

THE ROLE OF E-COMMERCE SYSTEMS FOR THE CONSTRUCTION INDUSTRY

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Introduction

E-commerce is being used extensively in other sectors of the economy, and examples include airline booking systems, Internet banking and online shopping malls. Some of these applications are more obvious to the public such as electronic banking. Banking on the Internet has grown rapidly, and customers can now access services such as balances, account transfers, bill payment, loan applications and investment planning. These developments have relied on the existence of a large market, a variety of services, and a need to store and communicate consumer data without having to rely on third parties. Obviously the market place in which our profession operates is not a mass market but the remaining two drivers have important implications for the profession. A recent report in the UK suggests that if the construction industry adopted e-business then they could expect to save up to 2.3% of building costs and reduce completion times by 15% (BuildOnline 2000). If savings of this magnitude could be realised in Australia then it would deliver significant benefits for contractors, professionals and other stakeholders.

There are two areas in which e-commerce systems are being utilised, firstly in the business to consumer (B2C) marketplace and secondly with business to business (B2B) transactions. The value of Business to Business activities exceeds Business to Consumer transactions by a ratio of 5:1, and this hints at the potential for B2B e-commerce transactions in the construction industry. These e-commerce systems require re-engineered processes, revised work practices, a re-skilling of staff, computer hardware and software and finally a connection to the Internet. A company

also needs a clear strategy and marketing approach to ensure that the systems deliver the desired level of returns.

While a range of IT systems can be found in most construction companies these normally include only fragments of the current range of e-commerce systems. The reasons for this include the high levels of investment required to operate these systems, the uncertainty of returns arising from these systems and the new skill sets required of staff. It is clear however that it will be necessary for these inhibitors to be overcome as e-commerce systems become more deeply embedded in the construction industry. As was suggested earlier the benefits are considerable, and they will flow to all of the stakeholders. Another likely outcome of the use of e-commerce in the construction industry is the creation of an information management role for one or more of the professional groups. The construction profession needs to be proactive in securing such a role, as there will be many others seeking to secure this management role.

The following sections of this paper will explain how the development of the Internet has supported application integration and the development of e-commerce systems, and how e-commerce systems are fundamentally changing the way in which businesses and customers are interacting. A number of examples will then be offered to show that e-commerce is not just a new technology, but also one that acts as a stimulus to seeking new ways of undertaking business. In a final section of this paper it will be argued that e-commerce systems will need to be embraced to secure an ongoing or expanded role for the construction profession.

The distinction between e-commerce and e-business

It is important to define the terms e-commerce and e-business since their use is often interchanged.

“E-commerce” is normally associated with buying and selling transactions that use some form of digital media. E-commerce data is transferred in a number of forms including legal documents, corporate data, project data, financial data and knowledge. Companies normally attempt to limit the distribution of this data to a specific set of recipients, and to prevent disclosure of this data to their competitors. Therefore e-commerce provides new ways to deliver information, services, financial and other business transactions.

While the use of e-commerce in Australia is still relatively low, financial institutions are now making changes to lower the transactions costs and to increase the security for transactions. Clearly financial transactions require an appropriate legal environment for the security of all parties, and similar concerns were overcome when the facsimile gained wide use. The Commonwealth Government has moved to address these issues in the Electronic Transactions Bill 1999. While it is not intended that this paper cover these issues in any great detail it will be shown that the intent of this legislation is to put electronic commerce and paper-based commerce on the same legal footing.

“E-business” encompasses more than e-commerce transactions, as it demands a review and redefinition of business models and a greater use of IT to maximise the value delivered to customers. This would normally require that an organisation review existing processes, develop new skill sets, modify corporate culture, accept a new level of risk taking, acquire new technologies and build new customer and business relationships.

These information, services and business transactions can be business to business (B2B) or business to customer (B2C). However it has been found that for every

dollar spent on business to consumer, business to business e-commerce spends five more. Therefore the focus of many companies is on ensuring the B2B transactions are operating effectively. Sloan and Low (2000) suggest there are three key stages of business-to-business e-commerce and these are provision of information, exchange of legally binding documents and electronic payments. As a company moves to a higher level of electronic transactions it is argued that business value is increased. Therefore e-commerce can be seen as a subset of a greater move towards improved business processes and the development of new services.

From software fragmentation to integration

Before examining e-commerce in more detail, it is necessary to understand how the evolution of personal computers and the Internet has provided a framework for business activities. The origins of the Internet can be traced back to the late 1960's when the US government funded a network of computers that would be used by researchers, government workers and defence contractors. The network protocol was named ARPAnet and this reflects the agency within the Department of Defence that provided the funding. In the 1970's ARPAnet was replaced with the TCP/IP protocol suite and this continues to be used for the Internet. The network grew the number of users, and electronic mail was a major application used in the early years. Cunningham (2000) suggests that the Internet has effectively been available for just fourteen years.

In the past two decades we have experienced substantial changes in IT, moving from a centralised model where computing power and applications were controlled and distributed to users, to one where the personal computer provided the user with control and flexibility in choice of applications, to a stage now where we appear to be cycling back towards a scenario with

more powerful computing power at server level, and less powerful workstations. The last change has also delivered LAN's, WAN's and connections to the Internet to users.

The fragmentation of software applications has effectively created 'islands of computing' and the computer industry has responded by building networking and data translation software. Bjork (1987) has described

these developments in terms of islands of automation, and he contends that developments in the past decades are focussed in distinct discipline based groups, and that over time integration of these applications will be achieved. Initially it was achieved by software bridges, and data exchange standards however the building product model was seen to be a major integration mechanism.

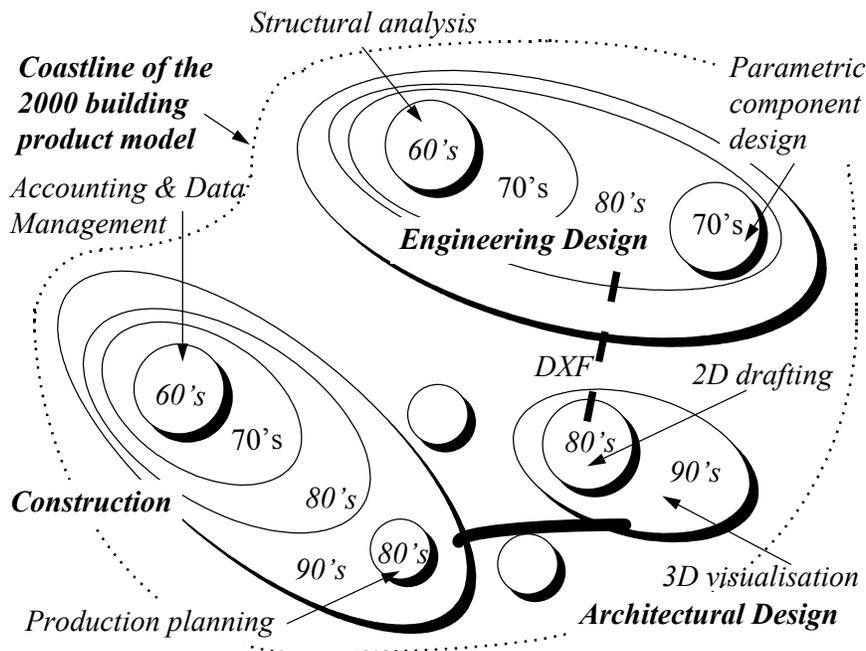


Figure 1 Islands of automation (Bjork 1987)

All of the islands described in his model including architectural design, engineering design and construction existed, and many of the applications can be recognised on typical construction projects. The model conveys an impression of evolution, a series of professional boundaries and integration, both horizontal and vertical, of all applications associated with each island.

It is evident that the fragmentation of professional roles has also generated a fragmentation of applications, and that the integration of applications is tenuous and relies on rigid data exchange standards. In the past decade computer users and software development companies have sought to introduce a number of integrating applications. Most computer users will be familiar with the integrated office suites, which are now being linked directly to web browsers and associated editors. A number of

construction applications such as Timberline demonstrate higher levels of application integration. The internet is also being used for integrating software applications and there are a number of web based project management systems and the BuildOnline web site (www.buildonline.com) is an example of this type of resource. In the past year two consortiums have announced the development of similar web based e-commerce hubs for use by companies in Australia.

The growth in Internet and e-commerce use in Australia

Obviously the use of e-business and e-commerce applications is limited unless

there is an available communications and technology infrastructure in place. In this section the current uses of the Internet and e-commerce will be discussed.

In the past ten years the Internet has been widely used by business and private users and it undoubtedly provides business with a considerable public communications infrastructure and a range of business applications. Recent forecasts suggest that Internet usage around the world is expected to grow to 268 million users by the end of 2001. The use of the Internet has also increased substantially in Australia and the ABS has published data that showed:

	Micro %	Small %	Total %	Medium %	Large %	All %
Businesses with access to Internet	17	24	19	49	85	21
Businesses with web site	2	7	3	18	50	5

Table 1 Proportion of businesses using the Internet, by size (ABS 1999)

The figures show that there was a relatively large number of companies using the Internet, and that the uses centred on communication and data transfer. A similar survey that measured the business use of IT reported that the proportion of businesses using computers rose to 63% in June 1997 (ABS 1999).

While all large businesses (200 or more employees) and 94% of medium sized businesses (20-199 employees) used computers, the proportion for all small businesses (less than 20 employees) was 60%, and for 'micro' businesses (less than five employees) 56%. One in three businesses had used computers for five years or more, and one in ten had used them for less than two years. (ABS 1999)

Another report (NOIE 2000) suggested that large Australian businesses have nearly reached saturation point in terms of Internet adoption and are nearing saturation in home pages. It was also reported that 21% of Small Manufacturing Enterprises (SMEs) connected to the Internet were engaged in Internet based sales, and 22% were actively placing orders for goods and services. It was found that small businesses in Australia had much lower levels of connections to the Internet, at 48%, than medium size firms at 82%. All companies with 100 or more employees were using computers, and of these 87% have access to the Internet, and 58% have a home page. Companies with incomes exceeding \$500 million are all using computers and have access to the Internet. Most of these companies also have an Internet presence that included a home page.

The building and construction industry lags other industries with 80% of companies using computers, and only 43% of companies had Internet access and less than 14% of construction companies had a home page. This may be explained by the complex nature of communication on construction projects where only limited agreement and adoption of electronic data standards and systems has been achieved. For example the documentation of projects is often undertaken using a variety of CAD systems, and something as simple as the layering standards and description of objects continues to limit the exchange of drawing data.

Other studies have found that while IT is used to generate considerable quantities of construction information, most is distributed in paper-based form. Electronic data interchange (EDI) and common data standards such as STEP offered a number of benefits however the construction industry has not yet adopted these technologies to the same levels that other industries have. Other developments promoted by the IAI to develop and implement international standards in the construction industry are yet to deliver the necessary level of change. Fortunately the wider use of computers, Internet and the related open communication standards are likely to remove a number of the existing communication infrastructure barriers, reduce setup and operating costs and permit more flexibility in these communication activities. There are also a number of web based project management systems being used in the UK and US, and these suggest future directions for the Australian construction industry.

In the past two years increased accessibility of the Internet and lower connection costs have motivated companies to move EDI transactions from private networks to the Internet. This supported by the ABS report that found that:

About 5% of businesses had a web-site/home page at June 1997... the

main uses of the Internet were email and information gathering. Only 1% of businesses used the Internet for selling or purchasing goods or services...Internet commerce currently comprises a small proportion of all electronic commerce in Australia. The number of electronic commerce transactions is large; in 1997 there were 1.5 billion such transactions in Australia. Their value was about \$16,000b, the bulk of which related to payments and clearances (valued at \$15,300b). There were 500 million EFTPOS transactions, with a total value of \$27.5b and an average value of \$55, and 600 million direct entry transactions, with a total value of \$540b and an average value of \$900. Consumer Internet transactions were valued at about \$55m.(ABS 1999)

It is apparent that the potential of e-commerce is now being realised. The NOIE report (2000) disclosed that an additional 49% of SMEs were interested in adopting e-commerce and 70% of those interested intended to do this within a year. Therefore one of the major findings of this report was that continued growth in both business to consumer (B2C) and business to business (B2B) e-commerce was likely.

Therefore the Internet is becoming a major impetus to the development of e-commerce in Australia, and the following table categorises categories of Internet applications by the degree of interactivity and by media richness. As can be seen in Table 1, as applications become more dynamic then the richness of media content increases, and this is further enhanced, as applications become real time and bi-directional.

It is interesting to note that applications with higher levels of interactivity tend towards the B2C e-commerce type, and that B2B e-commerce applications have lower levels of interactivity and often of the basic bi-directional level and static media type. This is expected given that the common use of B2B e-commerce in the construction industry would involve a

Interactivity		Increased media richness (→)	
High (Real time, multidirectional)		Inter relay chat	Video conferencing, internet phone
Extended (Value added, multidirectional)		Discussion forum, classified ad. Financial transaction	Collaborative working, virtual reality
Basic (Bi-directional)		Internet, fax and email	Video mail, voice mail, interactive television.
Reader service (Unidirectional)	Web banner, content index, online directories	Web content, company portfolios, product information	Live broadcasting audio streaming
	Abstract (multimedia segments)	Static (Picture, text)	Dynamic (Video and voice)

Table 2 Interactive service attribute matrix (Sloan and Low 2000)

number of structured and standardized transactions. Obviously the exceptions to these general rules are applications used for video conferencing or virtual team meetings.

While it may be difficult for Australian practitioners to appreciate how the construction profession may participate in current e-commerce developments, practitioners could offer much of the contract documentation in electronic form, by implementing higher levels of electronic communication and by increasing the levels of electronic lodgement for claims and other documentation. The "www.BuildOnline.com" and "www.VirtualSTEP.com" collaborative web sites provide examples of these systems from the UK and USA respectively.

Drivers of e-business

In the past five years the use of e-business systems has increased, and these systems are becoming more common in business and private transactions. There is no single driver for these developments, and the following table lists a number of these drivers.

As can be seen in table 3, the major changes in consumer expectations derive from automation of processes and the integration of services. The remaining drivers apply to B2B transactions, and these focus on automation, process and informational improvements. Many of the service/process and organisational trends can be related directly to the construction industry. However if we were to review the enterprise technology trends in the context of the same industry then it is evident that a number of these have yet to impact on an industry that lags the technology levels of other industry sectors. For example the convergence of infrastructure can be seen in some of the major companies but is lacking in many of the smaller companies. The integration of computer, telephony and voice recognition is uncommon as is the application of wireless applications. Therefore the impact of these trends is likely to be localised and delayed until companies adopt these technologies more widely.

E-business designs

The adoption of e-business systems is often undertaken with a focus on maximizing value and reducing the risks associated with implementation. There are essentially three basic e-business designs that can be used:

Drivers of e-business	
Consumer trends	Speed of service
	Self service: removal of intermediaries
	Integrated service
Service/process trends	Convergence of sales and service: acquire and retain customers, narrow the sales/service gap
	Ease of use: consistent and reliable information, single points of contact
	Flexible fulfillment and convenient delivery: streamlined supply chain
Organisational trends	Become brand intensive not capital intensive
	Retain the core processes and outsource the rest
	Increased process transparency and visibility: permit customers to track progress
	Continuous innovation and employee retention
Enterprise technology trends	Enterprise applications: connect the organisation
	Infrastructure convergence: merge voice, data and video
	Multi channel integration of systems: includes computer, telephony and voice recognition
	Wireless applications as an alternative to wired technologies
	Leveraging legacy investments to make data accessible across the organisation

Table 3 Drivers of e-business (Kalakota and Robinson 1999)

- Service excellence - by delivering what the customers want, with superior value. The drivers include consumer expectations such as speed of service, greater use of self-service, the integration of services and permitting customers to track progress.
- Operational excellence - by delivering quality products quickly but at reasonable prices. The drivers include narrowing the sales/service gap, a streamlined supply chain, outsourcing of non-core processes, leveraging legacy investments to improve information transfer and the use of new technologies to integrate systems.
- Continuous innovation excellence - by delivering products that extend performance boundaries and high value to customers. The drivers include continuous innovation and employee retention, the development of integrated service, flexible fulfillment and convenient delivery systems and increased process transparency.

The following table provides a number of e-business examples from a wide range of industries. Each of these examples contains a player, product and description of a process.

It is clear that companies can be the traditional or a virtual player, but either of

Player		Product		Process	
Physical	Virtual	Physical	Virtual	Physical	Virtual
	amazon.com	Books		Logistics	Marketing, ordering, payments
	emfinance.com		Mortgage		Mortgage applications and processing
DETR and BRE	Material info exchange	2 nd hand and un-utilised materials		Logistics, payment pricing	Information, matching buyers and sellers

Table 4 New business models of e-commerce (Sloan and Low 2000)

these can deal with physical and virtual products. The physical products have a requirement to transform raw materials into a product using some form of production process. The virtual product could be a financial transaction or arrangement such as a mortgage or reprocessed information. There can be both physical and virtual processes used in generating these products.

The example for DETR and BRE illustrates a construction related e-business design where a physical product (surplus and secondhand materials) is traded using a virtual marketplace, using both physical and virtual processes. This application demonstrates a hybrid model where both physical and virtual components contribute to an improved business design. Other examples that construction professions will be familiar with include web based project management systems, the provision of cost data and advice and electronic tendering portals.

There have been two recent announcements of B2B e-commerce services in Australia and each is supported by a number of major construction companies and associated finance and consulting organizations. The drivers for these developments appear to have come from the need to share the costs of development and to provide

companies with the opportunity to electronically procure goods and services. Both of these initiatives include supplier and sub contractor representatives and other industry stakeholders. Similar announcements have also been made in the UK, Europe and these also seek to deliver a range of services to a virtual construction community. It should also be recognised that these systems are by their nature "borderless" and that companies with offices and projects in different geographic locations, as well as global competitors can make use of these services. The types of services in the systems include:

- Online tendering
- Online procurement
- Online project collaboration
- Online auctions
- Online contractual agreements
- Online payment, and
- Online information services

One major assumption of these new e-business systems is that existing processes will be reviewed and re-engineered to make use of the benefits of new technologies.

Transforming a traditional process design into an e-business design

The opportunity to derive competitive advantage from strategic IT systems is

higher in industries where IT infrastructures of competitors are less developed or when they are not seen as a core competence. Weill and Broadbent (1998) suggest that competitive advantages will be sustained for only two to three years before competitors copy or improve the innovation. These periods will obviously depend on the nature of the IT systems, the extent to which competitors can source similar applications and the willingness of staff to adopt new business processes. Porter (1985) suggests that the phrase "technology diffusion" could be used to describe the duration of the lead-time for other companies to take up new technologies. Technologies that incorporate these links or separately developed proprietary technologies slow diffusion rates and enhance long-term competitive advantage. Therefore the initial users of IT have advantages, although other users can dissipate these advantages through aggressive investments. Advantages for initial users include: the ability to create and control the development of standards for the technology; the achievement of legal protection for proprietary systems and early profit taking. Companies who adopt the same or similar IT systems may have to invest heavily to neutralise the first mover advantages. The disadvantages associated with first movers are normally associated with costs and risks relating to user acceptance and reduced costs of technology as it matures.

The issue of seeking to attain technological leadership is also an important decision for companies. Hansen and Tatum (1989) contend that every company is either a technological leader or follower, and that the choice is determined by a combination of three factors, the sustainability of technological lead, first mover advantages and first mover disadvantages. The value of these new IT systems comes from the enabling of new applications that in turn create business value. There are a number of examples of construction companies who have sought technological leadership (Construct IT 1997) however it is clear that these companies have also introduced re-

engineered processes. Some construction companies in Australia have also committed to a continuing investment in technological advancement and organisational change (DISR 1998). Many of these companies have succeeded in staying ahead of their competitors by moving beyond automation of existing processes to a position where they re-engineer their organisation as well.

The following steps can be used when considering which processes could be transformed to generate increase value. It is important to ensure that you understand what customers value or care about, as it will be increased value that will help to deliver increased competitive advantage. Once this has been established then it will be important to review the range of existing and emerging technologies, and the ways in which these can be used to re-engineer existing business processes. Many of these new technologies will require substantial levels of process change, and it is imperative that the company makes a realistic assessment of the feasibility of these changes. The next step is to decide what business designs will deliver higher levels of value to the major customer groups, and what resources are required to create these experiences. Once the new processes have been identified it is necessary to examine the extent of organizational change required if these new processes are to be successfully adopted. The final step is then to plan the implementation of these changes and to ensure that adequate levels of resources are provided.

Examples of IT being used for competitive advantage

A recent report (DISR 1998) provides two examples of companies who have used IT to achieve competitive advantage, and these are Flower and Samios and National Engineering. Flower and Samios have re-engineered its business processes to obtain maximum benefits from the technology:

“By developing and maintaining a 3D model of the design from the outset, relevant drawings and documentation can be ‘peeled off’ the model at different stages without further work. Designs are easily amended, with instantaneous updating of elements of the model. Integrated use of multimedia packages has meant ease of communication of designs to customers. Furthermore, the combination of land modelling, measurement and costing capabilities in their systems has meant that they are not only faster, more efficient and more accurate, but that there are enhanced capabilities to manage and control the contracting and project administration process. Communications with suppliers and consultants is increasingly electronic, with e-mailed CAD drawings and documents now the norm.” (DISR 1998)

Future developments are likely to have a far greater impact on the company and the other companies they work with:

“John Flower foresees that in the near future, those external consultants involved in a project will access the 3D model of the project on the firm’s server, and will undertake their specialist component of the design work on-line, while having read-only access to the rest of the model. “When all the parties are working concurrently on a project in this way,” John comments, “they will transform the industry.””(DISR 1998)

The second example provided in the report comes from the construction contracting sector and it describes a substantial communication based development. National Engineering has developed IT systems to enable rapid communications and exchange of information while increasing value in the design, manufacture and construction processes. In one area the company uses CAD-CAM (computer-aided design and manufacture) systems to manufacture complex steel structures. Steel cutting and robotic welding machines are able to derive the measurement and shape information from the CAD drawings.

Drawings and many other documents are stored and transmitted electronically and this both improved productivity while removing delays in distributing information to a geographically dispersed project team.

The BuildOnline web site provides a series of case studies that can be used to illustrate the competitive advantage of adopting e-business systems. One of the cases relates to project collaboration and it describes the exchange of contract documentation with a geographically dispersed design team. The major benefits realised by the project team were:

- A substantial increase in the speed of communication associated with the electronic transfer of documents
- Increased accuracy of communications with reduced errors and rework costs.
- Substantial reductions in travel costs that would have been high given the dispersion of consultants.
- Reduced copy for reproduction of hardcopy documents, distribution and storage.

The second case study from BuildOnline related to the letting of a scaffolding contract, and it describes how e-business systems were used to electronically tender this work with five potential suppliers. Photographs and a detailed description of the works were provided on the web site, and suppliers were able to view these documents and respond to the RFQ. The benefits included reduced time for tendering the project, and reduced costs for suppliers to bid on the project.

Benefits of adopting e-commerce

All of the stakeholders in the construction process can benefit in some manner from the introduction of e-commerce. These benefits will be described in more detail in this section of the paper. Firstly the NOIE report included a number of macro economic forecasts relating to the higher

use of e-commerce, and the key benefits for the economy were:

- An increase in national output (GDP) by 2.7%;
- Real investment would increase by 4%;
- Consumption would increase by 3%;
- Real wages would increase by 3.5%;
- Aggregate employment would increase by 0.5%;
- Real exchange rate would increase by 2%.

This report (NOIE 2000) also forecast that the greatest usage of the internet by business will be between businesses, since e-commerce offers savings in inventories, shipping, reporting, sales transaction and customer support. It has been also forecast that the number of companies in Australia who are active in e-business will increase up to five times and this will result in more than 40,000 companies using e-business by 2005 (NOIE 2000). Howarth and Skotniki (2000) also suggest that e-business alters business value since it offers increased transactional speed and eliminates many manual activities.

“In general, e-commerce seems to offer the prospect of moving economic activity closer to some of the ideals of perfect competition: low transaction costs, low barriers to entry, and improved access to information for the consumer. It may significantly lower prices while improving quality. In doing so, e-commerce may significantly improve the efficiency of economies, enhance their competitiveness, improve the allocation of resources and increase long-term growth”. (DOCITA 2000)

Many of these outcomes would in turn deliver the construction industry increased levels of activity and profitability. A wide range of benefits for stakeholders in the construction industry have been suggested (BuildOnline 2000) and these include:

- Lenders – improved project transparency and improved risk management
- Owners/Developers – lower contingencies, increased project efficiency, reduced construction cost, reduced construction periods
- Designers and other consultants – time savings, improved communications, accuracy and specification
- Contractors/Sub-contractors – lower costs, time savings, increased control, enhanced communication and procurement processes
- Suppliers – lower inventories, reduced costs
- Manufacturers – reduced supply chain costs, improved information, purchasing and supply processes

The impact of e-commerce and e-business are far greater than the generation of benefits from improving the efficiencies of transaction processing, they are transforming the processes used in many industries.

“It is already clear that e-commerce will bring significant changes to business, consumers, government and the economy. Companies are changing the way that they undertake their business. New industries are emerging and old ones are getting a new lease of life. Others may not fit in this new environment and may decline.” (NOIE 2000)

Internal and external impacts of e-commerce

There are essentially two major categories of impact, internal effects such as the replacement of manual processes and external effects such as the flattening of marketing and sales structures. It is argued that these effects can offer up to a 30% cost savings for business (Howarth and Skotniki 2000). The potential impact of e-business on employment levels is not clear as the employment levels in the

banking and finance sector have been mostly static while the sector has increased its share of GDP from 6.6% to 7.6%. Given that many sectors of the economy have high employment levels, the introduction of these technologies could result in reduced employment levels. These views are countered by supporters of e-commerce suggest that it will lift aggregate employment and productivity gains will raise real wages.

The NOIE (2000) report argues that the greatest usage of the Internet is likely to be between businesses (B2B), and that business to customer (B2C) levels will be significantly less. There are a number of examples of e-business systems introduced by Australian companies and the system introduced by Mosaic E-Commerce Solutions offers an online marketplace for companies to offer procurement contracts to tender (Foresheew 2000). Lend lease, an Australian property development company, has also launched a financial product on the Internet which offers personal portfolio services (Kirby 2000). Therefore IT strategies including the use of the Internet and e-commerce are becoming essential ingredients in a competitive strategy, given that they can offer sustained competitive advantage.

Summary

It has been shown that e-commerce is now becoming widespread in its use and a number of stakeholders in the construction industry have also commenced developments in this area. The growth in the use of Internet and e-commerce in Australia suggests that the construction industry will become users of these technologies, and that when this occurs it will have a significant impact on the manner in which production takes place.

The drivers of e-business were show to be predominantly service/process, organizational and enterprise technology trends. A number of e-business designs were described and examples were provided to show how e-business opportunities could be mapped into a process and product matrix. Companies in

the construction industry can therefore use these tools to identify e-business opportunities for their specific areas of operation. A process for transforming a traditional business design into an e-business design was discussed and again construction companies can use this. It is however important that before any new business application is developed that the value framework of the client be reviewed, to identify potential technologies. Once this is complete it is necessary to review the capacity of the company to introduce these new systems.

While it is currently the larger companies that are championing these developments, it is clear that the many stakeholders will engage with e-commerce systems in the future. While the wider use of e-commerce exchanges could lead to a polarization of stakeholder communities, and threaten the roles of middlemen, Sloan and Low (2000) suggest that these developments may offer new strategic opportunities that could be used by current intermediaries to strengthen their position.

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