E-ERP: A Comprehensive Approach to E-Business

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ABSTRACT

The paper reports on the results of research carried out over the last two years on the state of e-business developments within ERP environments worldwide. Structured interviews were used to collect data in two stages. The first group of organisations was drawn from Australia and the results from this stage used to refine the data collection instrument. The second group consisted of relatively mature ERP based organisations from a range of industries around the world. The findings were analysed according to an established research framework from Business Process Change. This showed that while facilitators in aspects of e-business change management such as cultural readiness, knowledge and learning capabilities and relationship building were recognised by organisations, the extent to which they were incorporated as part of the implementation varied greatly. This suggests a rich field for future research study regarding the success of e-ERP projects.

INTRODUCTION

Numerous researchers have written about e-business and the impact this is likely to have on traditional modes of business operation. According to interviews conducted by Forrester Research with 40 senior IT and e-commerce executives, Electronic business will explode by 2002 because they expect 78% of their customers and 65% of their trading partners to have global electronic connections with them, up from 40% and 43% respectively. Online revenue growth has quadrupled each year. In 1998, it totalled $35 billion inter-company and $15 billion retail, worldwide. In 2000, out of 256 million users, 53 million buyers will average $4,090 each in e-commerce business (combined inter-company and retail). By 2003, online revenues will exceed $1.3 trillion (Hesterbrink, 1999: p3).

As more and more established organisations realise the need to form alliances with their customers, partners and suppliers over the Internet, integration with ERP systems becomes a critical issue. This combination of technologies offers **established** companies the opportunity to build interactive relationships with its partners and suppliers, improve efficiency and extend its reach, all at a very low cost. For example, GE estimates to save $500 million to $700 million of its purchasing costs over three years and cut purchasing cycles by as much as 50% (Hesterbrink, 1999: p3). Eventually, the company expects to buy the majority of its purchases through its Web-based bidding system.

Although these technologies have distinctly different functions, integrated they offer a sound infrastructure for doing business on-line (Venkatraman and Henderson, 1998). Here e-business means "making the key business processes of an organisation available over the Internet" (Boey, 1999: p1). Although simple, this definition nevertheless incorporates some subtle but key points about e-business applications with an ERP system (e-ERP). The primary beneficiaries of this e-business infrastructure are customers, business partners and suppliers, and employees. Figure 1 illustrates how these concepts relate to the core business-to-business (B2B) models, (adapted from Ash and Rossouw, 1999).

The paper reports on the findings from a multiple case study investigation of ERP enabled organisations that pioneered e-business projects. The key findings from each case study are captured into a theoretical framework taken from *business process change* research to derive an e-business change model. The model is then validated for future study of the broad and new complex phenomenon of e-ERP implementations.

Figure 1: Developments in e-ERP and Business Practice for doing e-Business
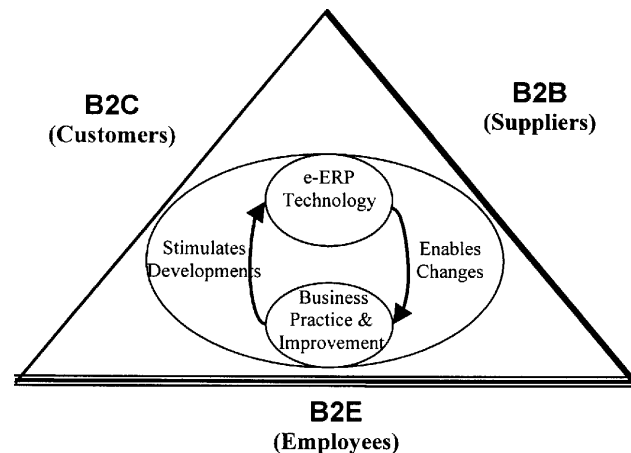
E-ERP IMPLEMENTATIONS

To achieve the maximum level of benefits from integrating an e-business application with an ERP package, it is important to understand from the outset the complementary nature of an e-ERP implementation. The stakeholders of an ERP system are potentially every employee in the company as well as key suppliers and customers. Typically, an ERP system in its final rollout will replace the majority of legacy systems and interface with the remaining systems. To the outside world however, the ERP system will be largely transparent, as it communicates with suppliers and vendors using traditional media or standard EDI transactions.

The main focus of the implementation will therefore be the integration of cross-company value chains using e-business tools. The importance of combining ERP packages with the Internet has a two-way benefit and return on investment. "Once Internet technology is efficiently integrated into the internal operation, its effective use for external interactions becomes a natural and easy *extension*. Without the internal infrastructure, external interactions will always be strained and limited" (Telleen, 1996: p.3). The coupling of these technologies is seen as "a shift from the traditional emphasis on transaction processing, integrated logistics and workflows to systems that support competencies for communications building, people networks, and on-the-job learning" (Manville, 1997: p.11).

Investigations of Local SAP Sites

In early 1999, ten Western Australian SAP-based organisations were contacted with a view to gathering information about the state of e-business developments within SAP R/3 environments. Significantly, SAP's R/3 system dominates the local ERP landscape. A structured interview approach using open-ended questions was used to capture information of current and future use of R/3 with Internet technology. In constructing an appropriate interview questionnaire, the issue of benefit maximisation was paramount and the focus of this was towards supply chain automation based around business-to-business models (Figure 1).

In general, the responses from IT managers interviewed revealed views and expectations of future developments similar to the key findings of the Nolan and Norton Institute Australian industry based study, (NNI Report 1998):

- Integration across the entire organisation is the key to large efficiency gains;
- Transparency of implementation and change process is important, both in terms of acceptance of the change and achieving the expected efficiency gains;
- Distinguish between striving to win new markets or customers and gaining cost efficiencies;
- Develop a benefits register and measure achievements against it.

Figure 2: Benefits from Internet extended SAP R/3 Implementation
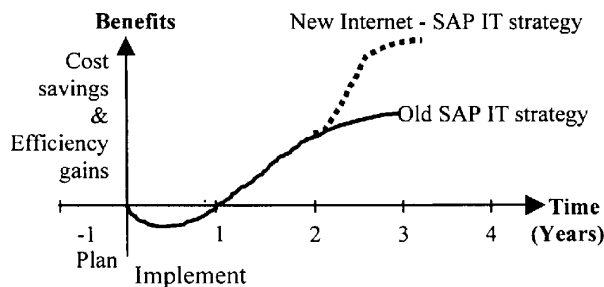
The information gathered from the 1st interviews gave rise to a generic IT strategy graph (Figure 2). The graph reflects the perceived benefits of a two-stage plan, where an R/3 implementation is followed by a second wave of Internet extensions. This evolutionary approach is observed to be the norm in Australia, for the "follower" type organisation (NNI Report, 1998). The findings below refer to the question; "What are the uses, benefits, barriers, and business drivers arising from the use of Internet technology integrated with a SAP R/3 system?" :

- Generally, the term used for the vertical axis "Benefits" was seen to include "cost savings" and "efficiencies" with internal processes.
- Most respondents agreed that Internet integration would lift the "Benefits curve", ie increase benefits, but the increase would not be exponential as shown by the dotted curve.
- The term "bolt-on technology" was used in regard to the Internet-SAP strategy. Again, this view undermines the notion that benefits could increase exponentially.
- Most respondents perceive that business integration with the web would raise efficiency.

These preliminary findings match those of the NNI Report (1998), where the actual benefits achieved from adopting e-commerce technologies have proved very disappointing. "The largest gaps between expected and actual benefits are related to supply chain, product development and customer service". It is in these areas of business practice where ERP systems are regarded as being traditionally strong.

Major Investigations of Overseas SAP Sites

Late in 1999, a further ten international SAP-based organisations were contacted with a view to gathering information about their use of SAP R/3, and in particular developments in Internet integration with their R/3 implementation. To identify the sites, a search using secondary literature, web sites, and SAP related industry consultants were conducted to identify major e-ERP projects. Tables 1a, b, c summarise the profiles of the organisations that participated in the study. The "e-business initiatives" selection criteria insisted each e-business project was to have significant organisational implications.

FINDINGS

The IT managers were interviewed to obtain a basic insight into each organisation's status of the use of Internet technology (web, intranets, extranets, and e-mail). They were questioned about "the benefits and barriers arising from extending their R/3 business processes onto the Internet". The findings are presented in the categories of the three basic business-to-business models (Figure 1):

- Business-to-Business (B2B) via Internet to support partners and suppliers
- Business-to-Employee (B2E) via intranets to support information/knowledge sharing.
- Business-to-Customer (B2C) via Web site to support customer interaction.

B2B e-Procurement ➜ Shorter lead times and lower costs

Table 1a: Case Studies on B2B projects

Alias	Size	Country	e-Bus	Project Title	Users
Biotech.com	Medium	UK	B2B	Staff research procurement	200
O&Gas.com	Large	Norway	B2B	Staff travel procurement	10,000 +
Pharma.com	Global	Switzerland	B2B	Sales Order Rapid Delivery	3,000 +

Key: Small < 100, Medium < 1000, Large (national), Global (multi-national)

With SAP B2B Procurement e-business solution, Biotech reported that "lead times to fill an order were shaved down from four to just one day – from the point in time when an employee identifies an order, to actual delivery". Having achieved shorter lead times, Biotech no longer needs to keep large stocks of materials, so expenditures are down and cash flow is healthier. Indeed, the company expects to save between ten and 15 percent on the cost of purchasing materials. Another goal of the business-to-business project was to build more long-term links with preferred vendors. So far, Biotech has identified three such vendors. Their Internet sites will be linked into the SAP procurement system, allowing Biotech staff to use e-procurement on the company 's own intranet and to purchase from both the internal catalogue and external online catalogues. This was made possible by a specially developed open catalogue interface. The procurement department already attributes one major success to its new procurement process: It has been able to increase the discounts previously offered by its three preferred vendors by a further five percent. But the benefits are by no means all one-sided. SAP B2B Procurement gives vendors plenty of opportunities, too, such as direct ordering. All three companies believe future benefits will come from industry portals, eg Chemicals, Oil & Gas marketplaces as follow:

- **To maximise the benefits** the notion of fast e-business adoption was emphasised. "Roll-out of the e-business solutions needs to be achieved very quickly for ROI". Also, there needs to be

"full cooperation between industry partners". "Collaboration between suppliers, to standardise item numbers. in catalogues. Further, "it is only with content that you gain a win-win, eg industry catalogues. This implies the importance of the B2B value chain. Finally, to make use of SAP's industry portal (via mySAP.com) requires "organisational culture change".

- **To minimise the barriers** (eg resistance to change) all suggestions were concerned with technical or more practical issues. This may have been provoked by an IT driven project mindset. The procurement applications need to be much more user friendly. They recommended "an upgrade to R/3 release 4.6" and "an increase in business application program interfaces (BAPI)s".

- **In the future**, all three organisations believe their ERP technology will play an integral part in helping these established enterprises build and operate online business-to-business models. Eventually their current B2B procurement will lead to industry specific e-marketplaces.

B2E Employee Self Service ➔ Improve quality of work life

Table 1b: Case Study of B2E projects

Alias	Size	Country	e-Bus	Project Title	Users
Bank.com	Large	Switzerland	B2E	Employee Info. Intranet	1,000 +
Employment.com	Large	Australia	B2E (B2B)	Employee self service +proc.	1,400 +
Engineer.com	Global	Norway	B2E	HR Employee Tracking	100 .
Media.com	Global	Germany	B2E (B2B)	Simple Ordering e-catalogue	1,000 +

Key: Small < 100, Medium < 1000, Large (national), Global (multi-national)

Three large established organisations in different industries implemented organisational intranets that combined with their SAP R/3 business processes. These solutions were easy to deploy while offering significant benefits from networked employees. Bank.com implemented the SAP Internet solution for internal address management. It covers all organisational information within the bank and is the most-used Web application, available for all 45,000 employees, with 300,000 transaction calls per day. It also implemented its own Intranet integrated with R/3 to facilitate the networking of the staff in the merger of two large banks. Banking is the main driver. "This is a generic back-office solution, not a SAP banking solution, to save time and paper for the distribution of staff information." It offers transparent access to important policy, manuals and procedure documents across all departments. "It also offers collective use of many functions" (Perez et al., 1999: p.49).

A major recruitment and employee services company, Employment.com, implemented SAP's Internet suite of employee self-service applications. This was used to network more than 1,400 employees in more than 200 offices, nation wide. It included an employee purchasing solution, "expected to realise considerable cost savings in our purchasing and human resources organisations over the next several years." It helped reduce administration tasks and paper (eg filling in forms, distribution of management information).

A leader in media sales and services world wide, Media.com implemented SAP Internet solutions to enable it "to further leverage its investment in its SAP system by extending the functionality of the R/3 system to casual users". This global integration strategy by networking the enterprise is viewed as "e-commerce survival". A change management team was commissioned to achieve this end. The numerous requests from various profit centres within the group for similar solutions showed a high level of acceptance from the user communities.

- **To maximise the benefits** the design of intranet interface has to accommodate the least trained employees. Requires concerted corporate focus. Managers and IT views must learn together (fast) to seek new business models. A recognition to create the Internet system as a **learning system**.

- **To minimise the barriers** increase the availability of supplier catalogues. Collaboration between suppliers, to standardise item numbers in catalogues. Easier linking of SAP data to Internet with a greater variety of BAPIs. "We need to understand the environmental factors including IT infrastructure." Corporate paranoia is in the minds of managers and consultants. Change management needs to be addressed and practiced.

B2C & B2B Customers/Partners Online sales ➔ Value added products and service

Table 1c: Case Studies on B2C projects

Alias	Size	Country	e-Bus	Project Title	Users
Charity.org	Small	Australia	B2C	Bus Admin via appln-hosting	unlimited
Scitec.com	Global	UK	B2C/B	Order Request System	unlimited
Society.com	Small	Australia	B2C	Online Store Sales	7,500 + members

Key: Small < 100, Medium < 1000, Large (national), Global (multi-national)

For Scitech the effect of integrating R/3 with Internet improved efficiency aspects of B2B sales worldwide. IT was the main driver in this B2B project. The system was developed to optimise processes between Scitech Computers and its partners and customers. Some 80% of orders (2200 key accounts) are handled by the ordering system with significantly reduced order errors.

Charity.org chose an application service provider (ASP) for its total IT support. This is the first ASP solution to use the Internet with R/3 in Australian. This infrastructure provided a fully integrated business "back-end" for the organisation's existing Web site, for the online sales of gift cards. It allowed for an improved product range (online), and a new business image. But "how do we let people know we have a web presence?" Some technical issues remain with matching their business processes with R/3.

Using SAP's suite of e-business applications, Society.com was "able to move its mail order business in a greater variety of directions without having to re-engineer its business processes, eg any time, anywhere". From the feedback through the web site (e-mails 20 to 30 per day), "we are beginning to understand what our members want even though we have not yet delivered this." Some technical problems, eg not enough business application programming interfaces (BAPI)s.

- **To maximise the benefits:** Communication between the two branches is an issue. Be more pro-active by making the web site enjoyable. Utilise synergy between industry networks, email lists, web links, and improve the e-learning capability on the web site. "E-nable" customers in ordering, using more visual power and through the development of an e-community. Empower staff in customer care service. Move from increased efficiency to improved effectiveness.

- **To minimise the barriers**: Publicity via e-mails and online catalogues. Improve the tracking of orders as well as resolve out of stock procedures. Some basic business issues were unresolved. Take charge of the ethical issues in credit taken from members before stock is processed.

Theoretical Framework of e-Business Change Management

In contrast to the West Australian cases the international cases showed signs of a shift from technology driven change to business process change for doing business online. Intranets integrated with

SAP R/3 were seen as the first Internet experience. They affected greater awareness of the business environmental factors. "We need to understand the environmental factors including IT infrastructure" (Guha's et al, 1997: p.121).

The relationships presented in the framework (Figure 3) are based on relevant work in organisational change, strategic management innovation, and information systems. The general thesis of the framework is adapted from Guha's et al, (1997) work on "Business Process Change Management".

This framework is used to map this study and as well as a guide for further study, aimed at identifying the facilitators and inhibitors for successful e-ERP implementations across multiple-case studies.

In order to avoid an original IT-centric position, e-business change (e-BC) is defined here as an organisation initiative to design an e-business project to achieve significant (breakthrough) improvements in performance. For example; "quality, responsiveness, cost, flexibility, satisfaction, shareholder value, and other critical e-business measures" (p.121). Such improvements are most likely to be realised through changes in relationships between; management, information, technology, and people - at the level of individual / team, corporate, and community (Venkatraman and Henderson, 1998).

Figure 3: Theoretical Framework of e-Business Change Management

(Adapted from Guha et al, 1997
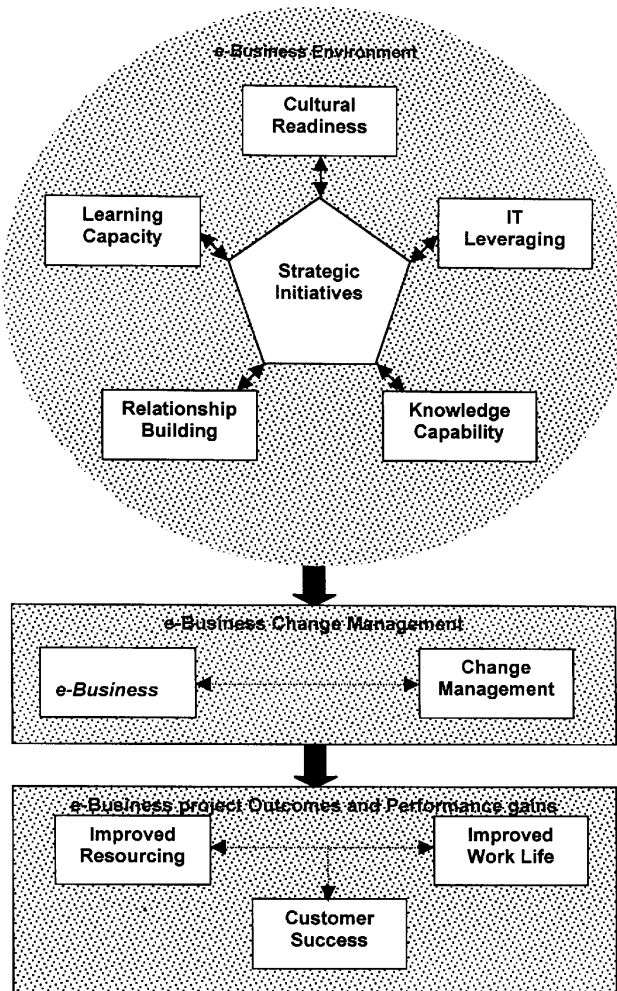
Antecedence of e-Business Change

In table 2, the initial findings of study are mapped onto components of the e-business framework (Figure 3). This mapping is used to verify and categorise the components of environmental and management factors. For example, only one company O&Gas.com referred to the need for cultural readiness - to maximise benefits, where as Bank.com complained about corporate paranoia - to minimise barriers.

Table 2: Summary Map of e-Business Change from Case Studies

Business Framework Components	#1 Bank	#2 Biotec	#3 Charit	#4 Emplo	#5 Engin	#6 Media	#7 O/Gas	#8 Pharm	#9 Scitec	#10 Societ
e-Business Change	Bus back-end	Cost, time saving	e-Bus. image	Admin cost saving	Staff Mgt saving	e-Com advant-age	e-Mkt advant-age	Cost, time saving	e-Com advant-age	Bus back-end
Environment										
Strategic Initiatives			+ve			+ve			+ & -	-ve
Cultural Readiness	-ve						+ve			
IT Leveragability	+ve			+ve	+ve	+ve			+ve	
Knowledge Capability		+ve					+ & -	+ve		
Relationship building		+ve						+ve		
Learning Capacity	+ve									
Management										
Change Mgt Practice						+ve	+ve			-ve
e-Business Mgt Practice	+ve						+ve		+ve	
Performance Measure										
Working life	+ve				+ve					
Business resourcing		+ve		+ & -		+ve	+ve	+ve	+ve	
Customer interaction			+ & -						+ve	+ & -

Key: -ve = minimise Barriers; +ve = maximise Benefits; + & - = both

Outcomes and Performance gains

Outcomes of e-business change (e-BC) can be measured at various levels within the broad complex phenomenon of an e-ERP project. In any examination of e-BC outcomes, consideration should be given to; (i) the environmental conditions for change, and (ii) the ability of the organisation to manage change in those conditions (see Table 2)..

To address these areas and issues effectively Kaplan and Norton (1992; 1996) offer the use of a balanced scorecard (BSC). The use of BSC for strategic enterprise management is a significant departure from traditional performance management programs that are to financial frameworks. The BSC provides that discipline that helps executive teams to articulate and better understand their strategies. In addition, the BSC enables organisations to introduce a new governance and review process that is focused on strategy and not on tactics. The governance process emphasises learning, team problems solving and coaching.

More recently, leading firms that have begun to undertake e-BC to meet strategic goals recognise that they only accomplish their objectives through people. If effectively managed, employees should ultimately be more productive in their work tasks and better able to serve customers, suppliers, and business partners. The key constructs that can be probed here are; gaps between effectiveness expectations (goals) and actual performance improvements, eg efficient company resourcing, quality of employee work life, customer satisfaction - from Venkatraman and Henderson's view of "virtual organising", (1998).

FUTURE STUDIES

In the future e-ERP technology will play an integral part in helping established enterprises build and operate B2B e-procurement solutions, that should eventually lead to the development of electronic marketplaces. Also, as e-business adoption becomes common place, corporate portals for empowering employees will be considered as an economic necessity. When these corporate front-end systems begin to look and feel the same, the real competitive advantage will ultimately come from the ERP back-end systems.

The next wave of economic advantage lies in revenue generation from business opportunities in new e-business models. As business strategy shifts from just cost savings to revenue generation, this research framework is recommended as tool for future study of the broad and new complex phenomenon of e-ERP implementations. A candidate area for future research is *e-business change and organisational performance, in ERP environments.*

In the next stage of the study all case organisations will be re-interviewed to gather information that will lead to identifying the facilitators and inhibitors for the success of e-business projects. The measure of success will focus on the outcomes of and performance gains of e-business change. The research challenge, then, is one of leveraging existing theory to circumscribe the research domain for examining diverse attributes of e-business adoption across multiple contexts.

CONCLUSIONS

The paper reports on the findings from a multi-case study of ERP enabled organisations that have pioneered e-business (e-ERP) projects. The paper reports on a study carried out during 1999 and 2000 on the state of e-business developments within ERP environments. Although these technologies have distinctly different functions, combined they offer a sound infrastructure for doing business on-line. We establish a theoretical conjecture; an e-business project built on the strong foundation of an ERP system, that can provide information for all business partners via the web, and can process incoming information from the customers and suppliers, is much more likely to succeed than one lacking this foundation.

The study was an exploratory investigation into the benefits from extending enterprise wide business systems beyond the organisation. The findings of the preliminary investigation of local Australian SAP sites confirmed the existence of the three generic business-to-business models: (i) B2B - to support information processing and communication, (ii) B2E - to support knowledge sharing, (iii) B2C - to support customer interaction on demand.

Analysis of the findings from interviews of ten overseas SAP sites, highlighted consideration of the environmental conditions and management of e-business change, when implementing e-business projects. For example, the capability to share knowledge, importance of the learning organisation, as well as the role of IT alignment between the ERP and e-business project. The key findings from each case study were mapped onto a theoretical framework, adapted from business process change research to validate an *e-business change* model, for future studies.

This research framework was chosen for its ability to examine complex phenomena. It is seen as evolutionary in nature, and was content driven. In order to avoid an original IT-centric position, we recommend the focus be on managing the change induced by e-business projects. We consider the framework to be a diagnostic tool for identifying factors contributing to success of new business models. It is NOT seen as a prognostic tool. It would appear to have some use by business professionals/consultants in e-business change projects.

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