Technology Application and Employee Participation: Comparative Contributions to B2B Technology Related Outcomes

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Abstract

The purpose of this paper is to test for the relative impact of B2B technology application and employee participation on typical operational and bottom line business outcomes. The constructs developed relate to employee participation and use of B2B technologies. A survey instrument was administered within a sample of the membership of GS1 Australia (formerly EAN Australia). Employee participation is found to be the strongest significant predictor of B2B technology related outcomes. Application of the technology is also found to be important in explaining outcomes, but generally to a lesser extent than participation. This study has been limited to organizations operating in the Australian Fast Moving Consumer Goods (FMCG) sector. This research indicates that employee participation is not only a good strategy for B2B technology implementation, but essential to ensure the full potential of the technology is realized. The evidence suggests that involvement and participation of different groups of employees, at different stages of implementation, can be a critical factor accounting for many of the outcomes organizations seek when adopting technologies of this type.
Introduction

The identification of the ineffectiveness and inefficiency characterizing the operation of many supply chain activities, along with the development of new technologies, has led many organizations to look to using technology to improve inter-organizational operations (Power & Simon, 2004; Wu, Chiag, Wu, & Tu, 2004). In many supply chains (e.g. fast moving consumer goods sector - FMCG), this move has been initiated by the adoption of barcode reading technology, the use of EDI, and more recently Internet technologies to streamline paper and funds based transactions (EAN, 1998a; Wortmann, 2000). The implementation and use of such technologies requires investment in both hardware and software, and is often accompanied by some level of process change (Berry, Naim, & Towill, 1995; EAN, 1998b; Edwards & Peppard, 1996). Such process change is usually also associated with change in the human dimension of an organization, and invariably this means that the human technology interface needs to be factored into implementation planning (Mitev, 1996; Mumford & Weir, 1979). This leads us to ask where the focus of implementation should rightfully be, given that the use and application of supply chain enabling technologies (now often referred to as B2B enabling technologies) is becoming more widespread. Who should be involved in implementation, at what level from the organization, and to what extent? Is extent of use of these technologies related to achieving better business outcomes, or are results a function of the level of involvement of employees in implementation? This paper attempts to throw light on these questions by analyzing the results of an empirical study of Australian companies within the FMCG sector.
Literature Review

Application of B2B Enabling Technology

Technologies enabling more efficient and effective trading partner interaction have been in existence for many years (Johnston & Mak, 2000). Such technologies have included Electronic Data Interchange (EDI), as well as barcodes and product numbering, and in more recent times the Internet and an array of standards based protocols enabling open communication between trading partners. Despite this long history of availability (e.g. EDI and barcoding has been in use in many parts of the world for over thirty years), evidence suggests that application and use of such technologies is still either limited (i.e. relatively few organizations using them), or shallow (i.e. those using them often only use at a very low operational level) (Power, 2002; Power & Simon, 2004; Sohal, Power, & Terziovski, 2002a; Van Hoek, 2001). The subject of adoption of these technologies, and in particular why EDI has been slow in application, has been the subject of a number of studies. Factors identified as being important have included: high cost of using Value Added Networks (VAN’s) (Rassameethes & Kurokawa, 2000); high requirement for cooperation between trading partners (Ramamurthy, Premkumar, & Crum, 1999); and in FMCG supply chains (particularly for manufacturers and wholesalers) lack of partner capability, existence of legacy systems and a lack of clear benefits (Koloszyk, 1998). Interestingly in the case of EDI specifically, some researchers have found that despite the existence of this perception of impediments to adoption of EDI, it is often accompanied by an understanding that extended use could lead to significant business benefits (Ramamurthy et al., 1999; Rassameethes & Kurokawa, 2000). Internet based applications have been seen by some
to offer a cheaper and more openly available alternative, perhaps overcoming some of these impediments. In particular, the marriage of the internet and EDI (e.g. through development of standards such as XML/EDI) has been seen as a cost effective way of accessing open networks, while at the same time leveraging legacy system investments (Johnston & Mak, 2000; Segev, Porra, & Roldan, 1997). Recent evidence suggests, however, that adoption of these emerging Internet based alternatives is also not as widespread as was expected (Fawcett & Magnan, 2002; Power, 2002; Van Hoek, 2001). This has led to research focusing on what some of the barriers to application of such technologies may be, and whether they contribute to improved organizational outcomes (Fawcett & Magnan, 2002; Frohlich, 2002). An emerging trend in the results of this research indicates that on the one hand the potential benefits of application are understood, and that there is substantial evidence suggesting that such benefits can materialize. On the other hand, however, the most substantial barriers appear to exist within organizations as much as between them. Some have identified these barriers in terms of cultural practices and functional structures (Fawcett & Magnan, 2002), while others have been more specific in identifying existing business models / structures, lack of technical skills and clarity of demonstrated costs and benefits as being critical (Frohlich, 2002). In the study of the adoption of technology based innovations generally it has also been found that extent of use can be associated with factors such as social efficacy and expected benefits (Venkatesh, Morris, Davis, & Davis, 2003). Where these findings converge is in recognizing the need for commitment at multiple levels within organizations, and the development of internal collaborative consensus on how application should proceed.
Human Factors in B2B Technology Application

The identified need to focus on internal issues when implementing B2B enabling technologies leads logically to a focus on the human factors relevant to the management of cultural change. This need had been identified by Forrester (J. Forrester, 1958) in his early work on industrial dynamics and the identification of what is now called the “bullwhip effect” (H.L. Lee, V. Padmanabhan, & S.J Whang, 1997). In this work he isolated three factors creating perceived distortions in demand patterns between trading partners, namely structure, amplitude and delays. The second of these, amplitude, Forrester attributed to the nature of decision making in humans (J. W. Forrester, 1961). Later system dynamics researchers extended this concept, isolating the primary influence as being irrational human behavior driven by a misunderstanding of real demand (Sterman, 1989). Others have also identified that one effective strategy for overcoming this problem is to have planning processes that focus on sharing information, working in groups, and developing system wide rather than local responses to matching supply with demand (H. Lee & Whang, 1999; H.L. Lee, V. Padmanabhan, & S.J. Whang, 1997; H. L. Lee, So, & Tang, 2000). This identification of the importance of managing the human interface with supply chain policy development mirrors and complements the theory of socio technical design (Mitev, 1996; Mumford & Weir, 1979). In particular, given the growing dependence of supply chain strategy on effective technology deployment, the importance this theory places on managing social systems in order to deploy technical systems effectively is highly relevant in this context. The question therefore remains as to where to focus in this context. The complexity of social systems has long been recognized, and the ability to identify and manage multiple system dimensions in order to effect the level of change required to enable effective
technology application has also begun to be understood (Baba, Falkenburg, & Hill, 1996; Spence, 2004). In particular, relevant factors that have been identified include employee driven process change and effective group boundary definition (Baba et al., 1996); the involvement of the right people and development of a culture of trust and participation (Power, 2004); senior management involvement and commitment (Sohal, Power, & Terziovski, 2002b); an open organizational culture where there is belief in change as a strategic imperative (Sohal, Power, & Terziovski, 2002c); incorporating “human judgment and understanding” in system design (Bensaou & Earl, 1998); and the need to share information as well as benefits between participating parties (Ballou, Gilbert, & Mukherjee, 2000). The essence of the importance of this interaction between humans and technology designed to facilitate access to, and more effective use of, supply chain relevant information is perhaps succinctly captured by Churchman when he states: “……knowledge resides in the user and not in the collection of information… it is how the user reacts to a collection of information that matters.” (Malhotra, 2000)

**Synthesis and Development of Research Hypotheses**

B2B enabling technologies offer substantial potential benefits for more efficient and effective information sharing between and within trading partner organizations. The evidence suggests, however, that application of these technologies is either limited (i.e. to relatively few organizations), and/or under-utilized even where they are being applied. Reasons for this apparent paradox are complex, but the importance of the human element, and the nature of complex social systems, appears to at least be an important determining factor. What is not clearly understood, however, is the comparative importance of the technology application related issues, and those related to the human side. If it is accepted that change in technical
systems requires social system re-alignment (Mumford & Weir, 1979), this begs the question of the relative contribution of both systems to an organizational outcome. Put another way, if organizations are investing in technologies for the improvement of supply chain operations, what emphasis needs to be placed on each system (technical vs. social), and how does this emphasis relate to outcomes. Unfortunately it is beyond the scope of a single paper to answer such a large question, but not beyond it to begin to investigate some of these relationships in a specific supply chain context. With this in mind the following hypotheses have been developed:

Hypothesis 1: Employee participation will contribute significantly to extent of benefits derived from the implementation of B2B enabling technologies

An important theme in the B2B e-commerce and supply chain management literature highlights the need for process change when implementing enabling technologies (Mabert & Venkataramanan, 1998; McCormack, 1999; Ruetterer & Kotzab, 2000; K.C. Tan, Handfield, & Krause, 1998). This body of literature also emphasizes the importance of involvement of stakeholders when embarking on such change programs (Champy, 1995; Hammer, 1990, 1996; Hammer & Champy, 1994). Following from this identified need for involvement, it would appear logical to propose that higher levels of involvement should contribute to better outcomes resulting from application of technologies. Further, it is also plausible to suggest that involvement could lead to participation, and that such participation (i.e. actively working within the implementation process) would further contribute to benefits and outcomes. In fact, a common thread running through the literature has been the need to encourage participation of as many stakeholders as possible in the implementation process (Agrawal & Pak, 2001; Bensaou, 1999; Bensaou & Earl, 1998; Crum & Allen, 1997; R.B. Handfield & Nichols, 1999). In order to have stakeholders participate (beyond just being involved), it follows that organizations need
to be able to develop a culture of participation. This hypothesis seeks to test for the extent of contribution such participation makes to a range of business outcomes.

Hypothesis 2: Extent of use of B2B enabling technologies will contribute significantly to extent of benefits derived from implementation of these technologies

Another common theme in the literature is a discussion about whether benefits derived are linked to the extent to which the technologies are used (Dabbiere, 1998; R.B Handfield, Krause, Scannell, & Monczka, 2000; Knechtges & Watts, 2000; Mussellman, 1997; Stevens, 1990; Truman, 2000). Some have identified that benefits are related to intensity of use of technologies such as EDI, particularly where there is a high degree of “interface integration” (i.e. integration between internal systems and EDI) (Truman, 2000). Others have claimed that Quick Response programs (incorporating use of a range of B2B enabling technologies) have reduced stock-outs and lead times, creating improved service levels (Mussellman, 1997). What is not entirely clear from research conducted to date is whether more use leads to greater benefits. In fact the results of some recent research provides evidence indicating that who you are, and where you are in the chain can have some influence on perceptions of benefits (Power, 2002; Power & Simon, 2004; Sohal et al., 2002a). This hypothesis is framed to test for the extent of the relationship between extent of use of these technologies, and the benefits derived.

Method

General

A survey was conducted within the Australian Fast Moving Consumer Goods (FMCG) sector. This survey covered a sample of 3356 companies that were members of GS1 Australia
(formerly the European Article Numbering (EAN) organization). GS1 Australia is the organization that administers, validates and issues standard barcodes, electronic product codes and product numbers to Australian companies. As well as promoting the use of these barcodes, GS1 market a system for the adoption and implementation of B2B enabling technologies for the management of supply chains. As such, the membership of this organization are involved in using B2B enabling technologies within their operations. This initial survey yielded 553 responses (response rate of 16.5%).

Construct Development and Survey Testing

A survey carried out in Australia and New Zealand during the early 1990’s was used to provide some of the bases for construct development (AMC, 1994). The study used a sample of 3000 sites, of which 962 responded (a response rate of 32%). The questionnaire consisted of a total of 246 questions developed by a committee of academics, site managers and prominent members of the consulting profession. Where the results indicated an acceptable level of reliability and validity for each construct these items were included in the survey. The construct used in this study specifically derived in this fashion covered employee participation. The items used to test for the contribution of B2B technologies to organizational performance, and those relating to extent of application of the technologies (use of the technology), were developed for this study specifically. They were derived from the review of the literature, and from previous case study research (Sohal et al., 2002a, 2002b, 2002c).

The survey instrument was tested during case studies conducted within the EAN member organizations (Power & Sohal, 2002). During the conduct of the cases interviewees were asked to comment on, and in some cases fill in, a trial survey. As a result of this process constructs in
the survey were able to be clarified and refined.

**Constructs Developed: Employee Participation Construct**

This construct was comprised of 10 variables (see Table 1 below) relating to the levels of involvement of various levels of employees from senior management to general staff and the extent to which participation was encouraged and fostered within the organization (five point Likert scales: “Not involved” to “Highly involved” or “Not at all” to “To a very large extent”). The reliability (alpha) coefficient for these ten items was .8316, and confidence in the validity of the construct was provided by the Kaiser-Meyer-Olkin Measure of Sampling Adequacy = .847 and Bartlett’s test being significant at .000 (principal components factor analysis).

<table>
<thead>
<tr>
<th>Employee Participation</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>When we develop our plans, policies and objectives we incorporate customer requirements, supplier capabilities and the needs of other stakeholders</td>
<td></td>
</tr>
<tr>
<td>Senior managers actively encourage change and implement a culture of trust, involvement and commitment in moving toward implementation</td>
<td></td>
</tr>
<tr>
<td>Champion(s) of change are effectively used to drive change in this organization</td>
<td></td>
</tr>
<tr>
<td>At this organization we proactively pursue continuous improvement rather than reacting to crisis / fire fighting</td>
<td></td>
</tr>
<tr>
<td>Ideas from production operators are actively used in assisting management</td>
<td></td>
</tr>
<tr>
<td>Our company has effective &quot;top-down&quot; and &quot;bottom-up&quot; communication processes</td>
<td></td>
</tr>
<tr>
<td>Extent of involvement during planning and implementation of: Senior Management</td>
<td></td>
</tr>
<tr>
<td>Extent of involvement during planning and implementation of: Middle Management</td>
<td></td>
</tr>
<tr>
<td>Extent of involvement during planning and implementation of: Front line Management</td>
<td></td>
</tr>
<tr>
<td>Extent of involvement during planning and implementation of: General Staff</td>
<td></td>
</tr>
</tbody>
</table>

Table 1: Items making up the Employee Participation construct

**Technology Application Construct: Use of the Technology**

This construct is made up of 21 variables relating to the extent of use of specific technologies (see Table 2 below). These include barcoding, product numbering, EDI, and some specific applications such as logistics labels and container codes (five point Likert scale: “Not at all” to “A very large extent”). The reliability (alpha) coefficient for these items was .9051, and confidence in the validity of the construct was provided by the Kaiser-Meyer-Olkin Measure of
Sampling Adequacy = .907 and Bartlett’s test being significant at .000.

<table>
<thead>
<tr>
<th>Use of the Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Extent to which your organization uses EAN product numbering and barcodes</strong></td>
</tr>
<tr>
<td><strong>Extent to which your organization uses EAN ID numbers</strong></td>
</tr>
<tr>
<td><strong>Extent of use of the following techniques and methods</strong></td>
</tr>
<tr>
<td><strong>Extent of use of EAN Location and Electronic Commerce Numbers</strong></td>
</tr>
<tr>
<td><strong>Extent of use of EDI for the following applications</strong></td>
</tr>
</tbody>
</table>

Table 2: Items making up the Use of the Technology construct

**Business Outcomes: Contribution to Business Outcomes**

This grouping was comprised of 17 variables (see Table 3 below) relating to the contribution of these technologies to a range of business outcomes. These outcomes included operational benefits such as reductions in inventory, improved stock management, and increased flexibility as well as bottom line benefits such as increased sales, improved customer satisfaction and increases in net profit (five point Likert scale: “Not important” to “Extremely important”).

Expected outcomes for organizations engaging in extended supply chain management initiatives are numerous in the literature (Crum & Allen, 1997; Fernie, 1995; R.B Handfield et al., 2000; Lancioni, Smith, & Oliva, 2000; Monczka, Petersen, Handfield, & Ragatz, 1998; Narasimhan & Jayaram, 1998; Shin, Collier, & Wilson, 2000; Tait, 1998; K.C. Tan, Kannan, Handfield, & Ghosh, 1999). The items comprising this construct are used as dependent variables in the analysis to determine the extent to which Employee Participation and Use of Technology explain variance in these outcomes.
Contribution to Business Outcomes

Contribution of implementation to the following outcomes in your organization at this point in time

- Improved customer satisfaction
- Reduced finished goods inventory
- Reduced WIP
- Reduced raw materials inventory
- Improved product traceability
- Improved stock accuracy
- Reduced time required for annual stock takes
- Increased productivity
- Improved service quality
- Improved product quality
- Increased flexibility
- Increased sales
- Increased net profit
- Reduced cycle times
- Improved cash flow
- Reduction in claims
- Reduced costs

Table 3: Items making up the Contribution to Business Outcomes construct

Results: Introductory Discussion

(Regression was used to test for the contribution extent of participation and use (independent variables), to business outcomes deriving from the use of the technologies (dependent variables)).

Both Table 4 and Figure 1 below compares the Adjusted R$^2$ values for the Employee Participation construct (as a predictor of the 17 business outcomes variables) with those relating to Technology Application (Use of the Technology).

<table>
<thead>
<tr>
<th>IV / DV</th>
<th>Customer Satisfaction</th>
<th>Reduced FG</th>
<th>Reduced WIP</th>
<th>Reduced Raw Mat.</th>
<th>Traceability</th>
<th>Stock Accuracy</th>
<th>Stock Take Time</th>
<th>Productivity</th>
<th>Service Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employee Participation</td>
<td>0.125</td>
<td>0.232</td>
<td>0.201</td>
<td>0.145</td>
<td>0.247</td>
<td>0.263</td>
<td>0.239</td>
<td>0.248</td>
<td>0.219</td>
</tr>
<tr>
<td>Use of Technology</td>
<td>0.08</td>
<td>0.15</td>
<td>0.19</td>
<td>0.114</td>
<td>0.16</td>
<td>0.201</td>
<td>0.205</td>
<td>0.25</td>
<td>0.19</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>IV / DV</th>
<th>Product Quality</th>
<th>Flexibility</th>
<th>Sales</th>
<th>Net Profit</th>
<th>Cycle Times</th>
<th>Cash Flow</th>
<th>Claims</th>
<th>Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employee Participation</td>
<td>0.172</td>
<td>0.221</td>
<td>0.144</td>
<td>0.231</td>
<td>0.266</td>
<td>0.211</td>
<td>0.242</td>
<td>0.212</td>
</tr>
<tr>
<td>Use of Technology</td>
<td>0.205</td>
<td>0.186</td>
<td>0.093</td>
<td>0.14</td>
<td>0.23</td>
<td>0.13</td>
<td>0.209</td>
<td>0.188</td>
</tr>
</tbody>
</table>

Table 4: Comparison of adjusted R$^2$ values – Employee Participation compared with Technology Application - effect on outcomes resulting from implementation of B2B enabling technologies (Note: ANOVA indicates all Adjusted R$^2$ values significant at .001 level)

Use of the technologies has a strong and significant overall effect on B2B related outcomes.

This is a result that is not surprising given that it could be expected that use of the technology
would be a necessary pre-condition for realizing these benefits. It is, however, apparent that employee participation provides a stronger effect than the technology application construct for 15 of the 17 dependent variables. Given that investments in technology are usually justified on the basis of financial return, the implication for assessment of technology choice and risk assessment is important. It would appear that the effort currently put (in many organizations) into developing technology implementation strategies would be better informed by an assessment of the practices within the organization underpinning its use. It appears, on the evidence, that it would at least be as useful to look at involving and engaging the right mix of people, and developing an environment in the organization in which the use of B2B enabling technology can best be exploited, rather than just focusing on application of the technology alone. It is not uncommon for organizations to have an apparent belief that more investment will yield higher return. The evidence of this study, however, suggests that investment in cultural infrastructure to support higher levels of participation provides a more rounded strategic approach to implementation.
Comparison of Adjusted R² Values - Employee Participation vs Technology Application Construct - Comparative Effect on Business Outcomes Resulting from Use of B2B e-Commerce Enabling Technologies

Figure 1: Comparison of adjusted R² values – Employee Participation compared with Technology Application - effect on outcomes resulting from implementation of B2B enabling technologies

Discussion by Hypothesis

Hypothesis 1: Employee participation will contribute significantly to extent of benefits derived from the implementation of B2B enabling technologies

The results from both Table 4 and Figure 1 above support this hypothesis and provide evidence suggesting the importance of participation at all levels of the organization. The mean adjusted R² value for the 17 dependent variables for this construct of 0.213 indicating that on average 20%+ of the variance for this group of outcomes was being accounted for by employee participation. Further examination of the Beta coefficients for each multiple regression model was conducted to throw further light on which elements of this construct were making a more significant contribution. Table 5 below shows items from the Employee Participation construct making a significant contribution to variance in dependent variables.
Items Comprising Employee Participation Construct | Significant Contribution to Variance in Dependant Variable (Beta Value significant at .05 level or greater) | Total DV's Influenced
--- | --- | ---
When we develop our plans, policies and objectives we incorporate customer requirements, supplier capabilities and the needs of other stakeholders | Improved customer satisfaction. | 1
Senior managers actively encourage change and implement a culture of trust, involvement and commitment in moving toward implementation | Reduced finished goods inventory, reduced WIP inventory, reduced raw materials / components inventory, improved product traceability, improved stock accuracy, reduced time required for stock take, increased productivity, improved service quality, improved product quality, increased flexibility, increased sales, increased net profit, reduced cycle time, improved cash flow, reduction in claims, reduced costs. | 16
Champion(s) of change are effectively used to drive change in this organization | Reduced raw materials / components inventory. | 1
Our company has effective "top-down" and "bottom-up" communication processes | Reduced finished goods inventory, improved product traceability, improved stock accuracy, reduced time required for stock take, increased net profit, reduced cycle time, improved cash flow, reduction in claims, reduced costs. | 9
Extent of involvement during planning and implementation of: Senior Management | Improved customer satisfaction, improved product quality, increased flexibility, increased sales. | 4
Extent of involvement during planning and implementation of: Middle Management | Reduced finished goods inventory, improved product traceability, reduced costs. | 3
Extent of involvement during planning and implementation of: Front line Management | Improved customer satisfaction, reduced WIP inventory, reduced raw materials / components inventory, improved stock accuracy, reduced time required for stock take, increased productivity, improved product quality, reduced cycle time. | 8
Extent of involvement during planning and implementation of: General Staff | Reduced finished goods inventory, reduced WIP inventory, improved product traceability, improved stock accuracy, increased productivity, improved service quality, increased flexibility, increased net profit, reduced cycle time, reduction in claims. | 10

Table 5: Items contributing significantly (Beta value significant at .05 level or greater) to variance in dependant variables (outcomes resulting from implementation of B2B enabling technologies) – Employee Participation construct

The data in Table 5 indicates that of the ten items making up this construct, four stand out as having influence across the broadest range of outcomes resulting from the implementation of B2B enabling technologies. These are “Senior managers actively encourage change and
implement a culture of trust, involvement and commitment in moving toward implementation” (16 of 17 outcomes); ‘Our company has effective "top-down" and "bottom-up" communication processes’ (9 of 17 outcomes); “Extent of involvement during planning and implementation of: Front line Management” (8 of 17 outcomes); and “Extent of involvement during planning and implementation of: General Staff” (10 of 17 outcomes). The combination of a senior management team creating organizational conditions highly conducive to change, the involvement of operational staff, and the existence of effective two-way communication processes has intuitive consistency, and would seem to be plain common sense. What these results do is highlight the importance of these factors for effective technology implementation (in this case B2B technologies). It also indicates where different groups in organizations can exert most leverage. For senior management it is in creating the conditions for change by developing a culture of trust and exhibiting commitment. For operational staff it is to have first hand involvement during both planning and implementation. It could further be proposed that the culture of trust being promoted from the top is essential for there to be effective two-way communication between senior and operational management. The hypothesis that employee participation will contribute to benefits experience through implementation of these technologies finds strong support. It can also be implied that participation in the appropriate activities by those charged with different responsibilities will further enhance positive outcomes.

Hypothesis 2: Extent of use of B2B enabling technologies will contribute significantly to extent of benefits derived from implementation of these technologies

The results from both Table 4 and Figure 1 above support this hypothesis and provide evidence suggesting that use of the technology plays an important role in enabling realization of business
benefits. The mean adjusted $R^2$ value for the 17 dependant variables for this construct of 0.172 indicates that on average 17% of the variance for this group of outcomes was being accounted for by use of these technologies. Further examination of the Beta coefficients for each multiple regression model was conducted to throw further light on which technologies being used were making a more significant contribution. Table 6 below shows which items from the Use of Technology construct made a significant contribution to the variance in which dependant variable.

<table>
<thead>
<tr>
<th>Items Comprising Technology Use Construct</th>
<th>Significant Contribution to Variance in Dependant Variable (Beta Value significant at .05 level or greater)</th>
<th>Total DV's Influenced</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extent to which your organization uses EAN product numbering and barcodes: Outward Goods</td>
<td>Improved customer satisfaction.</td>
<td>1</td>
</tr>
<tr>
<td>Extent to which your organization uses EAN product numbering and barcodes: Work in Progress</td>
<td>Reduced finished goods inventory, reduced WIP inventory, improved product quality, increased sales.</td>
<td>4</td>
</tr>
<tr>
<td>Extent of use of EAN Location and Electronic Commerce Numbers: Legal Entities</td>
<td>Reduced WIP inventory, reduced raw materials / components inventory, increased flexibility.</td>
<td>3</td>
</tr>
<tr>
<td>Extent of use of EDI for the following applications: Remittance Advice</td>
<td>Reduced raw materials / components inventory.</td>
<td>1</td>
</tr>
<tr>
<td>Extent to which your organization uses EAN product numbering and barcodes: Incoming Goods</td>
<td>Improved product traceability, improved stock accuracy, reduced time required for stock take, increased productivity, improved service quality, increased flexibility, reduced cycle time, reduction in claims, reduced costs.</td>
<td>9</td>
</tr>
<tr>
<td>Extent of use of EDI for the following applications: Purchase Orders</td>
<td>Reduced time required for stock take, increased net profit.</td>
<td>2</td>
</tr>
<tr>
<td>Extent of use of EDI for the following applications: Sales Orders</td>
<td>Improved service quality, reduction in claims.</td>
<td>2</td>
</tr>
<tr>
<td>Extent of application of EAN ID numbers to: Locations</td>
<td>Improved product quality.</td>
<td>1</td>
</tr>
<tr>
<td>Extent of use of EDI for the following applications: Evaluated Receipts Settlement</td>
<td>Increased net profit, reduced cycle time, improved cash flow, reduction in claims.</td>
<td>4</td>
</tr>
<tr>
<td>Extent of use of EAN Location and Electronic Commerce Numbers: Legal Entities</td>
<td>Reduced costs.</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 6: Items contributing significantly (Beta value significant at .05 level or greater) to variance in dependant variables (outcomes resulting from implementation of B2B enabling technologies) – Technology Use construct
The technology application standing out as having the broadest range of influence on this group of outcomes was “Extent to which your organization uses EAN product numbering and barcodes: Incoming Goods” (9 of 17 outcomes). Combined with this is the influence exerted by application of the technology to work in progress, (“Extent to which your organization uses EAN product numbering and barcodes: Work in Progress” (4 of 17 outcomes)), with these two items accounting for variation in 13 individual outcomes items. This provides stark contrast to item one in this construct, namely “Extent to which your organization uses EAN product numbering and barcodes: Outward Goods” (only 1 of 17 outcomes). The reason why this contrast is important is that the survey results also indicated that application of barcodes to outward goods was by far the most widespread application for this technology. This is further highlighted when the mean scores for the three items relating to application of EAN product numbers and barcodes are compared. Table 7 below shows this comparison.

<table>
<thead>
<tr>
<th>Items relating to application of EAN product numbers and barcodes</th>
<th>Mean Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extent to which your organization uses EAN product numbering and barcodes: Outward Goods</td>
<td>4.01</td>
</tr>
<tr>
<td>Extent to which your organization uses EAN product numbering and barcodes: Work in Progress</td>
<td>1.67</td>
</tr>
<tr>
<td>Extent to which your organization uses EAN product numbering and barcodes: Incoming Goods</td>
<td>1.75</td>
</tr>
</tbody>
</table>

Table 7: Mean score for items relating to application of EAN product numbers and barcodes

The implication here is that the majority of applications of this technology are focused solely on placing barcodes on goods ready for sale to meet the requirements of customers. In fact the only outcome that this application was found to influence was improvements in customer satisfaction. On the one hand this is an outcome that is not surprising given that many organizations would be applying barcodes as a result of a mandate from trading partners (i.e. major retail chains in the FMCG sector). The problem, however, for organizations implementing this technology is that the results indicate that this practice is great for customers,
but adds little value operationally for the implementing organization. Where the real benefits materialize is through applications within the organization, and in particular with suppliers. In other words, this technology needs to be applied holistically across the supply chain for real benefits to be realized. Unfortunately, the evidence suggests it is not generally the case.

The application of EDI also provides some noteworthy results. Contributing to most variance in the outcomes variables was, “Extent of use of EDI for the following applications: Evaluated Receipts Settlement” (4 of 17 outcomes). The outcomes affected in this case were “Increased net profit, reduced cycle time, improved cash flow, reduction in claims”. The efficiencies offered by electronic links between trading partners are apparent in these results. The other two applications of EDI to have multiple significant effects on outcomes were “Extent of use of EDI for the following applications: Purchase Orders” and “Extent of use of EDI for the following applications: Sales Orders”. The former affecting “Reduced time required for stock take, increased net profit”, and the latter “Improved service quality, reduction in claims”. Both of these relationships make sense with electronic purchase orders providing greater efficiencies and sales orders improving customer service while enabling more effective claims management.

What was somewhat surprising was that a number of EDI applications, often quoted in the literature as providing substantial potential benefit to organizations, did not register any significant contribution to variance in any outcome variable. In particular, “Extent of use of EDI for the following applications: Sales / stock on hand / stock on order data”, and “Extent of use of EDI for the following applications: Advance Shipment Notices” were notable cases in point. Neither of these applications recorded any impact on outcomes in the multiple regression models used. This is despite there being no substantial difference in mean scores for level of
activity across the 7 types of EDI applications measured (see Table 8 below).

<table>
<thead>
<tr>
<th>Items relating to EDI applications</th>
<th>Mean Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extent of use of EDI for the following applications: Sales Orders</td>
<td>1.76</td>
</tr>
<tr>
<td>Extent of use of EDI for the following applications: Advance Shipment Notices (ASN)</td>
<td>1.63</td>
</tr>
<tr>
<td>Extent of use of EDI for the following applications: Remittance Advice</td>
<td>1.63</td>
</tr>
<tr>
<td>Extent of use of EDI for the following applications: Invoices</td>
<td>1.60</td>
</tr>
<tr>
<td>Extent of use of EDI for the following applications: Evaluated Receipts Settlement (EFT)</td>
<td>1.45</td>
</tr>
<tr>
<td>Extent of use of EDI for the following applications: Sales / stock on hand / stock on order data</td>
<td>1.51</td>
</tr>
<tr>
<td>Extent of use of EDI for the following applications: Purchase Orders</td>
<td>1.45</td>
</tr>
</tbody>
</table>

Table 8: Mean score for items relating to application of EDI

Conclusions

The findings of this research provide evidence supporting both hypotheses tested. The results also show that there are apparent differences in the effects recorded for each of the constructs. In particular, the evidence suggests that involvement and participation of different groups of employees, at different stages of implementation, can be a critical factor accounting for many of the outcomes organizations seek when adopting technologies of this type. This finding in particular resonates with previous studies that have shown a significant association between adoption of innovations, familiarity with technology based benefits and expectations from use (Venkatesh et al., 2003). As well, the evidence suggests that such a strategy (for deployment and involvement of employees), combined with use of the technology, can create significantly greater potential for realization of outcomes than just application of the technology alone. The potential for participation to enhance the potential the technologies offer lies not in a general involvement of all, but in clearly defined roles for different organizational groups. Senior managers were found to have most impact when creating organizational conditions conducive to open communication and experimentation. Operational staff, on the other hand could have most
impact if directly involved in planning, implementation and use. As such, the roles of these two groups could be seen to be complementary, and therefore creating greatest leverage, when participation is facilitated to reflect this. Use of the technology was found to be highest for bar-coding in the area where there was the lowest level of contribution to benefit recorded (application to outgoing goods). The evidence suggested that the more powerful applications of this technology lay with incoming goods from suppliers. This application, however, was observed to be at a very low level of use, indicating that significant opportunities were being missed in this area.

The importance of combining effective strategies for the reengineering of both social and technological systems is highlighted by this research. The real opportunities for improving the performance of organizations through technology application, and therefore their potential to compete more effectively, is apparent. It is also apparent, however, that the greater opportunity lies in the strategic application of technology with the active participation of all employees. Further, such participation needs to be managed with a clear understanding of the roles to be played by different organizational groups, and in particular where each should be focused in order to maximize potential benefit. As such, the management of the social system, and the understanding of the dynamics of that system, is pivotal to the effective implementation and use of B2B enabling technology.
Implications for Managers

When managers are looking to invest in technologies they usually do so with a view to improving operational and bottom line performance. The implications of this research for managers pursuing such objectives is that they would be well advised to address the social system issues as well as those relating to the technologies themselves. In fact, it is plausible to suggest it would not be possible to assess, implement and apply these technologies effectively without the necessary involvement and participation of various employee groups. This research indicates that participation of this type is not only a good strategy for B2B technology implementation, but essential to ensure the full potential of the technology is realized. Those managers that can resist the temptation to focus purely on the technologies themselves, and address the important human and social aspects of its use and application, can be expected to be better placed to leverage such investments.

Limitations and Opportunities for Further Research

This study has been limited to organizations operating in the Australian Fast Moving Consumer Goods (FMCG) sector. The results therefore need to be read in this context, and it would be useful if these hypotheses could be tested in other countries and different industry sectors. While it is apparent from this research that the relative importance of the constructs have been established (within the bounds of the sample), what is yet to be established is whether there are other important factors affecting the strength of the relationships observed. For example, the role of knowledge, and how it could affect both social and technological dimensions offers a
possible avenue of future enquiry. Knowledge may be pivotal in this context, particularly in the role of an important moderating or mediating factor. In other words, it is plausible to suggest that neither of the constructs would play as important role if levels of knowledge (i.e. of the technologies and their attributes) were low. As such, it may be that it is an important pre-cursor to effective implementation, or if it is not present the potential of the other three constructs to effect outcomes could be severely limited. The nature of this relationship would therefore provide fertile ground for further research.
References


