden the analysis to include smaller firms that make up the majority of players in this group, and for whom reduced costs of access and use should provide incentives to adopt. The evidence indicates that although the adoption and use of supply chain management enabling technologies is more attractive to large and medium sized organizations, these same organizations appear to be inherently more susceptible to common impediments to extended adoption. At the same time, however, small organizations do not appear to be as encumbered by outdated processes and cultural inertia yet they do not adopt these technologies readily. There is also evidence found indicating that SME's should not be treated as a homogeneous group, and that there are significant differences recorded between small and medium sized firms traditionally defined as being SME's.

Keywords: *SME's, Supply Chain, Internet, Impediments*

1. Literature Review

1.1 Introduction

Adoption of established technologies for the management of supply chains (such as EDI) have been found to be more widespread in large rather than small organizations (Cash and Konsynski, 1985; Barua and Lee, 1997; Bytheway and Braganza, 1992; Lee and Clark, 1999; Power, 2002). Studies in the SME sector have identified that adoption of both established and emerging technologies has been subject to constraints, or at least extent of use to be ambiguous (DTI, 1999; Lockett and Brown, 2000). Some studies have found that smaller organizations

are using internet technologies as much as larger ones, but have also concluded that whether this will lead to extended adoption and improved supply chain performance was yet to be determined (Power and Sohal, 2002; Power, 2002; NOIE, 2000b). Others have concluded that although it may be easy to connect and use basic Internet functions, there may still be significant impediments to extended adoption that would enable real supply chain improvement. The emergence of Internet technologies should provide greater opportunity to adopt in the SME sector due to reduced cost of implementation and development of open standards (Addison, 2004). On the other hand,

although use of such technologies appears more widespread in larger organizations, there is evidence suggesting these organizations also face significant problems in implementation (Power, 2002; Power and Sohal, 2002). On balance it therefore appears that the adoption of supply chain management enabling technologies can be problematic. On the one hand there are significant potential benefits firms could realize, whilst on the other some evidence suggests that firm size may significantly modify ability to realize this potential. This paper explores why organization size appears to both moderate levels of adoption, and amplify impediments to adoption.

1.2 Supply Chain Technology Adoption

Difficulties in managing supply chains are a function of the complex relationships and interactions between networks of trading partners. This situation manifests itself as the “bullwhip effect”, characterized by amplified variation in orders as demand moves upstream (Lee et al., 1997b; Lee et al., 1997a; Walker, 2001; Djonckheere et al., 2004). The focus on managing the chain of supply across multiple tiers of the supply chain is largely a function of an increased awareness of this dynamic. Forrester modeled this phenomenon in the late 1950's, and since that time many explanations have been proposed to explain why it occurs, and how it can be counteracted (Forrester, 1958; Forrester, 1961; Lee et al., 1997b; Lee et al., 1997a; Serman, 1989; Djonckheere et al., 2004; Djonckheere et al., 2003; Disney and Towill, 2003a; Disney and Towill, 2003b). Among these has been the proposition that improved flows of information between trading partners can reduce the perceived variation in demand and therefore reduce this amplification (Lee et al., 2000; Lee and Whang, 2000). This has led to an expectation that technology can be used to improve information flows for this purpose. This expectation has not necessarily been realized as adoption and use of enabling technologies has been limited, and the benefits either not clearly understood or accepted. Although the literature highlights many benefits for organizations applying these technologies (Wood, 1997; Forrester, 1958; Forrester, 1961; Ballou et al., 2000; Belyea, 2000; Cachon and Fisher, 2000; Zeng and Pathak, 2003; Rosenzweig et al., 2003), other work in the area shows that implementation has been limited (Baum, 1997; Burnell, 1998; Johnston and

Mak, 2000; Chan and Swatman, 2000; Power and Simon, 2004).

This can be explained by many factors including: rapid technological change increasing the risk that current investments become quickly outdated (Hewitt, 1999; Froehlich et al., 1999); difficulties inherent in the nature of trading partner relationships and the requirement for organizations change (Power and Singh, 2007; Bowman, 1997); the temptation to focus on short term goals rather than long term strategies (Larkins and Luce, 2000); difficulty of dealing with legacy business processes (Parnell, 1998; Froehlich et al., 1999); cost and difficulty of implementation (particularly for EDI type applications) (Adams, 1997; Barua and Lee, 1997; Bytheway and Braganza, 1992; Ramamurthy et al., 1999). Internet technologies have more recently been seen to provide access for more organizations at a lower cost than longer established alternatives. Potential benefits include increased visibility of real customer demand patterns (Lee et al., 1997b; Coleman, 2000; Landry, 2003); significant decreases in delivery lead times (McCormack, 1999); information sharing and greater depth of relationships between trading partners (Manasco, 2000; Lancioni et al., 2003; Verecke and Muylle, 2006); improved visibility upstream along the chain to determine inventory availability (Radjou, 2000; Garcia-Dastugue and Lambert, 2003); and the development over time of a core competence in low cost customized manufacturing and fulfillment (Westhead et al., 2000; Cagliano et al., 2003). The open nature of the Internet also has a potential downside, including doubts being raised about the readiness of the Internet for large scale commercial transactions; lack of security; inability to confirm message integrity; vulnerability of messages to interception and fabrication; lack of user support; and difficulties in obtaining reliable assurance of authenticity or receipt (Sim, 2000; Baum, 1997). As a result, other research indicates that usage in practice is also still limited in many organizations in sectors such as FMCG to basic communications functions (Lancioni et al., 2000; Power and Simon, 2004; Power and Sohal, 2002).

1.3 The SME Context

There is evidence suggesting that adoption of supply chain enabling technologies has been more extensive in large rather than small organizations

(Cash and Konsynski, 1985; Barua and Lee, 1997; Bytheway and Braganza, 1992; Lee and Clark, 1999; Power, 2002). Early Australian research has found that only a limited number (28%) of small and medium enterprises (SME's) connected to the Internet were using it for basic procurement functions (Anonymous, 1999). This is despite the research being conducted at the height of the Internet bubble in the late 1990's. These results confirm earlier research from the US showing that the majority of SME's there saw EDI to be a cost to the business rather than a potential source of benefit [Raymond, 1996 #577]. A range of reasons for this reluctance identified included: moving onto the Internet could lead to uncontrolled growth; fear of alienating intermediaries; satisfaction with current business arrangements; concern about levels of understanding of the technology; time and expense of reengineering processes; fear their products would not be suitable for trading via the Internet. More recent studies in the SME sector have found adoption to be subject to constraints (DTI, 1999; Lockett and Brown, 2000; Power, 2006), and indicate that this reluctance may be in part due to a lack of solutions targeted at this end of the market (Vaaland and Heide, 2007). Some studies have found that use of integration technologies is growing in smaller organizations (Barclay, 2005), but that it is still unclear as to what the benefits will be and how they could be leveraged (Power and Sohal, 2002; Power, 2002; NOIE, 2000b; Koh et al., 2007). Others have concluded that although it may be easy to connect and use basic Internet functions, there may be impediments to extended adoption, or in fact the need to integrate may not be as great in the SME sector (Kuo, 2005). The nature of integration required in this sector has also been identified as being an important factor in effective adoption, with a focus on interoperability being identified as more appropriate for SME's (i.e. as against "all in one integration") (Bennett, 2004). Impediments to implementation identified in the literature include: shortfalls in management capabilities, combined with a lack of control systems, equity and resources (Bianchi and Bivona, 2000); the need to focus on processes first in order to ensure that technology supports strategy (Bennett, 2004); fear of alienating powerful trading partners, (NOIE, 2000a; NOIE, 2000b); cost of involvement in e-catalogs and related collaborative undertakings (Croom, 2001;

Elliman and Orange, 2000); low levels of technological capability (McIntyre, 2000); inherent risks encountered by SME's when attempting to integrate processes with trading partners (Faisal, 2006). At a practical level a recent German study highlights common practices within the SME sector mitigating against extended use of integration technologies including: widespread preference for FAX technologies; and use of manual systems for materials management making some technologies non-viable due to a lack of scale (Beck, 2005). The overall impression is that despite Internet technologies appearing to be attractive to the SME sector, the reality appears to be that smaller organizations are either reluctant to adopt enabling technologies, or they lack the general awareness of the benefits and potential sources of leverage such technologies provide.

1.4 Synthesis and Development of Propositions

The availability of enabling technologies allowing organizations (both large and small) to connect processes, systems and functions between organizations is growing as open standards provide low cost scalable applications. The reality, however, for SME's appears to be that adoption of such technologies is limited by a range of factors and conditions specific to their size and operating environments. What is unclear, however, is whether there are substantive differences between sizes of organizations within the generally accepted definition of what an SME is. When we talk of SME's there is often an assumption that all organizations employing less than (say) 200 people are a homogeneous group. This study, however, proposes that there are characteristic differences between companies employing less than 20 people, between 20 and 200 people, and more than 200 people. In other words, it would appear unrealistic to assume that all companies employing less than 200 people have the same limited levels of adoption, low levels of awareness, and are subject to the same lack of capabilities in this area. As such, four propositions are developed to test whether the reported lack of adoption of supply chain management enabling technologies, and the associated reported lack of capability and awareness of benefits, applies uniformly across the SME sector.

Proposition 1: *Adoption of supply chain management enabling technologies will vary significantly between small, medium and large organizations*

Proposition 2: *Perception of cost vs. benefit of supply chain management enabling technologies will vary significantly between small, medium and large organizations*

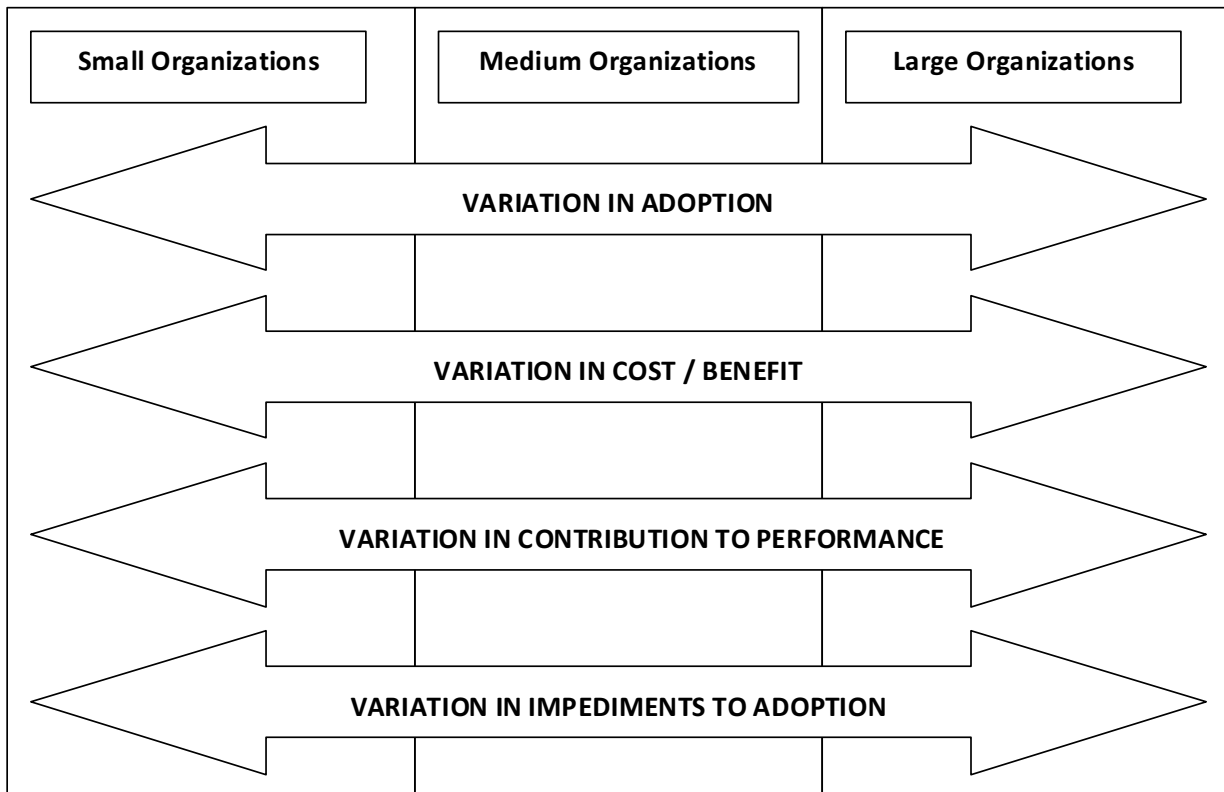
Proposition 3: *Perception of contribution to organizational performance of supply chain management enabling technologies will vary significantly between small, medium and large organizations*

Proposition 4: *Perception of impediments to adoption of supply chain management enabling technologies will vary significantly between small, medium and large organizations*

2. Method

Two surveys have been conducted within the Australian Fast Moving Consumer Goods (FMCG) sector. The first covered a sample of 3356 companies that were members of GS1 (formerly the European Article Numbering (EAN) organization) within Australia. This initial survey yielded 553 responses (response rate of 16.5%), and focused largely on the use of technologies that had been in existence for up to 30 years (bar-coding, EDI etc.). The second survey was conducted within the same membership 2 years later, and sampled 2470 organizations and a total of 281 usable responses were collected. This represented a response rate of 12%. The focus of this survey was on the adoption and use of Internet

Figure 1. Diagrammatic representation of research propositions



based technologies (XML, XML/EDI, Internet applications, Extranets, e-catalogs etc.). The primary analysis method used was One-way ANOVA. This method was used to compare mean scores between three groups of organizations; SMALL - those employing less than 20 people; MEDIUM - those employing between 20-199 people; and LARGE - those employing more than 200 people.

3. Findings

Proposition 1: Adoption of supply chain management enabling technologies will vary significantly between small, medium and large organizations.

The evidence from both surveys indicates that adoption of both types of technologies is higher in

large and medium sized organizations than in small ones. It is also apparent that the pattern of adoption across the three groups is similar for both types of technologies. In other words, it is not apparent that, for example, small organizations are using Internet technologies for managing supply chain functions more readily than they did EDI. Another striking characteristic of the data is that adoption increases across the three groups. As such, there is a clear indication that small organizations are using the technologies less than medium sized organizations, and they in turn are using them less than large firms. There is also some indication that the scale of the difference is greater between small and medium organizations for the traditional technologies such as EDI, although this is not generally applicable to all data points of comparison. The results therefore provide evidence supporting Proposition 1.

Table 1. Survey 1 – Extent of Use of EDI

Survey Item	Mean: <20 Employees	Mean: 20-199 Employees	Mean: >200 Employees	F Statistic	Sig.
Extent of use of EDI for: Incoming Sales Orders	1.55	2.07	2.08	9.714	.000
Extent of use of EDI for: Advanced Shipment Notices (ASN's)	1.46	1.83	2.05	7.804	.000
Extent of use of EDI for: Remittance Advice	1.43	1.84	2.15	10.643	.000
Extent of use of EDI for: Invoices	1.45	1.73	2.07	6.415	.002
Use of Evaluated Receipts Settlement (for enabling EFT)	1.31	1.55	2.07	11.027	.000
Extent of use of EDI for: Sales/Stock on Hand/Stock on Order Data	1.34	1.66	2.18	12.343	.000
Transmit purchase orders to suppliers via EDI	1.28	1.45	2.59	30.277	.000

Table 2. Survey 2 – Extent of Use of Internet Technologies

Survey Item	Mean: <20 Employees	Mean: 20-199 Employees	Mean: >200 Employees	F Statistic	Sig.
Extent of use of EDI for: Incoming Sales Orders	1.55	2.07	2.08	9.714	.000
Our organization is using electronic marketplaces for dealings with major suppliers	1.65	1.99	2.02	3.820	.023
Our organization is using extranets for dealings with major trading partners	1.4	1.64	1.83	4.233	.016
Our organization is using XML/EDI applications for web based document transfer	1.44	2.02	2.52	15.156	.000
Our organization is using XML applications for interfacing with major trading partners	1.28	1.61	2.06	10.953	.000
Our organization is using web based catalogs for dealings with major trading partners	1.56	1.65	1.94	2.819	.061
Our organization is sharing data (via the Internet) with major trading partners	1.36	1.81	2.02	10.070	.000

Table 3. Survey 1 – Perception of Costs vs. Benefits - Established SCM Technologies

Survey Item	Mean: <20 Employees	Mean: 20-199 Employees	Mean: >200 Employees	F Statistic	Sig.
Cost of implementation of SCM technologies	2.59	2.84	3.15	5.084	.007
Benefit of implementation of SCM technologies	2.74	3.13	3.72	12.607	.000

Table 4. Survey 2 – Perception of Costs vs. Benefits - Internet SCM Technologies

Survey Item	Mean: <20 Employees	Mean: 20-199 Employees	Mean: >200 Employees	F Statistic	Sig.
Cost of use of the Internet for B2B e-commerce	2.52	2.8	3.13	5.853	.003
Benefit of use of the Internet for B2B e-commerce	2.59	3.16	3.37	10.679	.000

Proposition 2: Perception of cost vs. benefit of supply chain management enabling technologies will vary significantly between small, medium and large organizations.

The data presented in Tables 3 and 4 indicates that perceptions of cost and benefit for both technologies to be significantly different across the three groups. At the same time the results for all three groups are almost identical for assessment of cost of both traditional and internet based technologies. This result indicates that neither group sees any great cost/benefit in emerging internet based technologies over those based on long established standards such as EDI. Interestingly, in the larger company group the assessment of potential benefit is substantially lower for Internet technologies (3.37) than that reported for SCM technologies in survey 1 (3.72), and also lower for the small firm group (2.59 against 2.74). The medium sized group is neutral on this issue reporting almost identical expectations for both forms of technology. This represents a lower level of expectation for Internet technologies in both groups (large and small firms) when compared with longer established technologies, and no greater expectation on the part of medium sized firms. The results provide evidence supportive of Proposition 2, as well as highlighting a general ambivalence in terms of the cost/benefit advantage of Internet based technologies across all three groups.

Proposition 3: Perception of contribution to organizational performance of supply chain management enabling technologies will vary significantly between small, medium and large organizations.

The results recorded in Tables 5 and 6 show again a significant difference across the three groups in terms of perceptions of contribution of both technologies to firm performance. The results also indicate a shift in perceptions of contribution to performance of SCM enabling technologies. The difference between organizations employing less than 20 people and those employing more than 200 appears to be uniform and consistent for both types of technologies. Where there is an apparent shift is in the perceptions of the medium sized organizations (employing between 20-199 people). In this group the perception of benefits accruing from use of Internet technologies is substantially greater (on average) than was recorded in the earlier survey for the longer established technologies. In fact this group record similar levels of benefit to those in the large organization group (>200 employees) on many of the variables tested. This is despite no apparent change in levels of use of either technology type within this group of firms (see Tables 1 and 2). The results reported therefore provide support for Proposition 3.

Table 5. Survey 1 – Perception of Contribution to Organizational Performance - Established SCM Technologies

Survey Item – Contribution of EAN System to:	Mean: <20 Employees	Mean: 20-199 Employees	Mean: >200 Employees	F Statistic	Sig.
Improved customer satisfaction	3.28	3.55	3.85	4.453	.012
Reduced FG inventory	2.01	2.43	3.43	16.095	.000
Reduced WIP inventory	1.62	1.98	2.78	18.484	.000
Reduced RM inventory	1.62	2.01	2.68	15.065	.000
Improved product traceability	2.2	2.75	3.28	14.552	.000
Improved stock accuracy	2.18	2.77	3.73	16.282	.000
Increased productivity	1.98	2.45	3.3	17.811	.000
Improved service quality	2.48	2.87	3.68	13.158	.000
Improved product quality	2.07	2.33	2.93	7.272	.001
Increased flexibility	2.06	2.30	3.00	8.889	.000
Increased sales 2.67	2.82	3.05	1.333	.265	
Increased net profit	2.25	2.70	3.23	10.554	.000
Reduced cycle times	1.85	2.35	3.13	17.536	.000
Improved cash flow	2.04	2.58	3.13	14.522	.000
Reduction in claims	1.91	2.52	3.18	19.686	.000
Reduced costs 1.98	2.52	3.13	15.743	.000	

Table 6. Survey 2 – Perception of Contribution to Organizational Performance - Internet SCM Technologies

Survey Item – Contribution of Internet technologies to:	Mean: <20 Employees	Mean: 20-199 Employees	Mean: >200 Employees	F Statistic	Sig.
Improved customer satisfaction	2.72	3.36	3.29	7.12	.001
Reduced FG inventory	2.19	2.68	2.76	5.057	.007
Reduced WIP inventory	2.08	2.58	2.55	5.097	.007
Reduced RM inventory	2.1	2.57	3.27	4.803	.009
Improved product traceability	2.38	2.93	2.98	5.561	.004
Improved stock accuracy	2.35	3.02	3.02	7.220	.001
Increased productivity	2.58	3.04	3.14	4.361	.014
Improved service quality	2.78	3.44	3.41	7.584	.001
Improved product quality	2.41	2.83	2.69	2.341	.098
Increased flexibility	2.61	3.08	3.41	7.432	.001
Increased sales 2.84	3.3	3.24	3.158	.044	
Increased net profit	2.71	3.33	3.41	6.77	.001
Reduced cycle times	2.35	3.05	3.1	9.077	.000
Improved cash flow	2.62	3.22	3.31	6.431	.002
Reduction in claims	2.21	3.13	3.06	13.7	.000
Reduced costs 2.56	3.25	3.43	9.1	.000	

Table 7. Survey 2 – Perception of Influence of Factors Affecting Capability to Implement Internet SCM Technologies

Survey Item	Mean: <20 Employees	Mean: 20-199 Employees	Mean: >200 Employees	F Statistic	Sig.
Computer literacy	3.27	3.46	3.20	1.203	.302
Outdated business processes	2.56	2.72	3.38	9.561	.000
Resistance to change	2.51	2.76	3.14	4.381	.013
Top management commitment	3.26	3.78	4.08	10.715	.000
Strategic alignment	2.94	3.20	3.86	11.480	.000
Compelling business case for change	3.02	3.09	3.45	2.587	.077
Rate of technological change	2.88	3.06	3.08	1.172	.311
Innovative culture	2.88	3.15	3.39	4.195	.016
Customer capability	3.25	3.59	3.57	3.482	.032
Supplier capability	2.99	3.42	3.41	5.055	.007
Legacy systems 2.46	2.86	3.16	7.687	.001	

Proposition 4: Perception of impediments to adoption of supply chain management enabling technologies will vary significantly between small, medium and large organizations.

Table 7 examines the perceptions within the three groups of the influence a range of factors are having on the capability to implement. It is interesting to note that the large organization group (>200 employees) reports a stronger effect for factors relating to process change, resistance, management commitment, legacy systems and strategic alignment. The implication is that large organizations are experiencing problems with structural change as a result of higher levels of use of Internet technologies. The small and medium sized firms, on the other hand, report that these issues have significantly less influence on their capability to implement. In many cases (e.g. legacy systems, supplier capability, top management commitment) the difference recorded between the small and medium sized firms is also substantial. Conversely, the medium and large firms start to converge in the degree of trading partner capability, with the results for both the mid-sized and larger company groups being almost identical, and still significantly different from that of the small companies (<20 employees). The results provide support for Proposition 4, whilst also highlighting some significant differences between small and medium sized firms, and similarities between medium and large sized organizations.

4. Discussion

The analysis of the data provides a number of insights relevant to each of the propositions tested. For Proposition 1, there are significant differences recorded in adoption rates for both traditional technologies for the management of supply chains (e.g. EDI), and emerging Internet based technologies across the three groups of firms. Small organizations are less likely to be using either established or emerging technologies than medium sized companies, and large firms record higher usage than medium sized firms. At the same time, there is little evidence indicating that usage across all three groups is greater for Internet based technologies than for longer established alternatives. A characteristic difference is recorded between companies employing less than 200 people (a typical cut-off point for SME's), and large companies (employing more than 200 people). At the same time, however, there is a significant difference also recorded between small firms (employing less than 20 people) and those employing between 20 and 200 people. An important implication of this observation is that SME's are not all the same, and indeed the analysis of this group (at least in the context of adoption of supply chain management enabling technologies) is oversimplified if they are treated as a homogeneous group.

For Proposition 2 while perceptions of cost and benefit for both technologies appear to be significantly different across the three groups

(higher for large firms, smaller for small firms), neither group sees any great cost benefit in emerging internet based technologies over those based on long established standards such as EDI. Large organizations have a higher assessment of the cost of both, as well as a higher level of confidence that benefits will accrue. Interestingly, Internet technologies are not seen to be cheaper or easier to implement by either large or small organizations, when compared to long established technologies such as EDI. In fact, in both the large and small groups, there is evidence suggesting that expected benefits are lower for Internet based technologies than for longer established alternatives. The implications for adoption of these technologies are significant given the typical resource and cash poor situation of a small firm. If benefits are not apparent it is hard to see how firms with limited resources could contemplate investing time and effort in implementation. This result resonates with studies that have found that basic technologies such as the use of a FAX are more appealing in this sector (Beck, 2005), that the perceived need is perhaps not immediately apparent in this sector (Kuo et al., 2005), and that solutions need to be specifically targeted at this sector (Vaaland and Heide, 2007).

For Proposition 3 large and medium sized organizations report higher levels of benefit from the use of these technologies than small organizations. For the established technologies the firms employing more than 200 employees report significantly higher levels of benefit than the medium sized group, and this group also report higher levels than the small company group. For internet technologies, however, there is evidence suggesting that the mid-sized and large groupings converge in their perceptions of benefits, despite lower levels of use of Internet technologies in medium sized companies. This result has a number of implications. Firstly, despite there being lower levels of usage of Internet technologies in medium sized firms, they apparently derive similar levels of benefit as do large firms. One possible explanation is that medium sized firms are not encumbered with process and culture related complexities that larger firms may be subject to. The results reported below for Proposition 4 also provide some support for this proposition with the medium sized companies reporting that outdated business processes, strategic alignment and top management commitment are less of a problem in their sector. Further, the difference recorded for both technologies

between the small and medium firms again highlights the need to be able break SME's into more meaningful sectors for analysis, and the importance of not treating SME's as a single homogeneous group.

For Proposition 4 large organizations also indicate that they are experiencing significantly greater problems with various impediments to adoption than are small organizations. Many of these impediments (strategic alignment, resistance to change, outdated business processes, legacy systems etc.) could be as much a function of the characteristics of larger organizations (multiple levels, functional divisions etc.), as of the fact that they are more involved in implementation than their smaller counterparts. There is also further evidence indicating that the small company group is significantly different from the medium sized firms on many of the impediments measured, further supporting the proposition that the SME sector is not a single homogeneous group.

5. Conclusion

The evidence from this study indicates that although the adoption and use of supply chain management enabling technologies is more attractive to large organizations, these same organizations appear to be inherently more susceptible to common impediments to extended adoption. This is apparently more the case for Internet technologies than for their predecessors. In other words, Internet based solutions appear more attractive to large organizations (i.e. they report higher levels of use), but paradoxically are probably going to create considerable organizational stress (pressure for change) as adoption spreads. The implication for large firms is that although benefits may be more readily apparent, extensive adoption could be limited by the extent and intensity of the "organizational discontinuity" experienced. The results for the medium sized group of companies provide some support for this proposition. This group report lower levels of adoption of both types of technologies, but indicate similar levels of benefit from the use of Internet technologies. At the same time, this group report that organizational impediments seen to be significant problems in the larger companies, are less of an issue in affecting their capability to implement. For small firms the problem appears to be one of awareness of the benefits, or even possibly of the relevance of these technologies for them. They in general appear to be both ambivalent and apathetic about the need to

implement, and about the possibility of leveraging these technologies for their benefit. This begs the question of whether there really is a gap in relevance for this group in that the technologies, and the solutions they support, have been developed aimed at firms with the resources to invest in them. As such, it may be that small firms are being alienated from participation by the economics of diffusion, or that the adoption imperative is just not apparent to them. Whatever the reason, the importance of breaking the SME sector into meaningful groups is highlighted by the clear differences recorded between small and medium firms in this study. The grouping together of firms in the SME sector would appear (at least in the context of this study) to be more meaningful if it is broken into groups more representative of the characteristic differences between firms.

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