E-Business Adoption in Construction: International Review on Impediments

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ABSTRACT

The adoption of e-business by the Australian construction industry lags other service and product industries. It is assumed that slow adoption rate does not reflect the maturity of the technology but is due to adoption impediments peculiar to the nature of construction. This chapter examines impediments to the uptake of e-business nationally and internationally. A systematic and extensive literature search of impediments (also referred to as obstacles, impediments or hindrances) to adoption has been undertaken and the findings discussed in this chapter. This review included more that 200 documents and these have been published in a searchable database as part of a larger research initiative funded by the Cooperative Research Centre for Construction Innovation.

The influence of levels of e-business maturity seen in other sectors such as retail, tourism and manufacturing was also captured and a number of major impediments were identified some including: privacy, trust, uncertainty of financial returns, lack of reliable measurement, fraud, lack of support and system maintenance. A total of 23 impediments were assessed in terms of impact to organisational type and size across reviewed documents. With this information it was possible to develop a reference framework for measuring maturity levels and readiness to uptake e-business in construction.

Results have also shown that impediments to e-business adoption work differently according to organisational type and culture. Areas of training and people development need to be addressed. This would include a more sensitive approach to the nature of construction organisations, especially to those small and medium enterprises. Raising levels of awareness and creating trust for on-line collaboration are other aspects that need attention, which current studies confirm as lacking. An empirical study within construction, to validate these findings, forms the subsequent phase of this research.

1. INTRODUCTION

"Using Internet-enabled technology can result in quantifiable benefits in terms of increased revenues, reduced overheads, greater efficiency and happier customers."
[e-MORI, 2001]

The adoption of e-business by the Australian construction industry lags other service and product industries. It is suspected that the slower adoption rate does not reflect the maturity of the technology but is due to adoption impediments peculiar to the nature of construction. In later sections of this chapter the findings from a systematic and extensive literature search of impediments to adoption is presented. Since the term "barrier" is most frequently found in the published literature it has been used for this research.

The documents in the literature review included a wide range of publicly available surveys, statistical data, governmental and industry reports and refereed articles from journals on 'e-business', 'e-commerce', 'electronic transactions', 'electronic supply chains' and related topics. As there is now a substantial depth of published international e-business experience, refereed journal papers and official reports from Europe, the US and Canada were also included in this literature review. The focus of these documents was not solely on the construction industry, as adoption experiences of other sectors can be used to identify major impediments across other sectors.

The literature review found that impediments to e-business adoption vary based on company size and business service type. It also found that e-business adoption models could not be implemented successfully by organisations without firstly matching the model to business needs and organisational capability. This can be explained partly by differences in the structure and size of businesses, access to resources, staff competencies and the manner in which organisations deliver services and products to their customers or clients. For this reason a number of e-business adoption models relevant to the construction industry are discussed. Because the impediments to e-business adoption have different impacts, they been categorised in terms of their *'impact levels'*. A number of diagrams in the following sections of this chapter will illustrate the relationship and level of impact of individual impediments based on business type and size (such as SME, contractor, consultant and supplier). Finally a reference framework for measuring maturity levels and the readiness of construction organisations to adopt e-business systems is presented.

In the following section we will define the key terms and the context for impediments to e-business. It should be noted that since the focus of this research was *'environmental'* rather than *'technical'* issues to e-business adoption, the literature review focussed on impediments arising from the nature of the industry, such as *culture*, *economic structure*, *industrial relationship constructs*, and Environmental constraints such as *company values*, *knowledge and skills development, technology adoption policies, industrial relations* and *the nature of construction supply chains*.

1.1 A Definition of E-business

The term *"e-business"* is commonly used to describe Internet-enabled systems that provide information, facilitate transactions or provide shared business processes (Bloor Research, 2005). The Department of Commerce (2002) argue that e-business technology typically supersedes either paper-based systems or Electronic Data Interchange (EDI) to provide an improved communication channel between business partners. Other definitions of e-business that are evident in other industry sectors include:

- the undertaking of business related transactions and information exchanges utilising an electronic format and environment (e-MORI 2001).
- the creation of networks that act as electronic supply chains (NOIE 2001a); and
- the creation of commercial efficiency with subsequent benefits for all stakeholders (Ribeiro 2001).

Clearly there are a variety of perceptions existing in industry, and NOIE (2001b) confirms that misconceptions of e-business terms are still an issue. They explain that the mis-conceptions include the lack of understanding of the difference between 'e-business' and 'e-commerce'. E-commerce is essentially a part of e-business concerned with financial transactions and therefore does not require shared or redesigned business processes. It is further argued that by integrating business processes, then consultants, contractors and the wider supply chain can perform more efficiently and reliably; supply chains can be consolidated; and the long term relationships between participants in the construction process can be enhanced. For the purposes of this research we have adopted the NOIE (2001c) definition for e-business namely "the facilitation and integration of business processes".

1.2 E-business Process

"….the concept of e-business is slowly being embraced by the construction industry because it would appear that security issues, financial costs, changes to existing business practices, and a lack of management commitment are the major barriers to its adoption"

[E-business Watch: European Commission, 2005]

There are a number of processes that can be associated with e-business and the following table lists and defines the four of the major processes related to e-business (NOIE 2003).

Table 1 E-business process (NOIE 2003)

Process	Description
e-procurement	Procuring direct or indirect projects, parts, components, materials, plant services, experts and manpower, as well as handing added services. Disseminating and gathering information about projects, components, services or plant.
e-transactions	Transactions across the space between the buyer and seller in the supply chain involving, projects, parts, components, materials or plant
e-logistics	Delivering parts, components, materials, plant, information, energy to the point where they are needed
e-collaboration	Facilitates coordination of various decisions and activities beyond transactions among supply chain partners. Collaboration among teams in a virtual space such as collaborative design, planning and project management. Information across business partners such as order, invoices or plans and specifications.

The e-business process applies to three main types of relationships namely, Business-to-business (B2B); Business-to-client (B2C) and Business-to-government (B2G). NOIE (2001) contend that Business-to-business (B2B) e-commerce is considered to have larger impacts across the economy than business-to-client e-commerce. Typically, B2B e-commerce is about transforming the back office functions of firms to make them more efficient and this in turn impacts along the entire value chain of an industry. Therefore the focus of many companies is on ensuring the B2B transactions are operating effectively.

The B2G e-business relationship is focused on improving the quality of government services to the business community through the rationalisation of licensing, compliance and enforcement activities. Clearly these relationships are often present in construction activities, and a different set of impediments may exist for each circumstance. NOEI (2003) illustrates e-business *up-take differences* across various industry sectors (see Table 2).

Table 2 Adoption steps by sector (NOIE 2003)

	All	Manufacturing	Building & Construction	Wholesale Retail	Transport Storage	Business Services	Personal Services
Use Computers	85%	81%	77%	81%	85%	94%	85%
Internet connected	61%	59%	50%	51%	60%	81%	59%
Place orders using the Internet	17%	14%	7%	17%	17%	22%	20%
Make payment on the Internet	12%	11%	6%	11%	10%	15%	12%
Receive orders using the Internet	15%	14%	6%	15%	25%	15%	20%
Receive payment using the Internet	7%	8%	2%	7%	8%	8%	8%

The initial steps towards e-business up-take include use of computers, Internet connection, placing orders using the Internet, making payments on the Internet, receiving orders using the Internet and finally receiving electronic payments. It is clear from these results that the construction industry is at the very early stages of e-business adoption, and that this lags the adoption levels of other industry sectors. An interesting observation that can be made is that the construction industry has high levels of interaction, and that at the higher stages of adoption requires lower levels of interaction.

The impediments to e-business adoption appear in different ways across the industry sectors and within particular segments of each industry. It is likely that the drivers for a large contractor to use e-business systems will be different to those by consultants or small businesses. Therefore a deeper understanding of these impediments and how they impact organisations within the construction industry should help organisations make informed decisions regarding the use of e-business systems. This in turn should help to improve the overall performance of the construction industry.

2. CONTEXTUALISING IMPEDIMENTS TO CONSTRUCTON

"A priority is to ensure that barriers to equitable access to the online world are identified and addressed, if the broad benefits of the information economy are to be realised."
[NOEI Australia's Information Economy: The Big Picture, April 2002].

In contextualising impediments to e-business Cheng and Love (2001b) suggests that 'barriers' to e-business adoption behave in particular ways depending on the characteristics of the business such as the industry, business type and organisational culture. Khalfan (2002) highlighted the importance of contextualising impediments by sector, activity and organisational and personal profiles. For example, the Department of Innovation, Industry and Regional Development (2002) found that *training* would mainly be a barrier for small businesses but typically becomes an enabler for the larger organisations – where formal training agendas tend to be in place. However *cultural change* and *implementing new systems* become impediments for the larger organisations but are enablers for SME's due to their ability to adapt quickly to change.

2.1 Applied Methodology

A preliminary review of literature provided a number of impediments to e-business adoption. Approximately 20 of these were selected and then located across more than 200 papers using a series of Boolean queries. A second stage of this analysis validated individual impediments against the findings of other research and *impact levels* were established where these documents provided clusters and hierarchical lists. These lists provided a means to identify *'barrier-impact'* to *'organisational size / type'*.

2.2 Quantitative Searching Procedures

A database of over 200 documents related to e-business adoption and ICT were archived and indexed so that all documents and their content could be searched and accessed using inherent features of Adobe Acrobat 6™ . As documents are indexed all of the PDF files are scanned 'word by word' so that subsequent 'word' searches can be undertaken. The searches used Boolean type queries since this method offered a greater number of options for combining terms, searching for exact phrasing, alternating words and excluded words. This approach provided the initial method for identifying the impediments with most occurrences in the literature. The search facility *Indexes* content from the full archive and it also enables subsequent searches through the entire set of documents.

The searches used a range of Boolean operators including:

- Using the AND operator between two words to find documents that contain both terms
- The NOT operator before a search term to exclude any documents that contain that term
- The NOT operator to exclude specific terms from query sentences
- The OR operator to search for either term. For example, E-business OR e-Business to find all documents with occurrences of either spelling.
- The ^ (Exclusive OR) to search for all instances that have either operator, but not both. For example, type IT ^ ICT to find all documents with occurrences of IT or ICT but not both.
- Parenthesis to Parentheses specify the order of evaluation of terms in a query. For example, type infrastructure & (quality | reliability). The query processor will perform an OR query on quality and reliability, and then perform an AND query on the result with infrastructure

The result of each search is a list of documents and the references to where the term or terms were found. The full index table has *hyperlinks* to documents and inferences, and this allows easy access to the specific reference in the document. The following table describes the search procedure including barrier type, search criteria, number of documents that match the criteria and the number of inferences. The original barrier list on Table 3 (barrier column) was established out of the results of various papers and international surveys including: E-business Watch: European Commission (2004), NOEI (2003) and e-MORI (2001). Table 3 also includes columns with Boolean query criteria, inference results and context sentences for interpretation.

Table 3 Barrier search to e-business adoption

Barrier	Boolean query criteria	Number of Documents	Number of Instances	Context for interpretation – this column provides examples on how individual instances from search results were contextualised and en relevance assessed.
Confidence / Trust	confidence ^ trust	81	662	"Many privacy concerns stem from a fear of the unknown. Participation in electronic transactions requires a 'leap of faith' for many users. Trust is important as customers and SMEs feel they lose control of personal information when using electronic technologies for transactions (Brown 2002). "Lack of confidence and trust contributed to 29% for non-adoption to an empirical survey and 17% were concerned with uncertainties in contract, delivery and guarantees" (Colto 2001).
IT skills training / literacy	Skills & (training | development)	84	845	PricewaterhouseCoopers (2001) found that the lack of e-commerce skills and training were the main internal barriers to the deployment of e-commerce in the UK consulting firms.
Cultural change	Exact term	16	27	Improving staff's competence can motivate them to work harder and commit to changes. New practices or changes will shake the status quo of the current operations. Without the commitment of staff, new culture cannot be aligned with new common goals and objectives (Cheng and Love 2001).
Business process change	Process change & change management	11	16	Moving to digital delivery requires new specialist skills such as IT skills and organisational change management skills and internal retraining and updating skills in support of the business transformation (Laidlaw 2001).
Initial financial cost	Financial cost	7	8	Cost- and skills - related barriers are felt more acutely by small firms, of which there are many in business services. However, as digital delivery options are developed there are likely to be more solutions available in the marketplace that are tailored to the needs of SMEs (Burnt 2000; Cheng 2001).
Privacy issues	Privacy	44	431	In an extensive survey of e-commerce activities in Europe, the United States, Japan, South Africa and India by Accenture (2001). E-business watch (2004) found that: 74% of firms surveyed cited security concerns as a barrier to further development of e-commerce; 67% cited the lack of a transparent regulatory framework; 66% cited concerns over privacy .
Goods unsuitable for e-sale	Goods & (fitness |suitability | maturity | unsuitability)	22	448	Goods and services were unsuitable for e-sales – 25% of respondents to a Eurostats survey (Brown 2002).
Service unsuitable for e-sale	Service & (fitness | suitability | maturity | unsuitability)	24	377	38% of respondents to an empirical surveys cited suitability as very important, and more than 50% said that it was either important or very important (Eurostats: European Commision, 2004).
Lose of current clients	Client base	6	9	Most banks are using e-commerce to increase their client base, thus increasing the intensity of competition. The other is retail and wholesale distribution where e-commerce is perceived, more than in other sectors, as an opportunity to increase their supply base. The network impacts are least acknowledged by the manufacturing sector (NOIE 2001c).
Uncertainty of financial returns	Financial & (Uncertainty | returns | risk | trust)	38	138	The cost, skills and accessibility impediments noted in many studies are felt most acutely by SMEs. They need support in the areas of technical standards and the development of e-business tools scaled to, and affordable by SMEs (Jacobs 2001).

Lack of reliable measurement	reliable AND reliability	48	102	Research indicates that industry and consumers have several concerns about online transactions. In order of priority, they are concerned about its reliability, about the confidentiality of their own records if available online, and about the potential for websites and third parties to track their activity while they access information (NSW Office of Information Technology, Australia 2003).
Need for face to face communication	Face to face	37	102	Direct interactions between individuals, under certain conditions, significantly account for adoption of a variety of innovations (Weknert 2002). According to E-business watch: European Commission (2004) this risk results from a replacement of personal services by more efficient online customer self-services.
Management commitment	Exact term	6	10	The concept of e-business is slowly being embraced by the construction industry because it would appear that security issues, financial costs, changes to existing business practices, and a lack of management commitment are the major barriers to its adoption (Proverbs and Faniran 2001).
Maintenance running costs	Maintenance AND running costs	71	364	The cost factors incurred before and after implementation. Most importantly are the running costs and the cost for training, which is imperative when implementing the system (Construct IT: Salford University, 2003a).
Connection speed	Exact term	5	6	Slow Internet connection speeds for both individuals and businesses have been a particular bottleneck, although there has been a great deal of policy attention and broadband rollout has gathered pace in most countries (Palacios 2003).
Technological updates	Updates	64	246	Most significantly, any revisions or updates to the standards need only be changed online to be made available to all consultants (Construct IT: Salford University 2003b and 2004).
Gov. support and information	Governmental support	10	22	Industry emphasised this gap in government support, especially support for collaborative e-commerce initiatives (Donaldson 2000; Dixit 2003).
Quality of current infrastructure	Quality infrastructure	61	767	Success of B2B e-commerce depends on the quality of infrastructure integration, but is also influenced by many non-technical issues besides. Furthermore, there are factors that are peculiar to the context of cross-border e-commerce, where trading takes place between organizations that exist under different legal systems, languages and cultures by APEC Telecommunications, (Colto 2001).
Reliability of current infrastructure	Reliability infrastructure	24	215	Construction sector growth is fostered by strong growth in infrastructure and in Internet use, but its development will depend on growth of mobile applications, price, service, ease of use, speed and reliability (OECD 2003).
User authentication / fraud	Authentication fraud	9	87	These authentic-looking messages are designed to lure recipients into divulging personal data such as account numbers and passwords and credit card numbers – also known as *Phishing* (OECD 2003).
Not sure of benefit	Awareness	65	329	The slow up take and lack of experimentation on-line tendering has been linked by some to Optus' merger with Foxtel, and its subsequent lack of interest in the form, and the uncertainty surrounding the technology to be introduced (NSW Office of Information Technology, Australia 2003).
Dissatisfied with performance	unsatisfied ^ dissatisfaction	9	11	Instability arises because dissatisfied firms innovate by leaving the pack and charting a new course. If a deviant happens to emerge as a "winner," conceptions of best practice may shift away from popular innovations. By defecting from a common practice to emulate an uncommon (but apparently successful) one, mimics increase population diversity and promote temporal instability (Gray 2002 and Strang 2001).

2.3 Qualitative Inference Interpretation

In order to identify and highlight the main impediments affecting construction a searchable index was created using Adobe Acrobat™. The database held all documents in portable data format (PDF), and these documents included papers and reports on e-business and information and communication technologies (ICT). Impediments were then identified during the review process and using Adobe Acrobat™ Boolean cues search facility. The details of all impediments were then contextualised in relation to the list of common impediments. These impediments were then rated in relation to *impact levels* affecting construction and organisations under scrutiny.

Figure 1 illustrates results from a single Boolean query. The circle contains word or phrase to search for (e.g. adoption) though the full database. The database included some 200 indexed documents, in the example of figure 1 the term *adoption* was entered and all identified documents and inferences within each document is indicated in the drop-down menu (indicated by the rectangle below the circle), the drop-down menu has hyper links to directly access to the content under question. For the purpose of this review not all instances were accessed but results from individual papers were established into context and findings were validated in relation to their impact level.

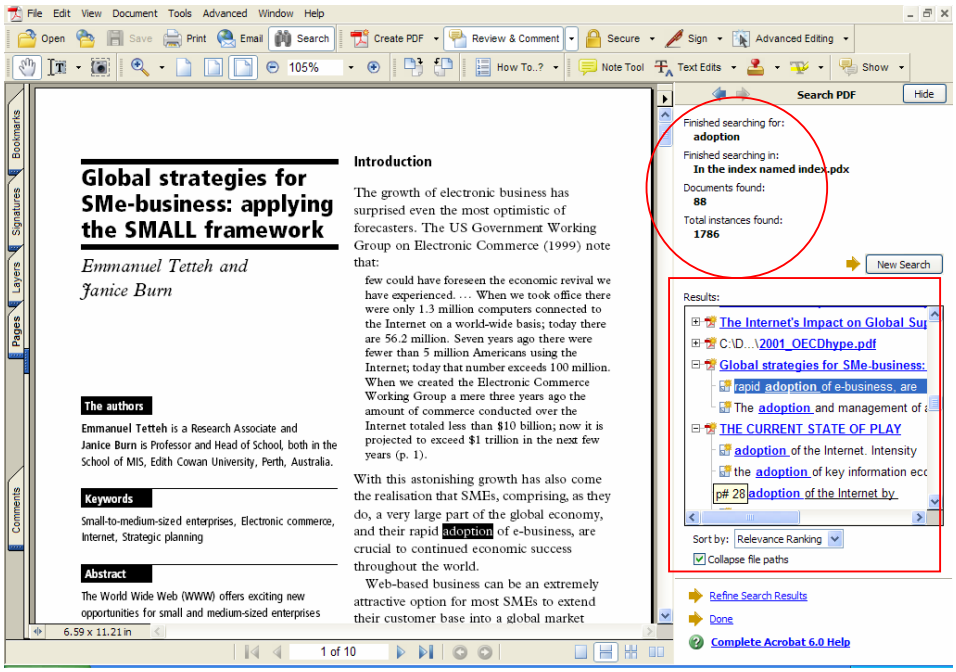

Figure 1 Index and instances

Figure 1 *Index and Instances* shows results with number of documents and inferences for a typical search query. Hyperlinks were used to access document content and assign impact values. Individual instances were accessed until paper results were contextualised and validated by the researcher using the following criteria:

Table 4 Likert scale criteria

Low impact (1)	Value (2)	Value (3)	Value (4)	High impact (5)
Authors' comments, observations and opinions.	Single and multiple case study results.	Multiple case study results and descriptive survey.	Statement drawn from multiple references.	Survey with statistical significance.

Figure 2 illustrates how the likert scale criteria were applied for each barrier. In this case the figure shows impact levels of SMEs in relation to impediments to adoption. All impediments are listed on the left hand of the screen save, any relevant impediments were dragged and dropped on the Likert scale. In this case the two poles of the scale included 'low impact to SME' and 'high impact to SME' and three impediments in relation to the scale are located here. This process was repeated also for other relevant industry organisations such as contractors, consultants and suppliers.

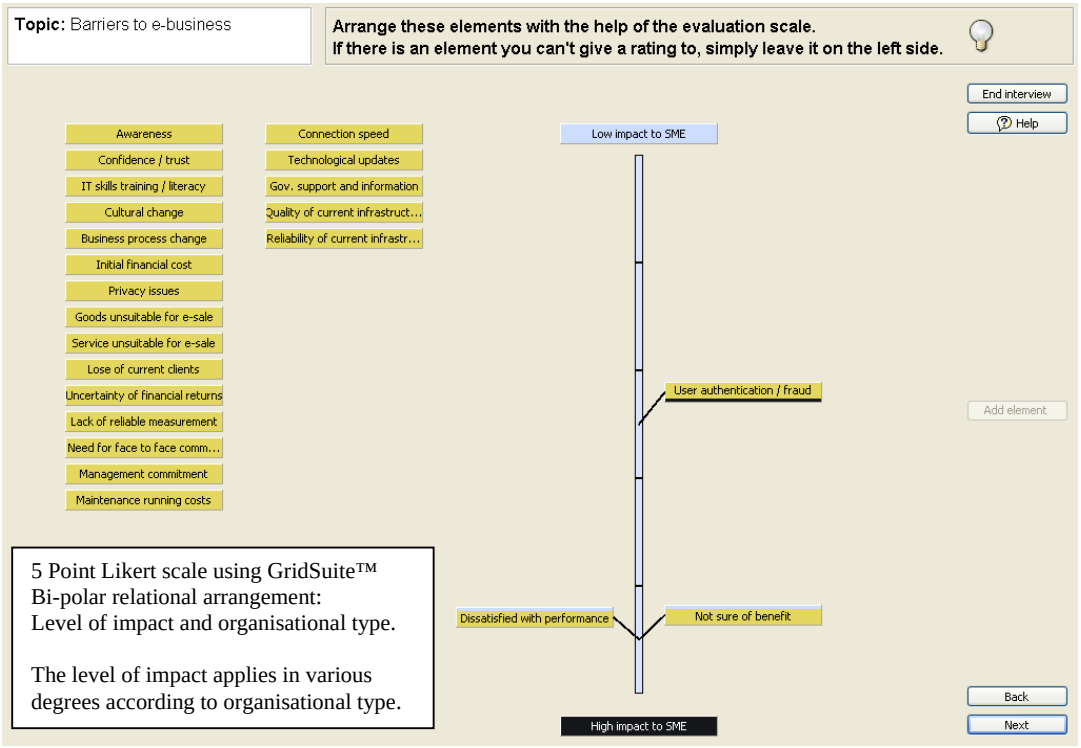

Figure 2 Assigning values

Barrier impact level relationships were then assigned to the following four groups:

- SMEs
- Suppliers
- Contractors
- Consultants

In summarising the findings, the *mean* of all assessed impediments was calculated applying the following equation which adds up all the ratings and then divides them by total of number of times a barrier was rated.

Equation 1 Impediment mean

$$\bar{X} = \frac{\sum_{i=1}^{n} X_i}{n}$$

3. CLUSTER ANALYSIS

In this heading cluster analysis has been applied with the *barrier mean results.* Cluster analysis refers to the grouping of results. Groups or clusters are established in relation to their numeric values. The following: *Tree diagrams and table cluster* displays linkage values based on mean results. The table provides insight into the relationship of impediments or organisations, and these are indicated by both the tree (or dendritic) and cluster (or pattern) diagrams. Figure 3 shows summary results in a scales grid indicating clusters and relationships between impediments and levels of impact to the various types of organisations:

- Impediments: tree relational diagram (top of figure: links from 40% up to 100%).
- Impact to organisational type: tree relational diagram (right side of figure)
- Impediments vs Impact: cross numeric (centre of figure)
- Impediments vs Impact: colour pattern clusters (bottom of figure)

Mean results were entered into the following grid figure revealing numerical relations between 23 impediments and their level of impact to organisational type: *barrier-business-impact* interrelationships. Figure 4 displays the matrix grid with rounded mean value results. Tree diagrams indicate the level of linkage as a percentage. Groups of impediments linked at 75% or above result in clusters. Tree diagrams provide insight into barrier relationships including:

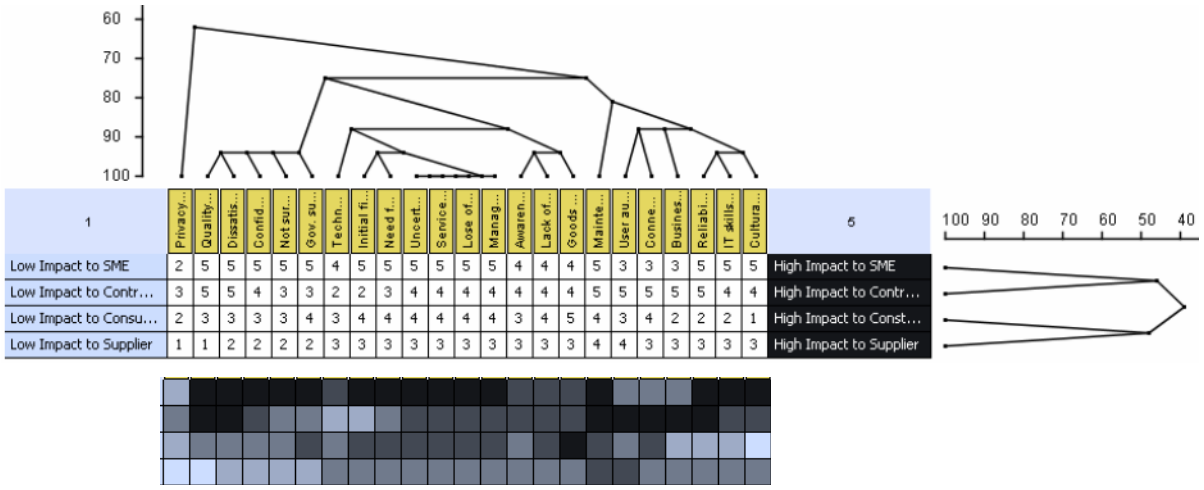

Figure 3 Cluster analysis: tree diagrams, numeric and color clusters

The following Figure 4 has dissected the cluster tree "*impediments to e-business*". The figure diagram has been developed based on the extracted from the above figure contents of Figure 3, and shows the relationships between the impediments (with 23 key items). This type of analysis reveals hierarchical structures and provides insight into the relationship between various impediments. Links in the diagrams are established from similarities of ratings on Likert scales, and cluster groups can then be identified.

3.1 Cluster Tree Diagram

The following figure shows the three main clusters and their impact level. It should be noted that the clusters relate differently according to the type of organisations, for example the relationships between clusters and company type – such as SME, contractor, consultant and supplier. Cross relationships can be identified in the *number or colour pattern grids* from Figure 3. High value or dark patterns (e.g. 5 or 4) indicate high impact levels and low value or light patterns indicate low impact levels (e.g. 1 or 2). From left to right the tree diagram starts with *'privacy issues'* this barrier links at only 62.5% with any other barrier on the list this would indicate a low level of impact across the four type of organisations.

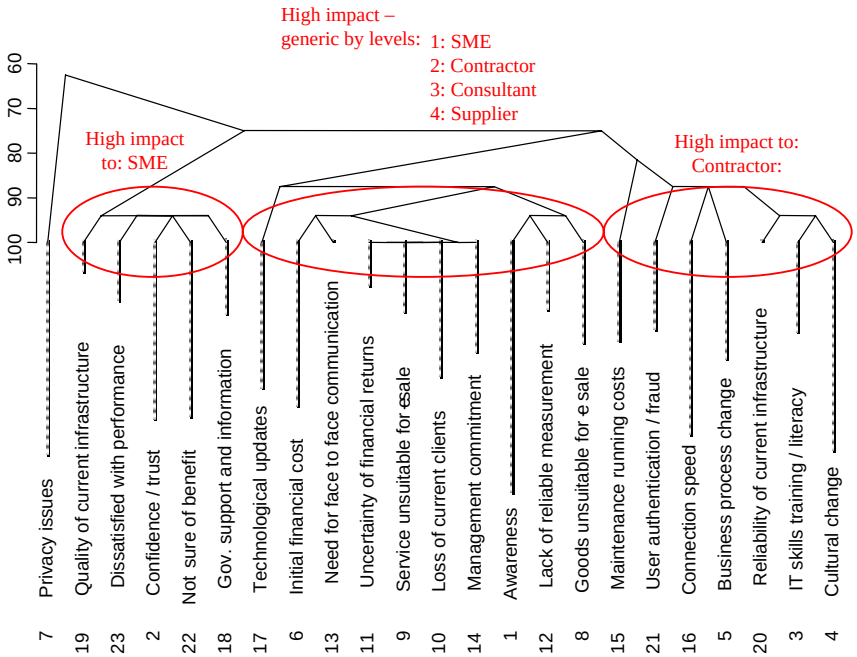

Figure 4 Tree diagram

The first cluster from left to right is formed with links of 93.8% between impediments. From the pattern grid (Fig. 3) this cluster shows a higher level of impact to SMEs (higher values). The cluster is also relevant to contractors. The cluster impediments affecting SMEs include:

- Quality of current infrastructure (linked at 93.8%)
- Dissatisfied with performance (linked at 93.8%)
- Confidence / trust (linked at 93.8%)
- Not sure of benefit (linked at 93.8%)

The following cluster (middle cluster figures 3 and 4) indicates all those impediments that seem to be more generic across the four types of organisations.

- Technical updates (linked at 75%)
- Initial financial cost (linked at 93.8%)
- Need for face to face communication (linked at 93.8%)
- Uncertainty of financial returns (linked at 100%)
- Service unsuitable for e-sale (linked at 100%)
- Lose of current clients (linked at 100%)
- Management commitment (linked at 100%)
- Awareness (linked at 93.8%)
- Lack of reliable measurement (linked at 93.8%)
- Goods unsuitable for e-sale (linked at 93.8%)

Although this second cluster has been defined as *generic* (as it scores high for all type of organisations) it is possible to identify that the list of impediments has the highest impact to SMEs, then to contractors, then to consultants and finally to suppliers. The final cluster from Figure 4 relates to all those impediments that have a higher level of impact to contractors (this is where mean scores show high. i.e. dark pattern areas):

- Maintenance running costs (linked at 81.2%)
- User authentication / fraud (linked at 87.5%)
- Connection speed (linked at 87.5%)
- Business process change (linked at 87.5%)
- Reliability of current infrastructure (linked at 87.5%)
- IT skills training / literacy (linked at 93.8%)
- Cultural change (linked at 93.8)

4. DISCUSSION OF THE FINDINGS

E-business in the Australian building and construction industry is presently neither advanced nor widespread. For this reason this review included domestic and international findings on empirical studies.

This research has identified both, evident and perceived impediments for e-business. The results suggest that impediments have differing levels of impact according to organizational type such as SMEs, Contractors, Consultants and Suppliers. By mapping the evident against perceived impediments to e-business adoption it will be possible to provide organisations with advice on how they should approach the adoption of e-business.

Other research agendas within and outside CRC are currently addressing legal and technical impediments such as interoperability and the outcomes of these research projects may influence the recommendations made in this chapter.

4.1 Barrier for SMEs

The research suggests that many smaller organisations have adopted a *"wait-and-see"* approach, citing the lack of stable technology, a suitable business model for the one-man business with risks associated to it. Fraud and other failures of many e-business exchanges have raised the level of perceived risk, making firms and individuals reluctant to invest in e-business systems.

The slow uptake of e-business and inertia of SMEs to change has encouraged them to continue operating as they have traditionally done. Many organisations in the construction industry rely on *"trust"* and trust is commonly developed over time. The fear to trust relationships not being developed on a face to face basis has been identified as a barrier to e-business adoption. Trust between business to business exchanges to ensure integrity and the delivery of promised level of service is also an identified barrier to e-business adoption.

Skills acquisition and skills development within SMEs organisations is also an identified barrier. While the education system develops skills in new entrants to the workforce industry associations need to play a pivotal role in raising awareness levels and in developing skills of practitioners. One way to achieve the *"raising of awareness"* would the dissemination of e-business case studies which includes cost/benefit analyses and peer testimonials.

It is important to assure SMEs that there is no need to have a web-site in order to go e-business – initially at least, as it could be simply the use of internet banking.

4.2 Impediments for Suppliers

This group has fewer impediments to e-business adoption given that they are effectively retail or manufacturing organisations, and there are numerous examples of successful e-business systems in other industry sectors. However one barrier directly related to suppliers is difficult of including non standard goods which are less suitable for sale on e-business systems.

4.3 Impediments for Contractors

The identified impediments for this group include system maintenance and running costs, issues relating to financial fraud, connection speeds from sites, the costs of infrastructure for temporary or short term projects, process and cultural change, as finally skills development. Interestingly some of the impediments affecting medium and large contractors perform as enablers for SMEs.

4.4 Impediments for Consultants

"Products or services unsuitable for e-sale" rated as a main barrier for consulting and SMEs. This is arguable to be a perceived rather than a real barrier as it relates to 'the way of doing businesses' especially in an industry where the face to face and paper paradigms remain strong. This might relate to risks perceived, specially related to legal issues such as dispute resolution and intellectual property.

The protection of *"intellectual property"* has also become a major issue for consulting organisations. Electronic versions of a company's intellectual property submitted to say a tendering process may be prone to copying by a third party for their own use. Suitable security and privacy arrangements are essential. .

4.5 Generic impediments to the Construction Industry

Generic impediments such as lack of awareness seem to affect all type of construction organisations. Many of them appear unaware that they may miss business opportunities if they do not adopt e-business. There are several reasons for this, and they include the view by some decision makers that e-business is not a strategic business issue. Many organisations have yet to develop a business case for online collaboration, and their understanding of the business implications of e-business can be overshadowed by a poor understanding of the technical issues.

Lack of skills, security issues and legal issues are commonly perceived impediments. Uncertainty about business models and how business entities organise for e-commerce is a major concern. The current waning of confidence in the Internet, further highlights these concerns. It is still perceived however that the lack of open standards is a major barrier.

A commonly identified barrier was the *"uncertainty of the financial returns"* from investments in e-business. This uncertainty is exacerbated by a lack of reliable measurement, therefore there is a need to clarify the costs and benefits of e-business. The lack of industry literature showcasing success stories in e-business adoption has contributed to the *"uncertainty"* barrier. Organisations also need to have confidence in the testimonials, and one way to overcome this is to have the information disseminated by professional or government bodies.

5. CONCLUSION

In identifying impediments to e-business adoption, this chapter has firstly provided a context to E-business practices both sectorial and within construction. These included identification of current key processes and definitions. It was argued that businesses adopt strategic use of the Internet to enhance businesses processes by small incremental stages and according to their maturity levels as to minimise impediments to e-business adoption.

Main impediments relevant to construction were identified from the existing literature and their impact level weighted against organisational type. Literature indexes were created using Boolean queries with key terms and sentences. A complete database of PDF documents was fully searched on each query using the Adobe Acrobat Indexing facility.

Impact levels from individual papers were then assessed and results evaluated. For this, inference searching and qualitative interpretation were carried out. The criteria has been applied consistently across the four type of organisations under scrutiny: Consultants, contractors, SMEs and suppliers. Mean values from each barrier were calculated and impact levels established by using cluster analysis.

Results have also shown that impediments to e-business adoption work differently according to organisational, type and culture. Areas of training and people development need to be addressed, this would include a more sensitive approach to the nature of construction organisations, especially to those small and medium enterprises. According to current studies, this is not happening. Empirical studies within construction are yet to validate or disprove the findings here presented.

It is concluded that to accelerate e-business adoption in construction, key aspects such as peer recommendations, moving towards sharing documents in digital format and developing non face-to-face communications are paramount. In the long term, cultural and attitudinal change towards technological implementation needs also to be addressed. Results have also shown that impediments to e-business adoption work differently according to organisational, type and culture. Areas of training and people development need to be addressed, this would include a more sensitive approach to the nature of organisations and better understanding of their needs and possibilities to embrace change, from the one-man-business to major contractors, from suppliers to consultants. According to current studies, this is not happening. Empirical studies within construction are yet validate or disprove the findings here presented.

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