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**CRC Construction Innovation**  
B U I L D I N G O U R F U T U R E

# Final Report: Adoption in the Construction Industry

Research Project No: 2003-003-A

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## PREFACE

This research project arose due to the identification of a gap in the research program of the Cooperative Research Centre for Construction Innovation (CRC\_CI). The gap was that too little attention had been paid to understanding to any great depth the social, cultural and economic reasons why the vast majority of the industry had not adopted e-business. Much of the CRC\_CI research investment has been devoted to the adoption of “high end” e-business tools and practices and, in particular, the development of computer software in anticipation of the day when all firms in the industry will be highly connected to each other and to all projects. The day when all the industry will be operating virtually and communicating electronically rather than through paper.

A number of case studies were commissioned because Queensland Department of Main Roads (QDMR), Queensland Department of Public Works (QDPW) and the John Holland Group (JHG) were interested in the firms that they deal with and the barriers and triggers that would increase their rate or adoption of e-business.

This report draws together the key findings from six case studies on the subject of e-business Adoption in Construction conducted in Australia by the University of Newcastle (UoN) and Royal Melbourne Institute of Technology (RMIT) from 2005 through to mid-2006 under the auspices of the Cooperative Research Centre for Construction Innovation (CRC\_CI). The project was lead by Associate Professor Kerry London from the University of Newcastle and has had two research teams working on it:

- University of Newcastle (UoN): Kerry London (Project Leader), Nathaniel Bavinton, Jonathan Mentink, Benjamin Egan
- Royal Melbourne Institute of Technology (RMIT): Professor Ron Wakefield, Dr Guillermo Aranda-Mena

The entire study involved six case studies. A protocol was developed which outlines the responsibilities of each team. The following are the six case studies and the research team responsible for each case study:

- RMIT: Victorian Building Commission
- RMIT: Queensland Department of Main Roads
- RMIT: Melbourne City Council
- UoN: Queensland Department of Public Works
- UoN: John Holland Group
- UoN: Brisbane City Council

There are individual case study reports completed for each case study.

# ADOPTION PROFILE

## 1.0 INTRODUCTION

This report draws together the key findings from six case studies on the subject of e-business Adoption in Construction conducted in Australia by the University of Newcastle (UON) and Royal Melbourne Institute of Technology (RMIT) from 2005 through to mid-2006 under the auspices of the Cooperative Research Centre for Construction Innovation (CRC\_CI). Reference to this timing is important because one of the key themes to emerge from the study is that the take-up of e-business is a dynamic phenomenon within the construction industry.

One of the fundamental underlying characteristics of the construction industry is the need for project information to be transferred between firms as an integral part of the products and/or service transactions. The industry is thus ideally suited to e-Business technology. The main claims of the benefits of e-business technology are that it will provide commercial efficiencies through more effective design and construction information management, procurement and contract management and facilities and operational management. However after the initial adoption by innovative firms e-business has not diffused throughout the large majority of the Australian industry. Therefore either the claims are false or the industry does not believe the claims or the industry is unaware of the claims.

The adoption of this technology by the Australian building and construction industry lags that of other Australian industries and industries in the USA and Europe (NOIE, 2001). As originally suspected and confirmed by this study the slow adoption rate does not reflect access to innovative and mature technologies generally, but rather the social, cultural and economic impediments and associated drivers related to adoption peculiar to the Australian construction industry.

Many elements of a technical solution have been solved and are available; therefore the research has sought to address the significant changes in business practices and consider strategies that will address social, economic and cultural issues at an industry, organisational and individual level.

The aim of the research project was to conduct research that would provide information so that we can develop education and training “tools” in the CRC\_CI that would eventually increase participation in various e-business technologies and ultimately assist in developing a greater awareness in the construction industry of the value of e-business to organisations. To enable this, the objectives were to:

- Confirm and investigate the nature of the constraints to e-business adoption through theory and practice and then to
- Identify strategies and techniques to raise awareness and increase adoption and diffusion in the industry based upon a literature review and four case studies of various levels of e-business adoption environments and then to
- Propose a technology adoption profile based upon the results of the four case studies (Note: the number of case studies was subsequently increased during the project)

There are numerous definitions of e-business and one of the most significant aspects of those attempting to define e-business is the development of a model describing various steps of e-business adoption. The following is just one such example:

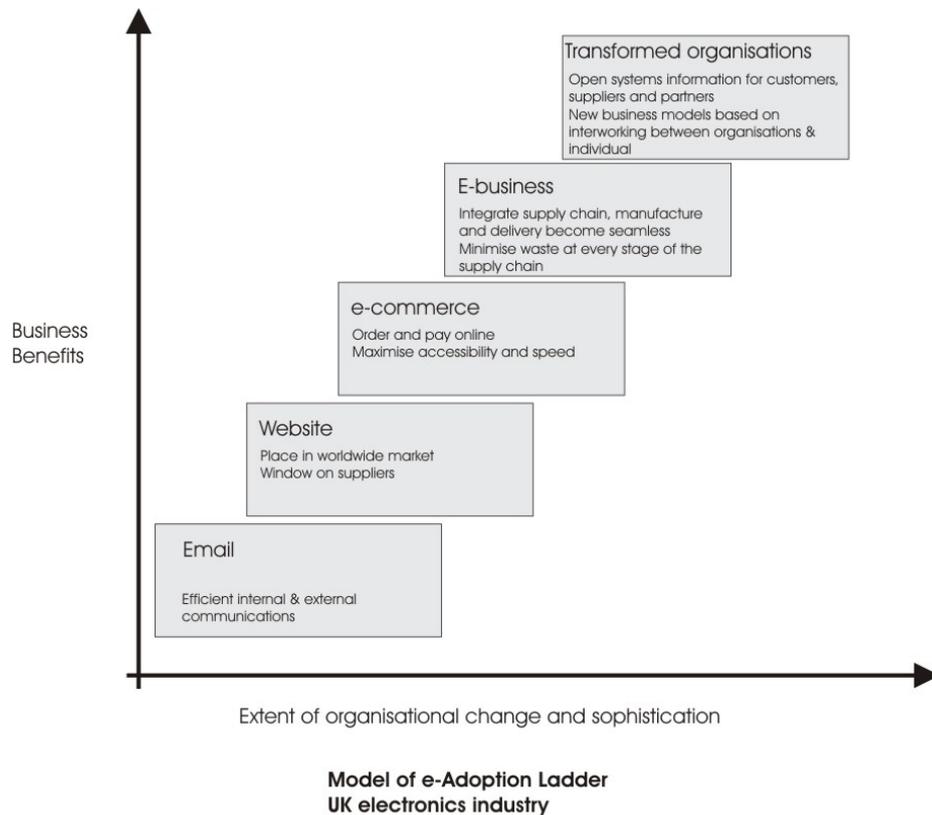


Figure 1 Property and construction e-business definition

This serves as a generic model of e-adoption however; it clearly highlights the need for greater clarity on the construction industry specific adoption profile. At the first workshop all team members agreed to the following definition proposed by London (2004):

**Box 1 Property and construction e-business definition**

Box 1 e-business in property and construction definition

E-business in construction involves any electronic exchanges of information in relation to the various stages of the design, construction and operation asset life cycle which includes;

1. internal organisational driven activity for firm core and support business including industry specific and generic business software applications, websites, email and electronic banking
2. externally linked online web based portals involving:
  - design collaboration and document management,
  - online tendering
  - procurement; purchasing and invoicing
  - information
3. online or internal organisational facility management systems

Our aim is to develop some form of an adoption profile that other industries have for the Australian construction industry.

The literature review identified the following commonly recognised barriers affecting e-Business adoption. It should be noted that these barriers are not industry specific in that they are not directly inferred from research conducted on the construction industry. Nonetheless, these barriers are useful in identifying patterns affecting the uptake of new technologies within the commercial and governmental sectors. As with barriers to e-business adoption factors or drivers exerting positive influence on the adoption and integration of e-business technologies is not construction industry specific but accurately portrays wider forces

influencing the general patterns of e-business adoption. A review of the academic literature revealed the following barriers and drivers which assist in the process of e-business adoption;

Table 1 Summary of Barriers and Drivers – Literature review

<b>Barriers to e-business adoption</b>	
1.	The lack of awareness of what e-business is and what it involves and further to this a lack of awareness or reluctance to see potential business benefits (Ingirige, 2002; NOEI, 2001; Parish, 2002).
2.	Informed resistance to innovation based on values and attitudes (Frank, Zhao and Borman, 2004)
3.	The lack of security and the perception of an insecure environment; the need for a regulatory and legal framework; lack of systems (Bennet, 2003)
4.	Market incentive, pressures and rewards and uncertainly regarding the financial returns from investments in various resources versus economic benefits (Tetteh, 2001; Veeramani, 2002)
<b>Drivers to e-business adoption</b>	
1.	Rewards, incentives and initiatives by governments including seeding programs, investment incentives and tax rebates (NOIE, 2001)
2.	Managerial characteristics or philosophy of the firms (Gray et al, 2002)
3.	SME's characteristics related to flexible specialisation (de Berranger et al, 2000; Malone, 1985; Montazemi, 1988; Stoerey et al, 1995); it is the flexibility of SMEs that can make adoption of ICT easier compared to larger more bureaucratic and inflexible organisations and some commentators claim that SMEs can be expected to adopt technology faster than large organisations
4.	Production related factors assisting e-business adoption; for example e-business technologies have the potential to transfer complex design information accurately (Elliman et al, 2000), thereby eliminating data transfer error (NOIE, 2001) as well as minimising delays as information is conveyed along the supply chain
5.	Reduction in transaction costs; small vendors and suppliers can bid on jobs using standardised forms on the site making bidding on jobs relatively inexpensive; costs in transferring information during the tender process is reduced. The website is also beneficial to large manufacturers as it creates an electronic auction market enabling organisations to receive a wide range of competitive quotations from vendors (Wenninger, 1999)

Although not strictly designated as barriers or drivers an important study on large construction organisations who have adopted e-business at a reasonably high level identified 11 factors that influence ICT diffusion and that they could be grouped into four main influences; individual, management, technology and workplace environment (Peansupap et al, 2003). Our study builds upon this work but seeks to understand SMEs and a greater range of adoption practices. SMEs have different levels of resources and capacity and managers are often closer to the workforce and daily operations than in these larger organisations and therefore we need to seek clarity on market economic and inter firm dependencies influences. We will also tend to focus more on the pathways to adoption towards developing a model of e-adoption which reflects the adoption-decision process rather than simply reducing the problem to a series of drivers, barriers or influencing factors.

Consideration of the barriers and drivers influencing e-business adoption suggests the following implications in relation to the adoption-decision process.

First, government based incentives are aimed at improving the attractiveness of adoption to firms by offering financial incentives and thus addressing the key issue of financial risk. The government intervention is aimed at a phase of the adoption-decision process of attitude development; i.e. changing the attitude towards the adoption through reducing the impact of firm costs.

Second, among the barriers discussed which prevent adoption of e-business technologies are factors such as the lack of awareness of the potential benefits. The adoption-decision process undertaken by firm managers is inhibited by the lack of accurate information and importance of organisational cultural and the values that influence decision making in the form of management practice or managerial philosophy. The managerial decision to engage in e-business relies upon an informed awareness of benefits, an acceptance of the advantages versus disadvantages and also a practical organisational capacity to then move the firm in that direction.

Although the key barriers and drivers drawn from the general academic literature into e-business adoption are quite extensive and clearly relevant to the present research it is also apparent that non construction industry specific research has not significantly integrated key behavioural and structural elements of the industry in relation to the vast majority of the Australian construction industry players who have not substantially adopted e-business. This study builds specifically upon past Australian studies which focussed upon larger contractors and diffusion of information and communication technologies (ICTs) by innovative players (Peansupap et al, 2003; Duyshart, 2003). Past studies have tended towards a normative approach (Peansupap et al, 2003; Duyshart, 2003; Cheng et al, 2001) whereas University of Newcastle elected to undertake a grounded theoretical approach. That is the findings of the case studies were more discovery oriented of *what taking place and what are the conditions is* surrounding the uptake or non uptake of e-business. The study is *positive* in nature – seeking to observe, describe and explain within the “loose” framework of diffusion theory and then build a model of adoption practices. We sought to use diffusion theory as the starting point and an interpretive framework but we were mindful that our ‘eyes’ were open to new developments and idiosyncrasies of the construction industry players and the adoption-decision process specific to construction rather than a generic social-business system.

International literature highlights that e-business adoption is complex and that there are many factors influencing adoption and yet many studies attempt to reduce the adoption-decision process to a clear set of individual variables; whereas we proposed that there are relationships between these variables and that the adoption-decision process is various combinations of these factors. There has been little attempt to build this picture of the complex inter-relationships in a qualitative manner between one factor and another or to even explore the diffusion of e-business technologies and the adoption-decision process phenomenon from this perspective.

## 1.1 Theoretical Framework

The research was conducted by the two Universities’ across six case studies; commencing with a common theoretical grounding in a literature review of e-business adoption in construction and then the development of conceptual frameworks based upon diffusion theory. The theory underpinning the study was based upon Rogers’ theory of Innovation Diffusion (1962; 1995). Whilst not referring specifically to the diffusion of e-business as innovation, Rogers’ work does provide an initial framework through which examination of the diffusion of e-business through construction supply chains can be examined. Rogers’ defines the diffusion of innovations as the process by which knowledge of an innovation is transmitted through communication channels, over time, among the members of a social system. The four key elements comprising Rogers’ diffusion theory are defined as;

- The innovation: an idea, practice or object that is perceived as new;
- Communication channel: can be mass media and/or interpersonal networks and is the means by which messages about the innovation gets from one individual to another;
- Time: comprising a) the innovation-decision process, b) relative time which an innovation is adopted by an individual or group – an innovation’s rate of adoption

- The social system; a set of interrelated units that are engaged in joint problem solving to accomplish a goal.

Within this framework diffusion is largely measured through the degree of adoption within a social system. Adopters are categorised by Rogers' as innovators, early adopters, early majority or laggards. These adopter categorisations are differentiated primarily in relation to diffusion as a temporal process- diffusion happens in time, whilst the other key elements of innovation; communication channels and social system exert variable influence upon the temporal diffusion process depending on their specific qualities. According to Rogers for example, communication channels vary in importance according to the type of adopter; mass media and expert knowledge has more influence on innovators, whereas personal networks are more important for late adopters (Rogers, 1995). The key processes in Rogers' diffusion theory are thus the adoption-decision process and the rate of adoption- comprising multiple phases and influenced by various factors. As noted earlier in relation to a discussion of the barriers and drivers for e-business, the adoption-decision process is a key phase through which an individual (or group) passes from:

1. first knowledge of the innovation;
2. to forming an attitude to the innovation
3. to making the decision to adopt or reject the innovation
4. to implementing the innovation and confirming the decision taken

This transition from first knowledge of the innovation to its implementation measure as a temporal process encompasses the innovations rate of adoption. This may be affected by various factors relating to the key elements of Rogers' theory including; the specific attributes of the innovation in question – its relative advantage, compatibility, complexity, trial ability and observability (Rogers, 1995). Also influential is the type of innovation decision being made including option/individual, collective/organisational and authoritarian/hierarchical. This factor parallels the recognition of organisational culture and managerial philosophy as a driver to e-business adoption.

The basic significance of Rogers' theories of innovation diffusion can be found in his acknowledgement of the complexity of the process. His unravelling of this complexity displayed considerable insight considering the inception of the original theory in the early 1960s.

## 1.2 Critique of Diffusion Theory

Rogers' diffusion model is a useful starting point for analysing the processes involved in diffusion, and is particularly relevant to the present study due to its recognition of the importance of social and cultural factors on the adoption and diffusion of innovations. However, aspects of the theory must be extended and modified before it can be applied to IT (Bayer and Malone, 1989) and more specifically to e-Business within the construction industry. Particularly significant to this discussion on diffusion theory is the need to introduce networked information technology itself as a primary communication channel with certain characteristics which will considerably influence both the e-business adoption-decision and the rate of adoption.

There are other limitations to Rogers' diffusion model. Bayer and Malone (1989) argue that Rogers' theory of diffusion is oversimplified in terms of binary dualism of 'adopt' or 'not adopt'. There is no means for the analysis of cases where innovations are partially adopted or explanation offered as to why innovations are adopted in some form other than the one intended by the developers of the innovation. They also identify the lack of differentiation between adopting an innovation at a firm level and at an individual user level, and also the

failure to consider adoption and diffusion as a function of interactions between social systems.

Rogers' tendency towards a simplified binary conceptualisation of the adoption-decision process is considerably problematic in that it does not address the complex nature of the construction industry, nor does it take into account the flexibility and multi functionality of information technology and e-business in relation to construction projects. Firms are typically selective on the project information that they require to conduct their own businesses; i.e. they take parts of documents and transform it to suit their own purposes and their own business and information technology systems. Therefore this makes it very difficult to make broad generalisations about level of adoption as it can be quite individualistic and idiosyncratic. It is proposed that it is difficult to place firms into one definite category because adoption is not simply an either/or situation – and if it is then this is a fairly simplistic reading of the situation. The diversity of e-business applications and also the competitive nature and fragmented structure of the industry with so many SMEs with restricted resources – grounded simultaneously in project-based relationships of close collaboration with limited time frames – introduces the notion of discontinuance in the temporary project organisation. Yet it is even more complex than that – firms know that they will work again with other firms – it may not be on this project but it may be on the next and that intervening period may see e-business adoption changes in one or either of the firms. These changes may only be quite subtle and yet they may create incompatibilities in relation to product (software) or process (business practices) between the two firms which did not exist on the last project. A firm may shift slightly in its uptake because it is influenced by another firm and this diffusion of shifts can be either an impediment to one firm or a driver depending (assumed) on also the economic relationship between the two firms. This discussion is speculation and yet as the results of this study documented in the case studies and presented later in this document bear out there are very interesting inter-relationships which have now begun to be uncovered by virtue of this study.

To summarise collaborative and supply relationships between firms along supply chains are not permanent, but both dynamic and transient –but they are not atomistic and the supply chain upstream and downstream linkages influences the adoption-decision process constantly in enabling and inhibiting ways.

In summary collaborative relationships between firms within supply chains are not permanent, but both dynamic and transient. In considering adoption and diffusion within supply chains, our research model acknowledges that adoption of e-business for one project and in collaboration with a particular group of firms to form a supply chain does not necessarily translate to the utilisation of e-business methods permanently. Rather each supply chain exerts its own pressures on collaborating or competing firms and these pressures are unique to the supply chain in question as a product of the specific project requirements, supply chain industrial economics and the organisational and communicative practices of participating firms.

### 1.3 Conceptual Framework and Research Methodology

Different conceptual frameworks and methodologies were adopted by the researchers. The conceptual model, methodology and interpretive discussion for the UoN case studies were replicated for each case study and case study saturation was achieved in the results. A conceptual model was developed by RMIT for one case study (Victorian building commission) but was not repeated as an interpretive framework for the two other studies. The method for RMIT case studies was similar but not exactly replicated for each case study and therefore cross case analysis and comparison is problematic. The result of the case studies is described and case study saturation can not be aimed for nor achieved. The RMIT case studies however have an advantage that they are intrinsic to the particular requirements of the specific e-business innovation of that industry partner (MCC, VBC, QDMR), i.e. they can be categorised as instrumental; i.e. they are instrumental in describing one particular 'case' and situation.

### 1.3.1 Royal Melbourne Institute of Technology

RMIT adopted a conceptual framework for the VBC case study which was developed by Wejnert (2002) and was based upon Rogers' Diffusion of Innovation theory (Rogers, 1995). This framework was only adopted for the Building Commission of Victoria's case study. The other two case studies, Melbourne City Council and Queensland Department of Main Roads, resulted in collecting and presenting information about usage patterns, barriers and drivers with no theoretical interpretation or cross case analysis.

The Wejnert framework offered a simple, yet comprehensive framework to analyse the implementation and diffusion of innovation from a number of important angles. Based upon three major diffusion components this conceptual framework is tabled below.

Table 2 Framework for Analysing Implementation and Diffusion in Innovation (Wejnert, 2002)

Public versus Private Consequences	Social Entity Variable	Environmental Context
Benefits versus costs	Familiarity with the innovation	Geographical settings
Business sector	Status characteristics	Societal culture
Collective actors / economic region	Socio-economic characteristics	Political conditions
Diffusion processes that differ in nature	Position in social networks	Global uniformity
	Personal characteristics	

The RMIT research objective was to identify the factors influencing the diffusion uptake of e-business and the Internet use for business purposes by small construction enterprises. The methodology chosen was a case study design using a qualitative approach via telephone interviews overlaid with a quantitative analysis of the results using Grid Suite<sup>®</sup> software.

The Interview schedule differed across the three case studies and therefore it is not possible to conduct a cross case analysis. However there were some basic simple questions asked about usage, barriers and enablers and it is possible to present these results. Each case study design was tailored to the case study proponent's needs and answered the initial description of what the suppliers or stakeholders to MCC, VBC or QDMR did in relation to e-business adoption and key barriers and drivers as individual distinct isolated factors.

### 1.3.2 University of Newcastle

The key conceptual and interpretative framework for UON research was based upon the Degree of Adoption concept. This concept has emerged from the critique of Diffusion Theory (Rogers, 1995), which remains a corner stone of the research framework.

Central to Roger's well-known conceptualisation is the adoption spectrum, which categorises adopters from Innovators to Laggards. However, to measure adoption primarily as a temporal process and categorising adopting agents according to a simplistic binary relationship of adopter/non-adopter is perhaps to overlook the very real complexities and contradictions operating within many small and large business organisations.

To account for prospect of the realities of adoption being considerably more complex the Degree of Adoption (Table 2) approach seeks to invoke the idea of a more conglomerate indicator to describe individual firm's adoption patterns.

Table 3 Degree of Adoption – Key dimensions

DIMENSION	DEFINITION
Rate of adoption	Rate is characterised by the changes in perceptions and attitudes towards e-business from firm, individual and supply chain as adoption moves from low

	level to high level e-business experience.
<b>Mode of adoption</b>	Mode is the form (software, internet etc) that the adoption of the innovation takes in terms of the practical uses it is put to within the organisations practices and processes
<b>Level of adoption</b>	Level is the extent to which adoption of e-business innovation is integrated into, and thus impacts the structure, processes and practices of an organisation

The UoN objective was to qualitatively explore the factors influencing organisations current and future propensity to adopt e-Business and penetrate deeply into the adoption-decision making process and the inter-relationships between the various factors influencing adoption. We were aiming to describe the rate, mode and level and identify key characteristics of the adoption-decision process so that the industry partners would be able to with deeper insights begin to understand the impact of their policy decisions in relation to e-business adoption by their suppliers and various stakeholders.

Of relevance to this point that the current diffusion models do not adequately accommodate differential modes of adoption. Of relevance to this point is recognition of the different functions of firms in the construction supply chain, and accordingly their diverse organisational structures and modes of operation. Yet as noted previously many firms are taking the same piece of project information and manipulating and repackaging it in relation to their business needs. Related to this flexibility required at an organisational and supply chain level is also the need to recognise relative autonomy of individuals within firms. The diffusion of an e-business innovation is not simply a managerial decision but rather individuals have a certain capacity to determine to what extent the e-business application is used efficiently and effectively in relation to their specific role within the firm. In this sense it is possible to account for both partial adoptions within firms and also alternative (and often creative) modes of adoption.

This more complex reading of the adoption and diffusion process overcomes simultaneously Rogers' simplistic binary of adoption/non-adoption process and his emphasis on the temporal rate of adoption in the categorisation of adopter types. This is achieved while maintaining his insights into the influence the social system in both the form of operating and structural pressures from the supply chain and also in the circulation of social, cultural and business meanings and values that influence the development of positive or negative attitudes towards e-business applications.

Ultimately the success of diffusion of e-business is reliant upon the firms' economics and social 'space' or environment and then the capacity to achieve the change. Although it is important to be aware of the structural drivers and barriers to e-business the present research focuses on the importance of diffusion within and between business and the interdependencies between upstream and downstream linkages. Rather than taking the approach that a firm either adopts or does not adopt it is suggested that adoption and ultimate dispersion across the industry is based upon firms being along a continuum of 'reflexivity' relying upon e-business awareness, responsiveness and adaptability attributes.

We would suggest that people change their perceptions about the value of e-business and this is central to the adoption-decision process and that it is then these perceptions and changed attitudes which then drive implementation. These are also constantly being 'updated'. However a positive 'attitude' towards e-business will not suffice it is also the actual 'form' or mode of the e-business and how well it integrates into current practices within and across firms, that is e-business innovation compatibility. Finally the importance of communication, social networks and trust is paramount. A large percentage of SMEs within the construction industry can be classified under the category of late to non adopters which exemplifies according to Rogers (1995) the significance of inter-personal social networks. This interpretation has been identified previously and we seek to confirm how significant it is

for SMEs in the Australian construction industry and how this specifically relates to a pathways to e-adoption model.

The methodology chosen was a constructivist case study design. The data collection mode was predominately lengthy and detailed semi –structured face-to-face interviews. The length of the interviews was a minimum of one hour but in many cases they were much longer and involved. Many issues and facets to the problem were explored in depth and at times we would come back and explore ideas again and again and probe into the ‘whys’ so that we could capture rich data about the decision-adoption process. The data analysis was ‘critical’ and interpretive and involved firstly thematic coding and analysis followed by axial coding and analysis. Thematic coding involved the development of descriptive codes of responses on a case by case basis. Axial coding involved ‘repackaging’ those descriptive codes across cases to identify common themes and underlying themes arising from our further critique and interpretation of the data.

In constructing the interview schedule three main themes were identified as central to the exploration of e-business adoption within the construction industry: degree of adoption, supply chain influence, and web-portals. From these central themes (Table 4) respondents where open to articulate their individual perspectives on the barriers and drivers impacting their organisation in the adoption of e-Business.

Table 4 Key Interview Themes

THEME	DESCRIPTION
<b>Degree of adoption</b>	<p>Establishes understanding of e-business and perception of value.</p> <p>Identifies the processes and practices undertaken in relation to how e-business has been adopted and the reasons why and how it has changed the organisation.</p> <p>Explores the internal barriers and drivers to Degree of Adoption i.e. those factors, internal to the firm, that restrict or promote the firm’s rate, mode or level of adoption in relation to social/cultural, structural-organisational, communication and economic considerations.</p> <p>Identifies strategies and techniques by which the organisations allow issues (new ideas, uptake, problems) about e-business enter/permeate the organisation and are adopted/resolved</p>
<b>Supply chain influence</b>	<p>Explores the barriers and drivers that can be attributed to organisational, social, cultural and economic influences of the supply chain; that is how the upstream and downstream linkages and cross market competition impacts upon e-business adoption</p> <p>Identifies strategies and techniques for minimising risks associated with e-business integration within the supply chain in relation to security of information and competitive advantage</p>
<b>Web-portals</b>	<p>Explores the uptake and internal barriers and drivers towards engagement with Industry Web-portals in relation to technological, communication and economic concepts.</p> <p>Identifies advantages of web portals and strategies and techniques in relation to uptake in particular skills and training.</p>

The twenty-seven firms were selected from a selection of suppliers (consultants, contractors and subcontractors) to three influential players in the construction industry; Brisbane City Council, John Holland Group and Queensland Department of Public Works. This of course only captures a snapshot of all the various suppliers (contractors, consultants and subcontractors) to these large organisations. Given this by the third case study the same dominant themes in relation to impediments and drivers were evident and the Pathways Model which was developed after the first case study was still applicable. Each case study had differences of sub impediments and sub drivers and these are discussed in detail in each case study report and summarised in this report.

The following table 5 summarises the theoretical and methodological approaches across each six case studies.

Table 5 Case Study Overview: Scope and Framework

Description	Case Study					
	1	2	3	4	5	6
Case Study Organisation	QLD Department of Public Works	John Holland Group	Brisbane City Council	QLD Department of Main Roads	Building Commission of Victoria	Melbourne City Council
Research Institution	University of Newcastle			Royal Melbourne Institute of Technology		
Sector/ Scope / State	Public/ State / QLD	Private/ National	Public/ Local / QLD	Public/ State / QLD	Public/ State / VIC	Public/ Local / VIC
Respondent profiles	<p><b>Micro to large<sup>1</sup> : 13</b>  <b>Contractors: 6</b>  <b>small 2:</b> residential, residential and commercial  <b>medium 3:</b> commercial, commercial and civil, shopfitter subcontractor  <b>large 1:</b> mining, civil, commercial and industrial contractor  <b>Consultants: 7</b>  <b>micro 2:</b> project management, architectural design,  <b>small 2:</b> quantity surveyor, surveyor  <b>medium 3:</b> architectural, land development, project management</p>	<p><b>Micro to large<sup>1</sup>: 7</b>  <b>Subcontractors: 7</b>  <b>small 1:</b> signage  <b>medium 4:</b> 2 kitchen commercial &amp; residential fabricators; 1 residential, commercial &amp; maintenance plumbing contractor; 1 walling subcontractor  <b>large 1:</b> electrical construction subcontractor and maintenance contractor  <b>Consultants: 1</b>  <b>micro 1,</b>                      structural engineering</p>	<p><b>Small to large: 7<sup>1</sup></b>  <b>Contractors: 7</b>  <b>small 1,</b> maintenance plumbing contractor  <b>medium 5,</b> construction &amp; maintenance plumbing; general contractor, fire protection subcontractor and maintenance, concrete structures contractor, structural refurbishment.  <b>large 1;</b> mechanical services construction and maintenance  <b>Consultants: 0</b></p>	<p><b>Medium<sup>2</sup>: 19</b>                      Contractors</p>	<p><b>SME<sup>2</sup>: 20</b>                      Members of Master Builders Association of Victoria</p>	Not stated
Conceptual / interpretative framework elements	Degree of Adoption: <ul style="list-style-type: none"> <li>rate/mode/level</li> <li>individual/firm/supply chain level of influence</li> <li>adoption-decision process and pathways</li> </ul>			None	Wejnert's Theory of Innovation Diffusion <ul style="list-style-type: none"> <li>Public vs. private</li> <li>Social entity</li> </ul>	None
Methodology: data collection	Semi-structured & open-ended interviews Face-to-face interviews 1.5-2.5 hrs in duration			Structured multiple choice Telephone interviews 45 minutes		Interviews
Questionnaire themes	<ul style="list-style-type: none"> <li>Degree of adoption</li> <li>Supply chain influence</li> <li>Web portals (e-tendering)</li> </ul>	<ul style="list-style-type: none"> <li>Degree of adoption</li> <li>Supply chain influence</li> <li>Web portals (e-tendering)</li> </ul>	<ul style="list-style-type: none"> <li>Degree of adoption</li> <li>Supply chain influence</li> <li>Web portals (e-tendering)</li> </ul>	<ul style="list-style-type: none"> <li>Views on e-business</li> <li>Supply chain influence</li> <li>Perceptions</li> </ul>	<ul style="list-style-type: none"> <li>ICT attributes and usage</li> <li>Importance of a web site</li> <li>Drive for take-up</li> <li>Awareness and skills</li> </ul>	<ul style="list-style-type: none"> <li>Role of web portals:</li> <li>Design process</li> <li>Construction process</li> <li>Facility management</li> </ul>

Notes: 1. Based on Australian Bureau of Statistics Business Size by Number of Employees: Micro: 1-4 Small: 5-19 Medium: 20-199 Large: 200+ employees

2: No definition in RMIT study

## 2.0 IMPEDIMENTS AND DRIVERS

### 2.1 Royal Melbourne Institute of Technology

The following are summaries of the impediments and drivers from the RMIT case studies. For consistency across all six case studies as far as practicable similar terminology has been used.

Table 6 RMIT QDMR Case Study – Impediments

THEME	DESCRIPTION
<b>Client relation</b>	Client/other parties restrictions Problems with clients Conservative thinking especially by senior managers Restrictions by others Capability issues having other ends
<b>Technical issues</b>	Lack of infrastructure Setting up problems Lack of training Lack of full understanding
<b>Privacy and security issues</b>	Concerns being security Impersonal, relations establishment may not occur Privacy issues

Table 7 RMIT QDMR Case Study – Drivers

THEME	DESCRIPTION
<b>Consistent adoption patterns</b>	External impediments No impediments No external impediments
<b>Behavioural issues</b>	Industry cultural change Cultural divide Impersonal in an industry that works on relationships
<b>Commercial issues</b>	Client dictates the rules Business relations will be different in the future Commercial reality Driver by market demand Nation wide programs are not up to speed with the private sector
<b>Technological issues</b>	Training skills associated with technology More compatible systems Software that is easy to use All documents on e-mail or CD

Table 8 RMIT MCC Case Study – Impediments: “Areas for Improvement”

THEME	DESCRIPTION
<b>Inconsistent adoption patterns</b>	Lack of consistency in rating tools, regulations and planning requirements
<b>Behavioural issues</b>	Behavioural issues related to industry/consumers not acting on long term value
<b>Commercial issues</b>	Lack of advice/tools not about products but about management of investment
<b>Technological issues</b>	Lack of advice as to existing building stock being poor and its applications for re-use

Table 9 RMIT MCC Case Study – Drivers

THEME	DESCRIPTION
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<b>Perceptions and attitudes</b>	Use case studies to demonstrate use of specific online tools Highlight collaborative decision making Increase organisations awareness of research publications on e-business uptake
<b>Organisational efficiencies</b>	Facilitate training Offer follow up expert consultation
<b>Economic benefits</b>	Allow time and space for error when introducing new practices Establish quantitative correlations on the use of specific e-business practices and improvements on green building performance
<b>Firm culture</b>	Use e-business as a communication tool to ensure improved service to client

Table 10 RMIT Case Studies – Key Themes Building Commission Victoria Impediments

<b>THEME</b>	<b>DESCRIPTION</b>
<b>Perceptions and Attitudes</b>	Innovation is difficult and complex; General lack of knowledge and awareness about e-business; Resistance based upon attitude Uptake if e-business is unstructured; Owner-managers required to give approval but often not the users; Waiting for 'help' and guidance from credible external parties such a government and professional bodies. Insecure environment
<b>Market economics</b>	Cost of IT equipment has been falling but still considered expensive and risky. Small businesses appear to be highly risk-adverse and rarely leaders in e-business adoption. Preferring to 'late' adopt industry systems with proven benefits.

Table 11 RMIT Case Studies – Key Themes Building Commission Victoria Drivers

<b>THEME</b>	<b>DESCRIPTION</b>
<b>Firm culture</b>	Learning is commonly informal.
<b>Organisational efficiencies</b>	None of the respondents transact money through their websites; Rural non-adopters appear confident with Internet banking and search engines. Typical adoption pathway starts with electronic bookkeeping onto email and/or electronic search engines to find suppliers.
<b>Management characteristics</b>	Attitudes to training. Time is the single most important factor needed for learning; often happening informally in users' spare time. Many respondents wanted their professional bodies to provide more guidance on training and skills development.

Also identified was the higher capability and importance placed on e-business by rural adopter respondents; who in comparison to all other respondents were the most mature users of email and the Internet.

RMIT also proposed a generic guideline for steps for firms when considering adopting e-business with the construction industry – this was as a result of the Victorian Building Commission case study.

Table 12 RMIT Case Studies – Steps to Deliver Value to SME’s through e-business

STEP	DESCRIPTION
<b>Identify</b>	Whether a business is an innovator, early adopter or a follower. Businesses in the first two categories are rare, and those in the last group tend to reduce the perceived level of risk by adopting only proven or mainstream processes.
<b>Review</b>	How customer needs are changing and what operational benefits can be achieved by new business process designs.
<b>List</b>	All of major business processes, and rank them in order of importance to your customers, business and contribution to the bottom line. In doing this identify which of the existing business processes require collaboration and information exchange. For these you will have to consider common information exchange formats and how collaboration will be maintained.
<b>Review</b>	The e-business case studies and best practice examples when deciding on which processes will be re-designed.
<b>Scan</b>	Emerging technologies, as they affect customer needs and customer needs then influence business designs. Eventually these business designs will affect processes, which in turn will influence the next generation of technologies.
<b>Examine</b>	The applications existing service providers offer, and the range of existing generic applications, then measure their fit with your specific needs. You probably should do this with your working associates so that collaboration on projects can be improved.
<b>Develop</b>	Your e-business plan and justification. Ensure that it has a focus on the customer, which it seeks creation of value, it transforms business processes into digital form, and it has a forward-looking application architecture (to enable integration with other systems while reducing costs and increasing customer satisfaction).
<b>Examine</b>	Your internal skills and abilities to deliver the e-business plan and aim to acquire any skills that cannot be readily found within your business. Of course senior management support and involvement and adequate training of staff are also going to be essential for success of your activities. So make allowances for this within the plan.
<b>Ensure</b>	That you have a narrow focus for each e-business design, and that there is an overall strategy in place to move from task orientated to functional then to integrated systems.

## 2.2 University of Newcastle

Similar to RMIT the UoN research identified a range of factors important to understanding within organisations; how e-business adoption is driven or impeded. The factors which impede adoption and the factors which drive e-business adoption can be similarly listed across each case study. The following tables 13 and 14 summarise the drivers and impediments respectively across each case study.

Table 13 summarises the impediments uncovered in the three case studies. There was a consistent pattern of primary or dominant themes across all three case studies which included an overarching barrier of inconsistent adoption patterns which underlies much of the e-business environment. This overarching theme breaks down into 4 main groups of influences including perceptions and attitudes, incompatibility with innovations, market economics and communication. Within each of these four clusters of themes there were various subordinate themes identified and there is a high level of similarity across each of the case studies. Some slight differences can be identified across the case studies as well.

Table 14 summarises the drivers uncovered in the three case studies. Again there was a consistent pattern of primary or dominant themes across all three case studies which included an overarching driver of perceptions of competitive advantage. This overarching theme breaks down generally into 4 main groups of influences including firm culture, organisational efficiencies and economic benefits and management characteristics. Within each of these 3 clusters of themes there were various subordinate themes identified and there is a high level of similarity across each of the case studies. Differences were identified across each of the case studies and there seemed to slightly more variability for drivers than impediments.

Table 13 UoN Case Studies – Impediments

Case Study	1	2	3
Case Study Organisation	QLD Department of Public Works	John Holland Group	Brisbane City Council
Inconsistent adoption patterns	<ul style="list-style-type: none"> <li>• Perceptions and attitudes</li> <li>• Incompatibility with innovations</li> <li>• Market economics</li> <li>• communication</li> </ul>	<ul style="list-style-type: none"> <li>• Perceptions and attitudes</li> <li>• Incompatibility with innovations</li> <li>• Market economics</li> <li>• Communication</li> <li>• Management dislocation from technology</li> <li>• Communication network underutilisation</li> <li>• Technological underutilisation</li> </ul>	<ul style="list-style-type: none"> <li>• Perceptions and attitudes</li> <li>• Incompatibility with innovations</li> <li>• Market economics</li> <li>• Communication</li> <li>• Management dislocation from technology</li> <li>• Communication network underutilisation</li> <li>• Technological underutilisation</li> </ul>
Perceptions and attitudes	<ul style="list-style-type: none"> <li>• complex and difficult</li> <li>• Resistance based on attitudes</li> <li>• Insecure environment</li> </ul>	<ul style="list-style-type: none"> <li>• difficult and complex</li> <li>• Generational discrepancy</li> <li>• Resistance based on attitudes: IT as 'white collar'</li> <li>• Perceived lack of benefit</li> <li>• Insecure environment: Duplication of systems (hard/soft)</li> <li>• Portals as complex</li> </ul>	<ul style="list-style-type: none"> <li>• difficult and complex :practical problems and philosophical</li> <li>• Generational discrepancy</li> <li>• Resistance based on attitudes: IT as 'white collar',</li> <li>• Perceived lack of benefit</li> <li>• Insecure environment: Duplication of systems (hard/soft)</li> <li>• Portals as complex</li> </ul>
e-business Innovation incompatibility	<ul style="list-style-type: none"> <li>• Previously held ideas</li> <li>• Client requirements</li> <li>• Incompatibility of systems</li> <li>• Standardisation</li> <li>• Govt influence and/or intervention</li> </ul>	<ul style="list-style-type: none"> <li>• Previously held ideas</li> <li>• Previous technology and adoption</li> <li>• Firm processes</li> <li>• Varied software</li> </ul>	<ul style="list-style-type: none"> <li>• Previously held ideas</li> <li>• Previous technology and adoption</li> <li>• Firm processes</li> <li>• Varied software</li> </ul>
Market economics	<ul style="list-style-type: none"> <li>• Perception of level playing field</li> <li>• Lack of perceived benefit</li> <li>• Lack of market incentive</li> <li>• Incompatibility of systems</li> <li>• Risk of return on outlay</li> </ul>	<ul style="list-style-type: none"> <li>• Lack of perceived benefit</li> <li>• Lack of market incentive</li> <li>• Lack of external pressures</li> <li>• Lack of internal pressures</li> </ul>	<ul style="list-style-type: none"> <li>• Lack of perceived benefit</li> <li>• Lack of market incentive: adaptability, varied software</li> <li>• Lack of external pressures</li> <li>• Lack of internal pressures</li> </ul>
Communication	<ul style="list-style-type: none"> <li>• Resistance to heterophilic (diverse/unlike sources) communication</li> <li>• Technological compatibility</li> <li>• Disassociation from end users</li> </ul>	<ul style="list-style-type: none"> <li>• Reduced information quality</li> <li>• Flattening communication network</li> <li>• Duplication of systems (hard/soft)</li> <li>• Communication network underutilisation</li> </ul>	<ul style="list-style-type: none"> <li>• Reduced information quality</li> <li>• Flattening communication network</li> <li>• Duplication of systems (hard/soft)</li> </ul>

Table 14 UoN Case Studies – Drivers

Case Study	1	2	3
Case Study Organisation	QLD Department of Public Works	John Holland Group	Brisbane City Council
Perceptions of advantage	<ul style="list-style-type: none"> <li>• Firm culture</li> <li>• Organisational efficiencies &amp; economic benefits</li> <li>• Management characteristics</li> </ul>	<ul style="list-style-type: none"> <li>• Firm culture</li> <li>• Organisational efficiencies &amp; economic benefits</li> <li>• Management characteristics</li> </ul>	<ul style="list-style-type: none"> <li>• Firm culture</li> <li>• Organisational efficiencies &amp; economic benefits</li> <li>• Management characteristics</li> </ul>
Inter and intra Organisational efficiencies & economic benefits	• Human resource advantages	• Resource planning	• Resource planning
	• Streamlined processes	• Streamlined processes	• Streamlined processes
	• Competitive advantage	• competitive advantage	• competitive advantage
	• Reduced production costs	• Improved productivity	• Improved productivity
	• Reduced communication costs	• Reduced communication costs	• Reduced communication costs
		• Reduced operating costs	• Reduced operating costs
		• Improved information management	• Improved information management
		• Streamlined communication	• Streamlined communication
Management characteristics	• Attitudes to innovations	• Attitudes to innovations	• Attitudes to innovations
		• Adaptability	• Adaptability
		• Compatibility with the innovation	• Compatibility with the innovation
		• Decision making	• Decision making
	• Risk management and innovation evaluation		
	• Attitudes to training		
	• Organisation support for training		
Firm culture	• Trust in the supply chain	• Trust – communities of practice	• Trust – communities of practice
	• Informal social networks		
	• Social business networks		
		• Individual autonomy	• Individual autonomy
	• Innovation as a culture		

By using an interpretative methodology the research was able to move beyond the superficial; enabling the discovery and exploration of the complexity of behaviours and motivations impeding and promoting e-business adoption internally and externally of the respondent organisations. This might best be illustrated by providing an example using quotes from respondents that illustrate how “Perceptions and attitudes” as an impediment encompasses a quite diverse range of respondent firm scenarios.

i. Modern business communication is complex and difficult and in the past (generational discrepancy) we could develop more humane relationships

Box 02 UON Firm 26 Quote

Less personal, less personal you know relationships ... whilst you might still have a telephone relationship with somebody or an email relationship with somebody, it's not the same as what they were 15, 20 years ago when you went down to the local hardware store or wherever it might be and picked up ... whatever it might have been ... I guess it's in that sense, there's probably less trust ... because you just simply don't know the person you're dealing with ... they're probably more distant, they're less trustful, they're all of those sorts of things, more difficult to maintain, they're anonymous, generally they're anonymous ... whilst my name might be (Peter) and my email address is PC or whatever it is, I could be Bill Bloggs. (Firm 26)

ii. Resistance by the management and a dislocation from the technology and a partial adoption pattern because of a perceived inability to assimilate computer culture within the firm; perception as complex and difficult and yet manager actually adopts up to date digital technology to record site observations but then doesn't take full advantage (partially adopts) within the firm (i.e. later in the interview we find they manually print out all the documents for the manager to view rather than computer storage)

Box 03 UON Firm 24 Quote

Blank, I am a blank. Really? You use email, do you use digital cameras for your photos? Yes. Yeah. Do you – I am computer illiterate, I've gone and done courses on it but I am illiterate, I just detest them. (Firm 24)

iv. Resistance based upon e-business being complex and difficult and people younger being better suited to computers – a generational interpretation

Box 05 Firm 26 Quote

I think in general terms it's a generational thing, I think there are plenty of examples of say the baby boomers who ... are digitally challenged ... you know the Xs have pretty well grown up with the bloody stuff and they don't think twice, they might not have the ability to access it all the time, they might not have it on their own desktop at home but they've generally got the ability (Firm 26).

v. Computer use/users negatively associated with costly 'mistake'

Box 06 UON Firm 24 Quote

And then so when I get that information coming back to where this chap cost me nearly twenty grand, [...] did that in his lunch hour, this bloke cost me nearly twenty grand! And then I can't, it's very hard for me to even understand what he's doing, he's got information there that I don't require because it's all computer generated. (Firm 24)

vi. A perception and corresponding resistant attitude by management and a management which is actively dislocated from the technology because of a preference for retaining person-to-person contact and struggling and find it difficult to adapt and combine new forms of communication (lack of compatibility) because of previously held ideas

Box 07 Firm 23 Quote

We find that well, the works we do we still like face-to-face contact. It's just that sometimes it's, in the works that we do the explanation over well say sending an email, that is how I have

always done it, it's... I mean that works it's very effective without a doubt but sometimes you sort of like need face to face to explain or to show. (Firm 23)

vii. Resistance is based upon lack of perceived benefit and this lack of internal pressure to change can be driven by external pressures from clients or other firms that they deal with. Computers seem to not produce any organisational efficiencies and benefits and force the person to take longer (where's the benefit?)

Box 08 Firm 24 Quote 1

Because I'm computer illiterate ... I can do nine quotes in my head with a scale rule ... in the same (time) as what it would (take to) mess around (on the computer) because there's so much information in that rig you know I've gotta go through (Firm 24)

viii. Resistance is based on an employee's perception that management is dislocated from the technology, that there is a lack of perceived benefit and that it is a difference in attitude between generations. The boss is old school, so any change needs to be compelling

Box 09 Firm 23 Quote

Yeah well that's right I mean like I said him being old school as well I mean unless he's going to see a real good beneficial thing to it he doesn't want to be a part with it. (Firm 23)

This revisiting and critiquing of the data only takes place through full immersion in the comments and continual association and interaction and input between the four researchers to provide a greater degree of triangulation of perspectives thus agreeing on the eventual coding and interpretation of the data. The limitations are of course acknowledged. We also need to acknowledge that this is only based upon 27 firms. It would be ideal to repeat this study with another state government department, local government department and also commercial contractor for increased replicability and validity. However we note that we did reach a degree of saturation by the third case study.

It has been quite common in the literature related to e-business in both construction management and economics and mainstream management and business research to conduct reductionist research. By reducing the research problem to a set of factors it is easier to comprehend and to deliver panacea recommendations to accelerate the diffusion of e-business in the construction industry. The research underpinning the BCC, QDPW and JHG case studies were attempted to go beyond providing a set of impediments and drivers and effectively 'peel' away the layers of these factors through an exploratory and critical interpretative approach. This enabled the researchers to further 'lift the veil' from the respondent's initial statements and expose a diverse range of impediments and drivers. Nonetheless at some stage it is important to reduce findings so that humanly we can comprehend the phenomenon. The dilemma then is:

*How do we attempt to portray the situation in a simplified manner but not to demean the research problem and ensuing results in a simplistic manner; i.e. how to still provide the industry partners with some meaningful and rich yet simplified outcomes which can be useful?*

To address this question we sought to be guided by consideration of how we should interpret three main findings and how to capture these findings in the development of the e-adoption profile:

1. **Causal Inter-relationship Linkages:** the emergence of the fact that many of the impediments and drivers (causal factors) are inter-related i.e. linked;

I.e. the complex interweaving of impediments and drivers reminds us that the individualisation and reduction of factors is to a large extent a conceptual device for explication and NOT a reflection of the industry reality and thus if we are to provide, develop and/or implement policies, processes, tools, strategies, techniques and various initiatives then we must know what we are aiming to address and what the implications are given the complexity of the adoption-decision process exposed through this research

2. **Impediment to Driver Transformation:** the emergence of the fact that there was a tendency for impediments to transform into drivers;

An early assumption was to view e-business adoption as operating in a 'binary' environment consisting of barriers and drivers. However, an important finding of the research was to discover barriers possessed a high degree of fluidity. Meaning barriers are found to be somewhat amorphous and can be re-evaluated and transformed through specific techniques that allow them to be transformed into drivers and positive factors in e-business adoption. Hence it was determined the term 'barrier' with connotations of finality and impassibility was a misleading and unsuitable descriptor. Accordingly, the more suitable term 'impediments' has been substituted for 'barriers' in the findings of the research.

3. **e-Adoption Decision Pathway Model:** the emergence of the fact that there were common pathways of e-business adoption.

Further to the impediment to driver transformation is that this transformation is key to our understanding of the e-business adoption – decision process. The Pathway model emerged through the data analysis – we began to see that firms moved through various but largely common pathways and these pathways were largely evident as firms displayed the different characteristics of low to mid to high to very high levels level of e-business experience.

To address the causal linkage issue grounded in the empirical study the University of Newcastle researchers were able to compile a number of causal diagrams linking key drivers influencing Impediments to e-business Adoption and Drivers of e-business Adoption. The case study reports can be referred to for these diagrams. Our first attempt at the diagrams produced reactions that there were too difficult to understand even given the textual explanations of the causal linkages. By way of explanation we have now provided one of these diagrams in stages to progressively unravel the linkages for one of the case studies (QDPW).

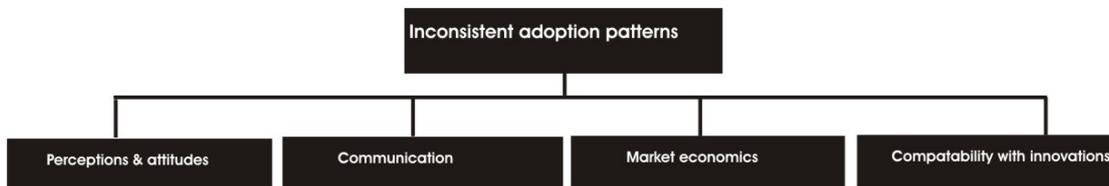


Figure 2 Key Impediment of Inconsistent Adoption Patterns and Primary 4 cluster impediments for e-business Adoption QDPW case study

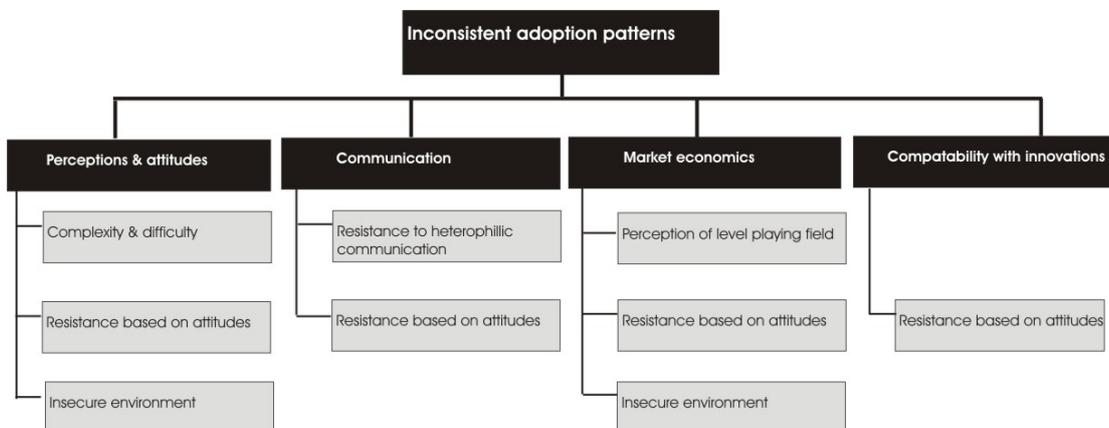


Figure 3 Subordinate Impediments e-business Adoption QDPW case study

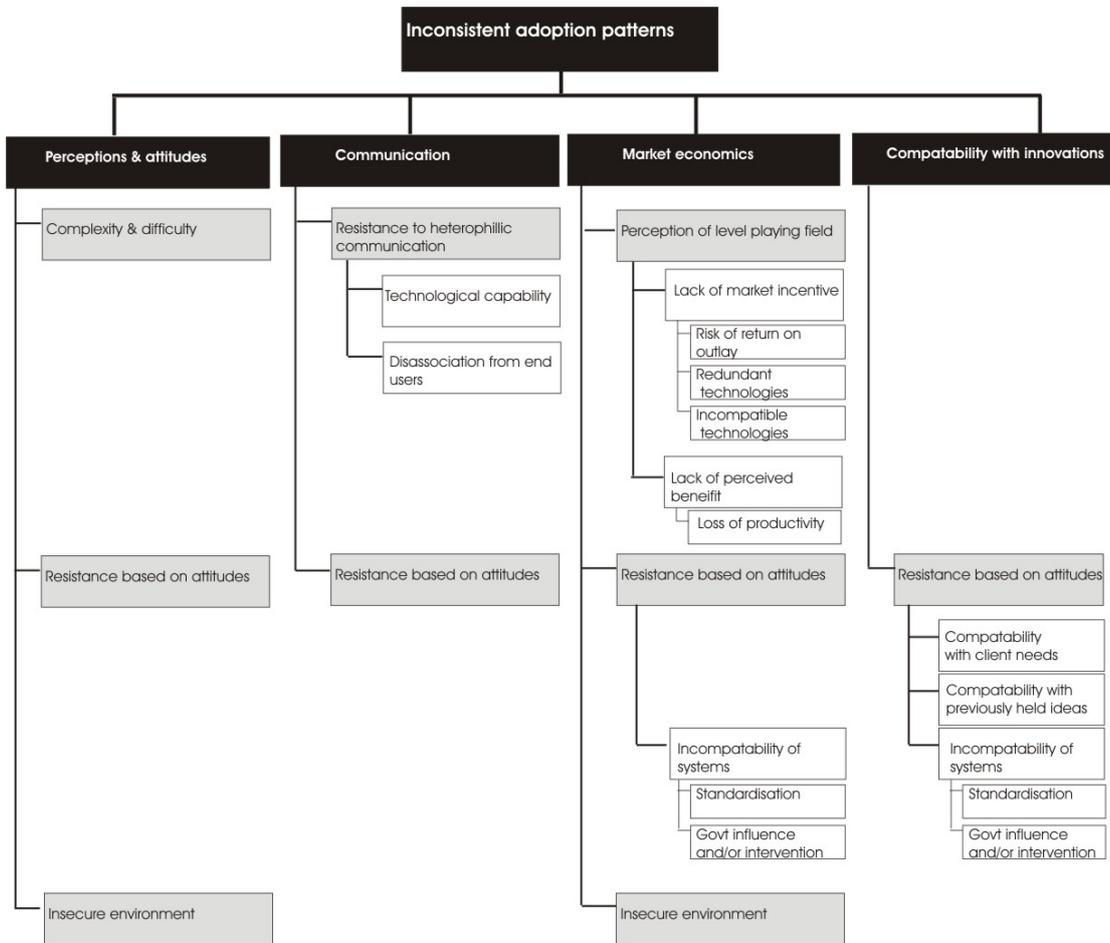
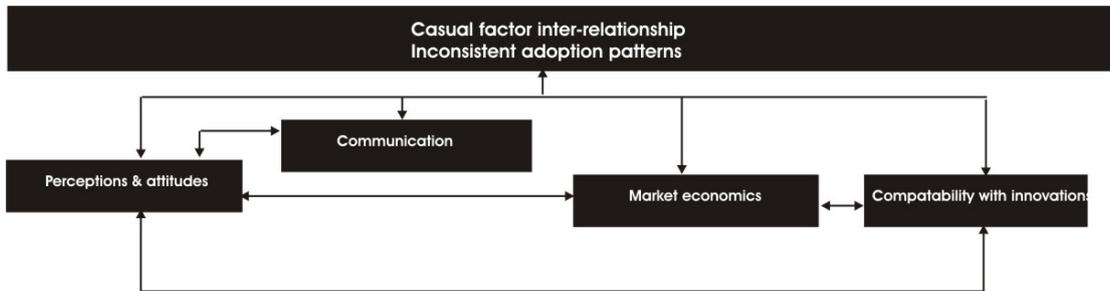


Figure 4 Themes within Subordinate Impediments e-business Adoption QDPW case study

Figure 5 Primary Causal Linkages e-business Adoption QDPW case study



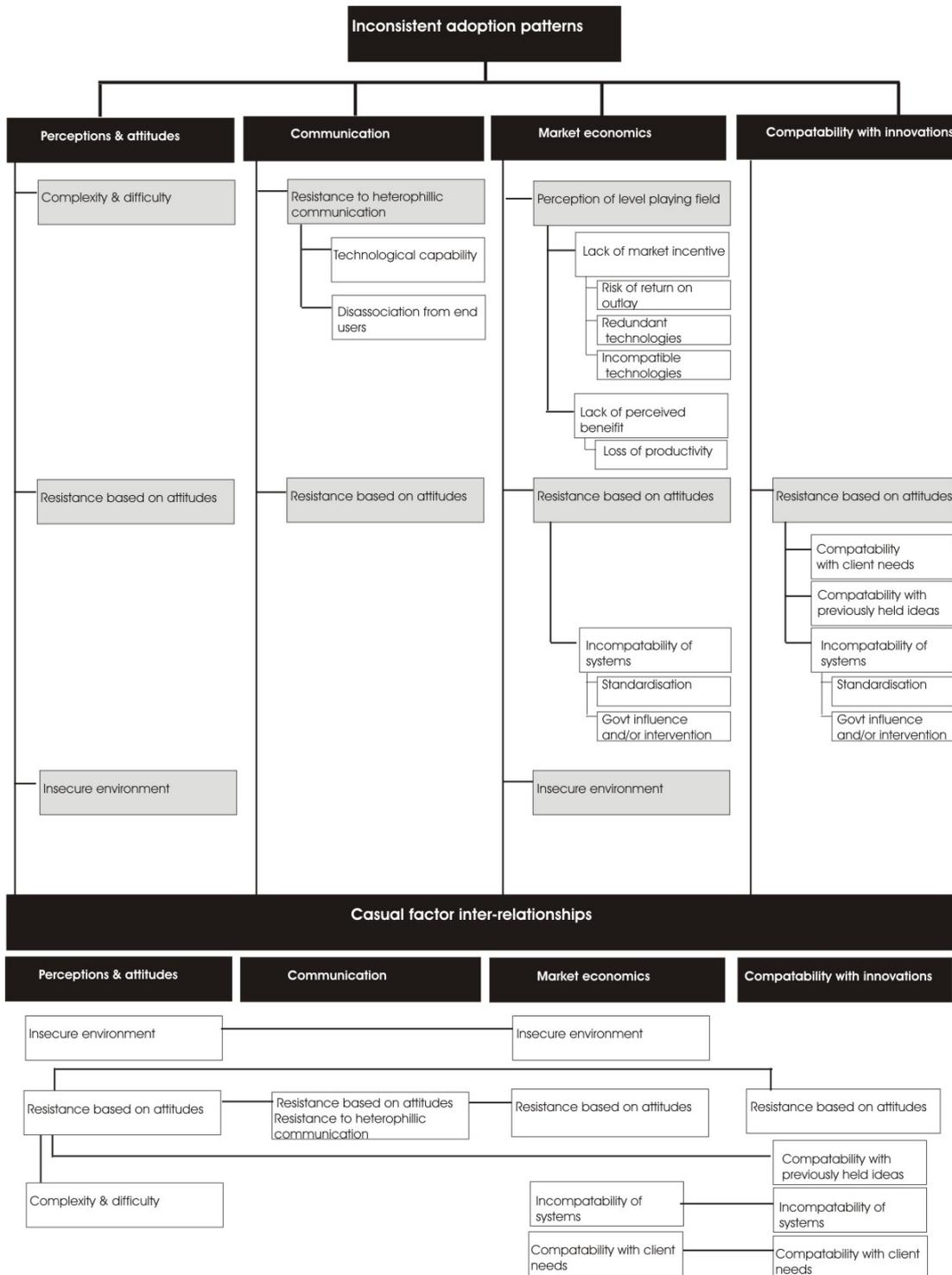


Figure 6 Specific Causal Linkages e-business Adoption QDPW case study

For a more complete explanation the case study reports should be referred to however a brief overview is now provided. There was an overarching impediment to e-business adoption which was constantly referred to by all participants and that was the structure of the industry and perhaps the inertia of the industry in relation to inconsistent adoption patterns – a perception that it was just too large, complex and difficult a task to adopt e-business as the whole industry would need to adopt and adopt all the same software and methods of operation, standards etc. Within this overarching impediment there were four interrelated subordinate impediments including perceptions and attitudes, compatibility of the innovation, market incentives (including i.e. risk on investment and uncertainty regarding returns) and heterophilic and homophilic communication. The inconsistent adoption patterns are a direct cause of incompatibility problems such as software incompatibility, but in addition to that a firm’s experience with e-business also influences

their approach towards further adoption. Resistance to adoption of e-business arises because Incompatibility is linked to incompatibility with client needs and this is where the upstream importance of clients and the supply chain influence is critical. If a client does not have enough market influence then firms will not elect to adopt and change any e-business practices. An outcome of inconsistent adoption patterns is the financial problems caused by different organisations utilising different software programs or using different editions or versions of the same software. Issues of inter-organisational (supply chain and upstream and downstream linkages) compatibility becomes an important impediment to adoption.

However incompatibility based upon disparate software is the not the sole expression of e-business innovation incompatibility. Another recurring theme was that IT applications are also frequently incompatible with pre-existing business process and operating systems within a firm. Incompatibility can cause delays in processes with the inevitable frustration and financial consequences. Equally important such occurrences can add markedly to the perception of adoption as complex and difficult and therefore then incompatibility relates to a resistant to adopt based upon attitudes which is underpinned by an idea of the innovation being too complex and difficult. The e-business environment itself can be complex or the fact that it is too complex or difficult to get others to adopt. Thus the outcome of this impediment is that the potential e-business applications of an innovation are never simply evaluated and considered for adoption just on the basis of its own attributes but also on the basis of a whole range of pre-existing organisational – structural – cultural – economic conditions that determine the relative ease of the adoption-decision process.

There is little doubt that IT adoption has a considerable economic outlay and that frequently economic benefits are not felt immediately but can often take some time to accrue. It was a key theme in our research that smaller operators keenly felt the financial pinch of outlay on IT equipment and related software (or perceived it as a large cost). Thus the lack of market incentive in terms of prohibitive cost intersected frequently with an attitude that the status quo is a workable proposition. In many cases this was enough to convince smaller operators that a given adoption was unnecessary and thus improvements to business process even through incremental e-business technology adoption (and minimal cost) offered by innovations are not pursued. This degree of uncertainty regarding returns on investments held by the smaller-end operators is an outcome of their perception on the value of the innovation, which can also perhaps be considered as a lack of awareness of the potential benefits an e-business application can offer. An important point which emerged from the analysis is that these attitudes are common across individuals of comparable strata within the industry and hence related to their position in an economic structure and specific market dynamic as much as their participation in an industry culture. What we were regrettably unable to determine, due to lack of time and resources, was any more specificity of firm attributes or supply chain attributes and any similarities and/or differences across different types of supply chains – type by what the chain delivers and type by industrial market characteristics.

For smaller operators (and this is what isn't appreciated by larger operators) it is not just the initial outlay but the 'true' cost of e-business which needs to be considered critically – i.e. operational and training costs and then system maintenance costs. Associated with these costs and thus wrapped up lack of market incentive and lack of perceived benefits is also the consequent loss of productivity that is associated with staff training. Interestingly this was not only a consideration for the small operators but the medium and large sized firms as well.

Barriers to diffusion as an outcome of perceptions and associated resistance based on attitudes can be considered from two aspects; perception of an insecure environment as well as the perception of e-business as complex and difficult (which was discussed previously). The perception of IT environments as insecure is a commonly held assumption prevalent throughout the construction industry and has been identified in numerous other research studies as well. The finding allows us to confirm the findings of these other studies but does not offer anything specifically new. However a significant twist to this finding is the degree to which perceptions of IT as an insecure environment have insinuated itself into lower levels of organisational trust, in which firms deploy stringent intranet security measures designed to protect sensitive information

and defend against loss of commercial advantage via leakage of sensitive information. Thus the issue regarding security of information is rooted in deeper notions of the economics and value of private information as competitive market advantage. It is difficult to imagine a cultural shift towards greater transparency of process and ease of information availability and file sharing taking place amongst an industry supply chain composed of firms that do not trust their own employees. The changing of this perception and attitude towards security of information must begin at managerial level and must begin within some firms before we can even hope to move the industry towards any high end of open systems along the supply chain.

The perception of e-business as difficult and complex is an interesting finding that demonstrates the power of attitudes and perceptions in influencing patterns of adoption. Our research made use of a hyphenated concept indicator “perceptions of complexity-difficulty”. We found this useful precisely because it showed the relationship between the perception of complexity, which is usually a marker of conceptual distance between required operating knowledge and previously held ideas and available skills sets, and an interpretation of that complexity as ‘difficult’. This perception of complexity-difficult is associated with market economics – in this sense ‘difficult’ becomes understandable as a euphemism for unavailable resources in terms of manpower or capital to invest in understanding the complexity in order to turn that greater (more complex) capacity into advantage – thus perception of difficulty is rooted in deeper notions of lack of perceived benefit in relation to cost implications to the firm.

These perceptions and resistance to change attitude were evident in smaller end operators who occupy the lower end of the spectrum of adoption. Their processes remain impervious to any perceived IT benefits largely on the basis of these perceptions and attitudes. We found that their perceptions of complexity and difficulty are frequently not the product of personal exposure and usage of the e-business application in question, but rather the product of ‘myths’ and second hand knowledge passed on through informal networks – like minded managers communicating and reinforcing similar attitudes and approaches. Consequently the firms at the lower end can be considered to belong to primarily homophilic communication networks (homophilic refers to like minded people) on the basis that their perceptions of ‘complexity as difficult’ is rarely challenged. A position in a homophilic social network is likely to produce a culturally indoctrinated set of attitudes that forms the basis for an easy dismissal of potential benefits of IT adoption on the basis of many justifications.

This is only a summary of the discussion of the QDMR case study to serve to illustrate the explanation of our understanding of the linkages between the impediments and drivers. A more detailed explanation of each of the case studies and each of the causal linkages can be found in the individual case study reports.

While the above provides a rich insight into the real world complexity of inter-relationships between impediments and drivers towards e-business Adoption within the construction industry; there is also a need to develop a more manageable and generalised conceptual framework from the results; i.e. something more tangible that can begin to provide some direction for this industry problem and for those seeking to improve overall industry adoption. This was achieved through the introduction of the idea of ‘pathways’ towards e-business Adoption. This framework achieved a number of important things:

- i. Provides recognition of the fluidity and transformation associated with ‘impediments’ and ‘barriers’ to e-business adoption
- ii. Reflects the general dynamic that exists within organisations in relation to adoption decision processes and the conditions that need to be created so that an individual firm in construction specifically can assess their own position towards adoption of e-business practices
- iii. Recognises change ‘pathways’ are neither prescriptive or unique but numerous and subject to ongoing transformation

The Pathways Model is described in the final Section Adoption Profile as it relates to level of e-business experience and degree of adoption. There were three Pathways identified and high e-business experience firms exhibit all pathways whilst low level need to “get” onto the first pathway. The Pathways are described in detail after the levels of e-business experience results are presented. The impediment to driver transformation and the e-adoption decision pathway model

### 3.0 Adoption Profile

The adoption profile outlined in this report is aimed at the third research objective determined at the outset of the research project: to develop an e-business technology adoption profile specifically for the construction industry players.

The two goals of this adoption profile are to:

- Firstly, describe the attributes of firms corresponding to different degrees of e-business experience and capability.
- Secondly, to propose, grounded in empirical case studies, a series of recommended steps in relation to the adoption-decision process relevant to each degree of e-business capability and experience with the aim of providing a framework for firm’s to assess their degree of e-business Adoption and move along the appropriate e-business adoption pathway

Towards achieving the first goal a two day workshop was held at the University of Newcastle with both research teams in attendance and the following degree of adoption profile in relation to e-business experience was developed based upon the findings of the 6 case studies. The following Table 16 outlines the template which has been developed specifically as a result of interviews with 66 organisations in the construction industry which can be used to identify and classify e-business experience across 3 dimensions of degree of adoption; rate, mode and level. Each case study report documents in more detail the e-business experience characteristics of each firm with various descriptions of what their current mode of adoption. The two day workshop was designed to form an agreement on the definitions of what constitutes low, mid, high and very high e-business experience and consideration of rate, mode and level descriptions of each category. This section synthesises the six case study reports in this respect.

Although the six individual case studies within the overall research program have produced identifiable differences in the research design and conduct for the case study reports produced by each research team, these differences are considered to contribute by increasing the overall richness and providing a wider perspective for the development of recommendations suitable to the wide variety of organisational conditions and circumstances within the industry. Despite methodological differences, there were identifiable trends uncovered through the cross-case descriptions that related to the characteristics of a firm as measured on a spectrum of e-business experience and capability from Low to Very-High.

The adoption profile developed for this report is grounded in the identification of key characteristics and organisational attributes of firms according to this classification scheme of Low to Very-High e-business experience. Hence, it is offered as a research outcome applicable to all the industry partners and research participants.

The second goal of the adoption profile is achieved through the development of the description of the adoption-decision process through the discussion of the e-Adoption Decision Pathways Model specifically developed by the University of Newcastle research team and grounded empirically in the interpretation of the results.

#### 3.1 Adoption Profile Firm attributes

The levels of e-business experience correspond to different characteristics across the degree of adoption dimensions of rate, model and level.

### **3.1.1 Degree of Adoption**

The Degree of Adoption and/or level of e-business Experience is a synthesis of a number of dynamic processes which only capture an organisation at a particular point in time. However, key factors have been identified that contribute to assessing the different levels of diffusion within the construction industry. This provides us with a diagnostic tool and hence the capability to determine any organisation's current and future propensity to adopt e-business solutions.

The Degree of Adoption measure provides a static and diagnostic approach in conjunction with the measure of e-business Experience. The e-Adoption Decision Pathways Model described later in this section attempts to reflect the dynamic nature of e-business Adoption within the Australian construction industry.

#### Rate, Model and level of Adoption

In Roger's Diffusion Theory the rate of adoption is implicitly represented as a temporal process with adopters ranging from Innovators to Laggards spread along a time based continuum.

In these case studies it is argued that the driver of the adoption rate is not time *per se* but rather a change in behavioural characteristics that are mediated through management characteristics, firm culture and supply chain influence. So although adoption rates may still be envisaged as operating along a time line; at any point in time a shift in the 'perception of advantage' will impact upon one or more of the three key pathways: Perceptions, Compatibility, and/or Communications and will move an organisation along the e-business Adoption continuum. A discussion on the pathways is presented in the following section.

In table 3 previously degree of adoption was provided and definitions of the key dimensions of rate, mode and level were presented as part of the conceptual model. We shall now revisit these definitions and "update" them based upon the findings of this study.

Table 15 Degree of Adoption – Key dimensions

DIMENSION	DEFINITION
<b>Rate of adoption</b>	<p>Rate is characterised by the changes in perceptions and attitudes towards e-business from firm, individual and supply chain as adoption moves from low level to high level e-business experience.</p> <p><b>Firms move from a low e-business experience and a ‘culture’ where participants struggle to perceive the benefits to firm, individual and supply chain integration to a very high level of e-business experience and an associated ‘culture’ where participants perceive, understand and leverage e-business as an economic market advantage.</b></p>
<b>Mode of adoption</b>	<p>Mode is the form (software, internet etc) that the adoption of the innovation takes in terms of the practical uses it is put to within the organisations practices and processes.</p> <p><b>Firms move from a low to very high level of e-business experience displaying four mode categories including;</b></p> <ol style="list-style-type: none"> <li><b>1. minimal use of applications,</b></li> <li><b>2. generic uses of industry standard applications,</b></li> <li><b>3. externally driven adaptive applications and uses;</b></li> <li><b>4. internally produced creative applications and uses</b></li> </ol> <p><b>Table 16 provides descriptions of each level of mode.</b></p>
<b>Integration Level of adoption</b>	<p>Level is the extent to which adoption of e-business innovation is integrated into, and thus impacts the structure, processes and practices of an organisation.</p> <p><b>On the level of adoption scale firms of low level of e-business experience have no level of integration. Firms move from a medium level of e-business experience to a high level of e-business experience displaying the following three integration categories:</b></p> <ol style="list-style-type: none"> <li><b>1. Minimal integration into processes</b></li> <li><b>2. consistent integration into processes</b></li> <li><b>3. rapid and reflexive integration into processes</b></li> </ol>

Note: bolded text indicates additional definition

Table 16 Mode of Adoption Descriptors

CATEGORISATION	ATTRIBUTES
<b>Minimal Uses of Applications</b>	<p>No company web presence</p> <p>Email as a secondary communication tool</p> <p>Use of account-keeping software such as MYOB</p> <p>EFT to pay and receive accounts</p> <p>Basic use of Microsoft Office suite of applications (or equivalent)</p>
<b>Generic Uses of Industry Standard Applications</b>	<p>Basic web presence (web-based advertising)</p> <p>Email as primary communications tool</p> <p>Use of PDF as standard document transfer format</p> <p>Regular back-up of important files</p> <p>Regular use of Microsoft Office (or equivalent) applications in the daily operations of the business</p> <p>Use of a CAD package such as AutoCAD for reading and modifying drawings</p>
<b>Externally Driven Adaptive Applications and Uses</b>	<p>Web presence regularly updated with relevant information</p> <p>Preference for on-line procurement</p> <p>Intranet technology used to communicate with employees</p> <p>Customisation of applications such as Microsoft Excel or Access database (or equivalent) for data analysis and reporting</p> <p>Mobile technology such as laptops and/or PDA's widely used</p>
<b>Internally Produced Creative Applications and Uses</b>	<p>In-house or outsourced creation of custom business applications</p> <p>Intranet is a fully functioning portal used to facilitate data exchange within the company</p> <p>Large-scale ERP (Enterprise Resource Planning) systems</p>

Table 15 Classification of e-business Experience through Degree of Adoption

		Degree of Adoption		
		Rate	Mode	Level
eBusiness Experience	Very High	Innovator Understand the Benefits Perceives the Potential Leverages the Capability	Internally Produced Creative Applications and Uses	Rapid and Reflexive Integration into Processes
	High	Early Adopter Understand the Benefits Perceives the Potential	Externally Driven Adaptive Applications and Uses	Consistent Integration into Processes
	Medium	Late Adopter Understand the Benefits	Generic Uses of Industry Standard Applications	Minimal Integration into Processes
	Low	Laggard Struggling to Understand the Benefits	Minimal Uses of Applications	

## 3.2 Adoption profile: Adoption-decision pathways

The Classification of e-business Experience through Degree of Adoption is one part of the adoption profile however, it is a static and thus limited description of the adoption profile. This section describes the dynamic characteristics of the e-business adoption-decision process which were uncovered through the QDMR, BCC and JHG case studies. This section seeks to answer the following questions:

- How does e-business experience levels relate to firm size?
- How does e-business experience levels relate to impediments and drivers?
- How does e-business experience levels relate to inconsistent adoption patterns?
- How does e-business experience levels relate to perceptions of advantage of e-business?
- How does e-business experience levels relate to the adoption decision process?
- How does e-business experience levels relate to e-adoption decision pathways model?

### 3.2.1 E-business experience and firm impediment/driver characteristics

The literature has typically provided us with studies which describe impediments and drivers. At times impediments have been identified as initially impediments which have been transformed into drivers. An important finding of the research undertaken in this study was the clarity with which we began to uncover more detail about this transformation process in relation to the construction industry players and the identification and classification of a typology of three distinct pathways of adoption.

Numerous impediments can easily transform into drivers for further adoption once they are re-evaluated and perhaps approached with new strategies or techniques. The tendency for impediments to transform into drivers is demonstrated by the corresponding presence of two key themes described by respondents as simultaneously barriers hindering and factors positively influencing e-business adoption. These two key themes are Perceptions and Attitudes and Compatibility with the Innovation. In addition a third impediment to adoption described as Communication (Heterophilic; communication between diverse groups and Homophilic; communication between similar groups) is also interpreted as an impediment to adoption in an unmanaged state that quickly becomes a key component in firm culture as a driver towards e-business adoption when it is addressed as a component of strategic management.

The following table 16 is a simplified assessment of each of the seven firms in the BCC study against the set of primary barriers and drivers identified within the case studies. We have then mapped the level of e-business experience and the size of the firms. It became apparent that the firms indicated aspects of each of the barriers and drivers in varying degrees which could be categorised on a spectrum from low/negative to average/neutral to high/positive.

Table 16 Assessment of case study firms – BCC case study

Case Number	Inconsistent adoption patterns	Management characteristics	Firm culture	Perceptions and attitudes	Compatibility with the innovation	Heterophillic & homophillic communication	Perceptions of advantage
22	—	😊	😊	😊	😊	😊	😊
23	😐	😐	😐	😊	😐	—	—
24	😞	😞	😐	😐	😞	—	—
25	—	😊	😊	😊	😐	—	😐
26	😐	😊	😐	😊	😊	—	—
27	—	😐	😊	😊	😊	😊	😊
28	😞	😞	😞	😞	😞	—	—

 Low or negative     
  Average or neutral     
  High or positive     
  Blank

These results can inform and guide the development of specific firm diagnostic Assessment Framework for self diagnosis by individual firms or an Assessment Tool for larger organisations wishing to influence the uptake of e-business by their suppliers. Larger organisations may be able to develop rewards and incentive programs for their suppliers which are more targeted and more effective strategies than now. It will also inform the choice of various tools, techniques and strategies and new policy development or initiatives and programs aimed at improving e-business uptake.

Strategic questions can be asked :

What type of firm is this initiative aimed at?

What level of e-business experience is the firm or group of firms at?

How will this initiative improve managers' perceptions and attitudes towards e-business?

How will this tool assist training if indeed it is training that is required?

How will this e-business technology transform the business processes of the target audience?

How does this new e-business initiative impact upon compatibility of technology or process between firms in various supply chain?

What influence will the e-business technology have on productivity of the firms it is aimed at?

Are these firms concerned with risk of return on outlay?

Are they concerned with compatibility of systems or standardisation?

Are we a large enough client to influence or demand compatibility with our systems?

What do our 'competitor' clients demand of their suppliers?

### **3.2.2 Pathways from impediments to drivers**

It then emerged from the analysis of the three case studies a discernible pattern of driver and impediment characteristics and associated attitudes towards e-business and perceptions of competitive market advantage towards e-business. We found that within the firms investigated in the construction industry in relation to e-adoption numerous impediments can easily transform into drivers which then translates into further adoption.

The tendency for impediments to transform into drivers is demonstrated by the presence of key themes described by respondents as simultaneously barriers hindering but then factors positively influencing e-business adoption. These patterns can be seen in three identifiable Pathways which we have termed : Perceptions Pathway, Compatibility Pathway and Communication Pathway.

The following discussion outlines a set of inter-related pathways that define the transformative relationships between the key themes discussed by respondents in the study. Pathways are the combination of the processes and strategic re-evaluations discussed by respondents as means of overcoming social, cultural and economic barriers to adoption by transforming the same structural conditions and organisational practices into resources for further adoption decisions and perhaps innovation.

The underlying starting point and context for e-business adoption is inconsistent adoption patterns and market economics – but from this position there emerged three pathways: Perceptions and Attitudes, Compatibility with the Innovation and Communications which are influenced by:

management characteristics, organisational and economic benefits and firm culture but in different ways. Firms who had reached very high levels of e-business experience exhibited high or positive attributes in management characteristics, organisational and economic benefits and firm culture and had moved through all three pathways. Firms who were of high e-business experience had passed through the Perceptions and Compatibility Pathways; firms of medium e-business experience had passed through Perceptions Pathway and had elements of Compatibility Pathway and firms with low e-business experience were in the early stages of the Perception Pathway (refer to Figure 7). It is noted that in organisational practice it is not so easy to identify a clearly defined starting point in a situation where there are a complex set of causal factors. Although represented as sequential and hierarchical it is noted that they are interlinked; i.e. changes in perceptions can lead to changes and improvements in communication modes or changes in perceptions leads to changes in compatibility which then further builds to improve perceptions and attitudes towards further e-business adoption.

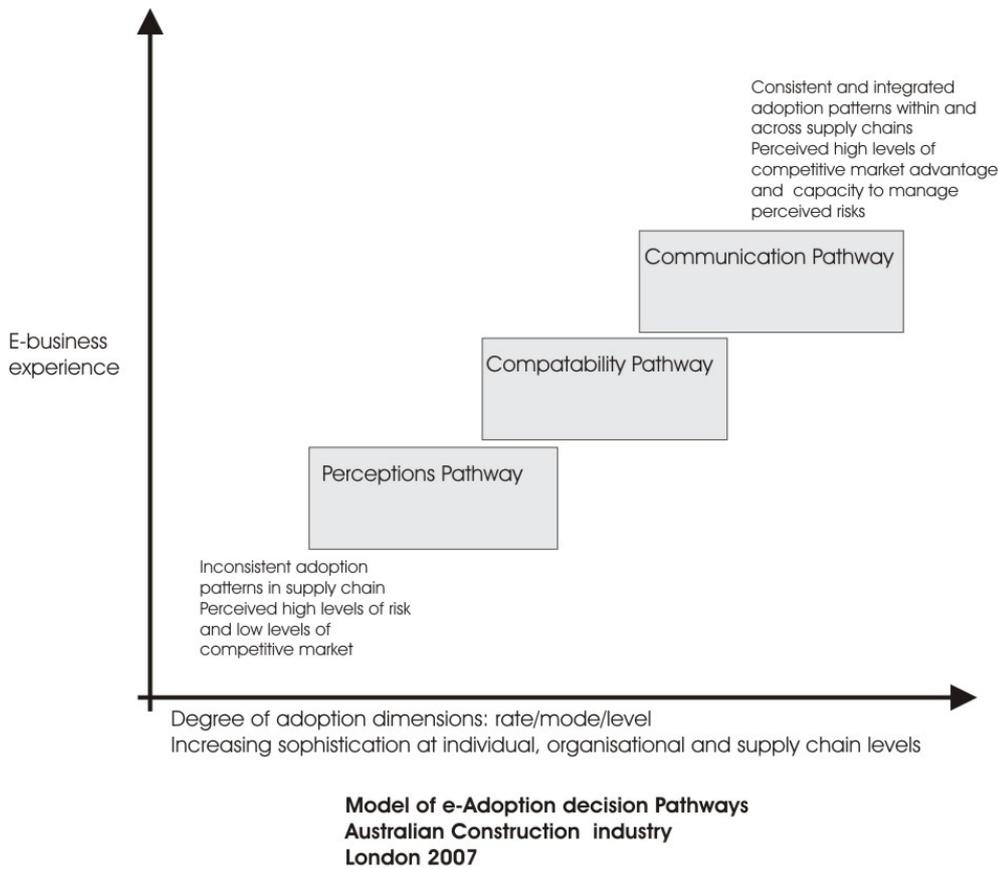


Figure 7 Model of e-Adoption Decision Pathways Model for the Australian Construction Industry (London, 2007)

Table 17 Perception Pathway

PATHWAY	DESCRIPTION
<p><b>Perceptions</b></p>	<p><b>Initial state:</b> High levels of inconsistent adoption patterns internally &amp; across supply chains and firm highly reactive to market economics</p> <p><b>Primary impediment:</b> Underlying negative attitudes towards e-adoption by management and staff and minimal or no apparent perceptions of economic advantage of e-adoption by management. High levels of homophilic communication (i.e. communication between individuals in groups who share common beliefs and have mutual understanding of each other) and high levels of shared belief and attitude of resistance to e-adoption, low levels of diffusion of e-adoption. High resistance to heterophilic communication (i.e. communication between individuals who have different beliefs, education and socioeconomic status).</p> <p><b>Pathway: Perceptions and attitudes</b></p> <p><u>Management characteristics:</u></p> <p>Management levels of awareness improve and move from active resistance to low levels and tacit understanding</p> <p>Decision making changes from active resistance to some degree of support for e-adoption</p> <p>Low level compatibility problems may be considered and resolved</p> <p>Perception of complexity begins to change from that of difficult to complex but may be solvable</p> <p>Improved understanding of e-adoption as a business proposition and less as a technological problem to actively resist</p> <p>Improved attitude towards training and a movement from resistant to small levels of organisational wide support</p> <p>Management are less dislocated from the technology</p> <p><u>Organisational and economic benefits:</u></p> <p>Management begins to develop improved perceptions of economic benefits</p> <p>Firm displays minimal though discernible benefits in at least one of the following: productivity, streamlined processes or reduced communication costs (rework, time delays)</p> <p><u>Firm culture:</u></p> <p>With low levels of tacit support firm culture and engagement is where the greatest transformation takes place – “a little bit goes a long way”...</p> <p>Staff move from low levels of technology use to improved utilisation of technology and improved realisation of the capacity of technology</p> <p>Staff begin to feel a greater degree of individual autonomy and empowerment</p> <p>Staff improve internal communication and begin to develop improved social and business networks</p> <p>Low levels of learning are initiated through homophilic communication networks</p> <p><b>Final state: Changed perceptions and attitudes and some improved perceptions of advantage:</b></p> <p>Management and firm begin to change perceptions of and attitudes towards e-adoption and increased confidence in: personal capability, technology capability and market advantage improves an e-adoption level which in turn explicitly improves organisational and economic benefits – not only the perceptions of benefits but real benefits are in evidence. Compatibility issues are still significant and although some slight changes may have occurred they tend to be relatively less significant even though there is still a high degree of variability in software used - because of the overall low level of e-adoption the problems of incompatibility perhaps are not fully realised because they are not realities. Management and staff primarily communicate within homophilic communication networks.</p>

Table 18 Compatibility Pathway

PATHWAY	DESCRIPTION
<p><b>Compatibility</b></p>	<p><b>Initial state:</b> Inconsistent adoption patterns internally &amp; across supply chains and firms reactive to market economics</p> <p><b>Primary impediment:</b> Incompatibility of e-adoption across organisations with varied software platforms or version and corresponding lack of accurate information transfer and corresponding frustration and negative attitudes and perception of e-adoption as complex and difficult. Incompatibility within an organisation of the technology to firm processes leading to low levels of perceptions of economic advantage of e-adoption and negative attitudes by staff and managers. There are market economic impediments linked to incompatibility impediment including lack of internal pressures and lack of supply chain market incentive (upstream client demand and downstream supplier pushes).</p> <p><b>Pathway: Compatibility</b></p> <p><u>Organisational and economic benefits:</u>            Managers perceive or are pressured towards e-adoption and address incompatibility issues due to clients demand and/or            A form of e-business adoption takes place and the innovation is intuitively useable and functionally simple and then the            Firm moves from a lack of compatibility in terms of processes and communication to an improved or more streamlined state of streamlined            Firm indicates a degree of improved information management            Firms indicate some form of reduction in communication costs and reduced operating costs            Managers perceive an improvement in productivity</p> <p><u>Firm culture:</u>            Negative attitudes and perceptions of complexity and difficulty are transformed to more positive attitudes and perceptions and less resistance by staff when the practicalities of use and integration with other internal systems and external systems are addressed</p> <p><u>Perceptions and attitudes:</u>            Managers perceive organisational efficiencies and move from high levels of resistance to improved levels of engagement            Managers perceive economic benefits to firm and improved e-business compatibility as aligned with firm objectives move from high levels of resistance to support for compatibility improvements</p> <p><b>Final state: Improved levels of compatibility with innovation and improved perceptions of competitive advantage:</b>            Management and firm begin to change perceptions of and attitudes towards e-adoption and increased confidence in: personal capability, technology capability and market advantage improves an e-adoption level which in turn explicitly improves organisational and economic benefits – not only the perceptions of benefits but real benefits are in evidence. Compatibility issues are understood and less significant and there is less degree of variability in software used, improved compatibility with client needs and increased levels of standardisation.</p>

Table 19 Communication Pathway

PATHWAY	DESCRIPTION
<p><b>Communication</b></p>	<p><b>Initial state:</b> Inconsistent adoption patterns internally &amp; across supply chains but compatibility issues have been resolved or are considered solvable. Firms are responsive to market economics but can see competitive advantages to e-adoption or may have experienced competitive advantages. Attitudes and perceptions towards e-adoption are positive.</p> <p><b>Primary impediment:</b> the primary impediment is in relation to communication in 'hard' and 'soft' forms. There is a general resistance to heterophilic communication and a generational problem. There are duplication of various systems; i.e. paper based and electronic and a general level of communication network underutilisation from one organisation to another.</p> <p><b>Pathway: Compatibility</b></p> <p><u>Management characteristics:</u>            Management are more aware of the idea of 'managed' innovative practices and processes in relation to e-adoption and move from resistance to heterophilic communication and insular and self-referential social and business networks to support, encourage and foster diffusion of ideas through difference of opinions often found in heterophilic communication            Management actively support and resource continuing education and reward innovation in e-adoption practices in the firm</p> <p><u>Firm culture:</u>            Firm culture is transformed from silo communication and lack of trust to high levels of trust and widespread communities of practice            Employees move from lack of empowerment to high levels of empowerment            Firm processes and practices are less rigid and become adaptable – a culture of e-innovation – adaptable, reflexive and continually seeking opportunities</p> <p><u>Organisational and economic benefits:</u>            Firms move from a perception and some degree of organisational efficiencies and economic benefits to perceptions of competitive advantage that is offered by e-adoption.            Firms move from perceptions to realities: in relation to streamlined processes, reduced communication costs and improved productivity.</p> <p><b>Final state: Heterophilic and homophilic communication patterns and high levels of perceptions of competitive advantage:</b>            A culture of innovation grounded in effective management of heterophilic communication where incompatibility is less likely to be an obstacle and less likely to be evident. E-Adoption is considered to an integral component of the organisation's business strategy and integral to core business rather than a support function to 'design' or 'construction'. New e-adoption technologies are evaluated in terms of how flexibility and adaptability capabilities and the contribution to the competitive and commercial potential of an organisation rather than fit to pre-existing organisational requirements.</p>

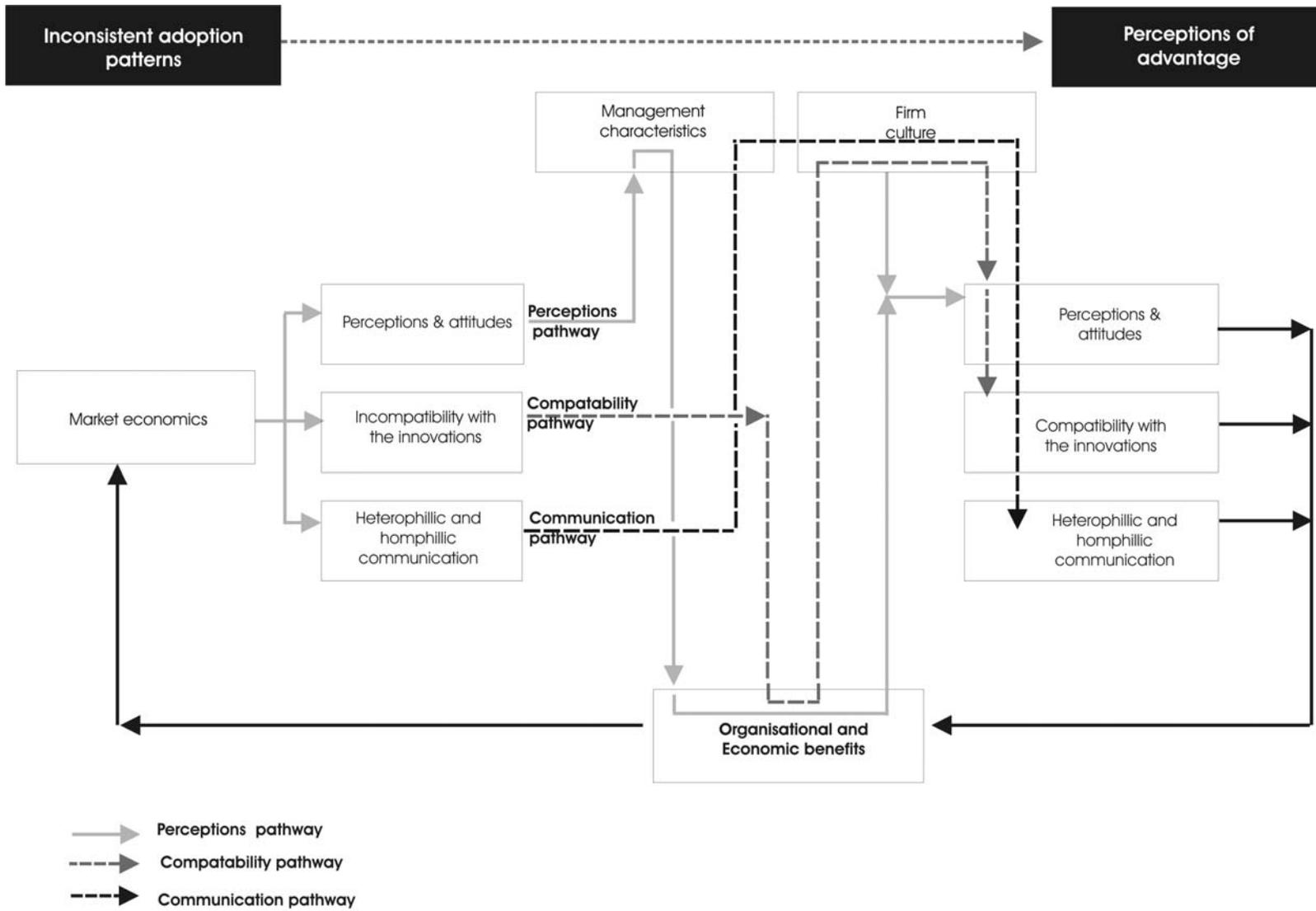


Figure 8 e-adoption Pathways

## 4.0 Recommendations

These recommendations are designed to provide an overall guidance to the industry and in particular the larger organisations interested in developing e-business leadership, through the establishment of e-business capabilities for the use of their client organisations or in other words e-business 'hubs'

Recommendation	Action by...	Focusing on...
<p><b>4.1 Create e-business diagnostic capability</b> Building upon the 'pathways' methodology create a diagnostic kit of Degree of e-business adoption (rate, mode and level) to enable larger organisations to assess and diagnose their own and those firms they wish to influence Degree of e-Business Adoption</p>	Industry organisations	Organisations planning to create 'hubs'; and their target suppliers
<p><b>4.2 Create e-adoption Pathways plan</b> Building upon the 'pathways' methodology and after diagnosis of degree of e-adoption profile for target group develop clear actions aimed at identified groups in relation to impediments and drivers</p>	Industry organisations	Organisations planning to create 'hubs'; targeted key suppliers
<p><b>4.3 Develop 'client-experience' program</b> Employees from larger organisations intending to act as e-Business 'hubs' to arrange 'work-experience' visits to smaller organisations to gather first-hand information about the target firms work environment to inform internal e-adoption plan to support targeted suppliers</p>	Organisations planning to create e-business 'hubs'	Internal knowledge acquisition; External target audience
<p><b>4.4 Develop 'back-to-basics' e-business rollout program</b> Improve usability of each e-Business site/portal; focus of usability – from the users' perspective – with limited functionality to begin with.</p>	Organisations planning to create e-business 'hubs'	External target audience (mainly smaller organisations)
<p><b>4.5 Develop 'value-based' e-Business rollout program</b> Process improvement must be a key focus for e-Business 'hubs' to be achieved by identifying key e-Business metrics for adoption rate</p>	Organisations planning to create e-business 'hubs'	Internal processes and priorities; External target audience
<p><b>4.6 Create e-business communications plan</b> Create a 'hearts-n-mind' communications plan to assist the typically smaller organisations change their attitudes towards e-Business; lead them through the E-business Experience Diagnostic Tool and Pathways Plan– may be indirectly by example using case studies; communicate specific initiatives others have taken to create economic and competitive advantage for their organisations; communicate the strategy and key features of specific e-Business 'hubs'; create a e-Business hub 'user-group' to gain direct feedback and establish ongoing user creditability.</p>	Industry organisations; Organisations planning to create e-business 'hubs'	External target audience (mainly smaller organisations)



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