E-BUSINESS ADOPTION: CASE STUDY ON MELBOURNE CITY COUNCIL CH2 BUILDING

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Summary

Web portals, online databases and E-business tools will play an increasingly important role in the building and construction industry for implementing and formalising sustainable design practices. This paper first offers a framework to identify and address a gap in the research literature on the incentives and impediments to the uptake of new E-business practices. We then focus on an E-business application for green building design using a case study involving the Melbourne City Council. Interviews with key stakeholders were designed and implemented to assess the usefulness of web sites and portals during three building stages: (1) design, (2) construction and (3) occupation. Results focus on the new Council House 2 Building (also known as CH2), one of 250 buildings for which the Melbourne City Council (MCC) has planning and operations responsibility. Finally, we extract lessons learned from this ‘World Leader Status’ Green Building to offer best practices that will support uptake and innovation of E-business in the design and early construction phases as well as the use of web portals and other online tools for decision-making in construction management procedures, commissioning purposes and ongoing facilities management.

1. Preface

This research project arose on the premise that little attention had been paid to understanding in great depth the social, cultural and economic reasons for the relatively slow adoption of e-business (defined in Table 1.1 below) in the vast majority of design, construction and facilities management (FM) industry. In Australia, much of the research investment has been devoted to the adoption of “high end” e-business tools and practices and, in particular, the development of computer software. This project sponsored by the Cooperative Research Centre for Construction Innovation (CRC-CI) aims to redress such balance.

Table 1 Construction E-business Definition

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<th>E-business in construction definition</th>
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<td>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:</td>
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<td>1. internal organisational driven activity for firm core and support business including industry specific and generic business software applications, websites, email and electronic banking</td>
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<tr>
<td>2. externally linked online web based portals involving: design collaboration and document management; online tendering; procurement; purchasing and invoicing; and information</td>
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<td>3. on-line or internal organisational facility management systems</td>
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In order to develop a greater awareness in the construction industry as to the value of e-business to organisations, a number of case studies were commissioned by the Cooperative Research Centre for Construction Innovation (CRC-CI) Project Titled “eBusiness Adoption in Construction” (London 2006). Six industry case studies were undertaken between two research teams from the University of Newcastle (UoN) and RMIT University to identify emerging web based tools and technologies and their adoption process in real life scenarios; including case studies with four Government organizations and two private sector organisations.

At an initial stage, the objectives of the project were to confirm and investigate the nature of the constraints to e-business adoption through theory and practice; then to identify strategies and techniques to raise awareness and increase adoption and diffusion in the industry based upon literature review and case study review of varying levels of e-business adoption environments; and then finally, to propose a technology adoption profile based upon the results of the case studies. A summary of the initial literature review is described below.
Table 2  Literature Review – Summary of Inhibitors and Drivers

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<th>Inhibitors to eBusiness adoption</th>
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<td>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, et al, 2002).</td>
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<td>2. Informed resistance to innovation based on values and attitudes (Frank, Zhao and Borman, 2004)</td>
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<td>3. The lack of security and the perception of an insecure environment; the need for a regulatory and legal framework; lack of systems (Bennet, et al, 2003)</td>
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<td>4. Market incentive, pressures and rewards and uncertainly regarding the financial returns from investments in various resources versus economic benefits (Tetteh, 2001; Veeramani, 2002)</td>
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<table>
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<th>Drivers to eBusiness adoption</th>
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<tr>
<td>1. Rewards, incentives and initiatives by governments including seeding programs, investment incentives and tax rebates (NOIE, 2001)</td>
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<td>2. Managerial characteristics or philosophy of the firms (Storey, 2004)</td>
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<td>3. SME’s characteristics related to flexible specialisation; it is the flexibility of SMEs that can make adoption of ICT easier compared to larger more bureaucratic and inflexible organisations (Sotery et al, 1995)</td>
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<td>4. Production related factors assisting e-business adoption; for example e-business technologies have the potential to transfer complex design information accurately, thereby eliminating data transfer error as well as minimising delays as information is conveyed (NOIE, 2001)</td>
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<tr>
<td>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</td>
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One of the major research achievements derived from the case study review was the development of the concept of eBusiness adoption pathways for the building and construction industry. Although not described to great length in this paper, the theoretical framework became the basis for case study review and the development of the technology adoption profile which is fully described in London (2006).

2. Theoretical Framework

The theory underpinning the research investigation and case study review process 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 building design, construction and operations 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: (1) Innovation: an idea, practice or object that is perceived as new; (2) 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; (3) Time: comprising both the innovation-decision process and the relative time which an innovation is adopted by an individual or group – an innovation’s rate of adoption; and (4) 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 systems exert variable influence upon the temporal diffusion process depending on their specific qualities (London 2006). 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 inhibitors 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) Forming an attitude towards the innovation; (3) Making the decision to adopt or reject the innovation; and (4) Implementing the innovation and confirming the decision taken.
This transition from first knowledge of the innovation to its implementation, measured 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 whether the decision is optional/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 following case study investigates E-business adoption pathways looking at scenarios at the design, construction and facility management stages.

3. Case Study: Melbourne City Council

The Melbourne City Council (MCC) presently has been involved in the planning and operation of over 250 buildings. This study uses the new Council House 2 Building (known as CH2) as the main case study to gain further understanding of how the uptake and innovation of E-business can be used in encouraging sustainable development in Design, Construction, Commissioning and Facilities Management. In comparing the original Council House Building to the new Council House 2 Building, design strategies aimed to achieve up to 80% reduction in energy use and up to 70% reduction in water use. MCC has established an Intranet browser to describe innovation strategies to its employees while also using their public website to make ongoing research reports more easily accessible - including CH2 AusIndustry's research findings with white papers and industry reports (Morrison, et al., 2005).

Results of this case study show that since the Council House 2 (CH2) building project began, the Internet, web portals, online databases, and tools have become influential and will continue to play an important role in achieving implementation of sustainable design in Australia. Although at the time when the Case Study took place the CH2 project had completed its design and construction phases, the project’s underpinning environmental values are expected to continue over the life cycle of the building. In addition to addressing the uptake of E-Business through the design and early construction phases, this study also looks at how (1) web portals and other (2) online collaborative tools can be used and developed for construction management procedures, commissioning purposes and facilities maintenance operations in the rapidly increasing area environmental responsibility at social and corporate levels.

CH2 is a ten storey building designed by a multi-disciplinary team lead by the City of Melbourne’s principal design team and a local architectural firm. Construction of CH2 commenced in 2005, with key contributions from the City of Melbourne including: Design, Project and Facilities Management. External consultants included: Architectural, Services Engineering, Environmental, Structural and Civil Engineering, Acoustics, Quantity Surveying, Builders and subcontractors.

4. Results Analysis

A premise is that online design and planning tools are already available but its use is not yet widely spread. Initial discussion with respondents took place to identify online tools that are preferred by industry in Australia. The study was then set to identify particular impediments and incentives for the uptake of E-business. Interviews were carried out with project stakeholders. For further detail on the full interview agenda and content analysis, refer to Aranda-Mena (2006) for full case study report. Refer to London (2006) for multiple case study analysis.

Interview results indicated that web portals with comprehensive and appropriate sustainability information related to the building and construction industry are not yet in full use across the industry. The broad scope of this project considers the world-wide potential for developing new sustainable products, tools, technologies and joint ventures to show what is possible. More specifically, the MCC Case Study aims to show how online tools, portals, resource databases for decision-making, payments, communication, presentation, reporting, and analysis are becoming increasingly available to industry. CH2 has proven to be a driver for innovation and collaboration, as a test bed for use, application, and piloting of new online business tools with contribution to the wider design, construction and facility management industries.

4.1 CH2 Goals

The overall CH2 goals have been achieved, including: (1) increasing the understanding and awareness of green building benefits; (2) increasing confidence in the selection of green and eco-preferred products; (3) increasing trust in the long term benefits; (4) facilitating information to justify the higher initial costs against life cycle costs, thus strengthening a business case; (5) alleviating the current situation of poor local availability of green building supply; (6) increasing understanding/communication across disciplines and with the client, and (7) indicating incentives for sustainability and general impediments to innovation. However, room for improvement still exists.
4.2 Areas for Improvement

The following issues need to be addressed: (1) lack of consistency in rating tools, regulations, and planning requirements; (2) behavioral issues related to industry/consumers not acting on long-term value; (3) lack of advice/tools not about products but about management of investment; and (4) lack of advice as to existing building stock being poor and its applications for re-use.

According to the AusIndustry’s CH2 Materials Report (Morison, et al., 2005), no internationally successful program for labeling construction material has been achieved yet, despite several attempts. The main problem with labeling construction materials is that it is subject to context and location, especially in terms of life cycle and performance expectations. Greater success has been achieved using specification or material choice support tools such as EcoSpecifier and the US Environmental Building News, and guidelines such as the Aurora Material Selection Guideline and the US Federal Government’s environmentally preferable purchasing (EPP) database. Labeling of materials is almost always completed by a third party independent from the manufacturer or its professional organisations, and usually includes some kind of certification.

4.3 Observations

To assist in improving construction, commissioning, and facilities maintenance, good policies and programs, real-time data, standards, benchmarks and online tools for decision-making are needed. For FM, most of the current online systems and tools can predict potential performance, but do not assess actual performance during construction and operation including affordability and costs.

As to the business case, the CH2 Total building costs $51.045 million, including $11.3 m on Sustainability Features (i.e. 22.1% of costs). The payback period claim is estimated that in 10 years time the sustainability features will have paid for themselves. Further benefits that could reduce this payback period include: (1) healthier staff – less time lost to colds, flu and other illnesses; (2) increased workplace effectiveness; (3) less costs for public domain and infrastructure; and (4) the value of this building as a guiding light in sustainable building.

In general, it is clear that the Melbourne City Council is making a considerable effort that will lead Australia towards cutting Greenhouse Gas emissions and reducing the use of Non-renewable Energy.

A follow-up study would suggest revisiting Melbourne City Council to ask pertinent questions such as: (1) Which online tools have been useful in facilitating the CH2 green building agenda?; (2) EcoSpecifier was developed and tested during the design and building of – has it changed because of CH2?; (3) To what extent has this type of project contributed to laying the foundations for the use of the Internet to support the Green Building Agenda?; and (4) For the Architect, Engineer, Construction Manager, Commissioning Manager, and Facilities Maintenance Manager: how do you see your contribution in general terms in achieving the Green Building Agenda? (5) What is the role of planners in incorporating transport and land use considerations to further facilitate the green building agenda within the larger regional and urban context?

5. Discussion: Value Propositions

What current online tools such as Internet portals to facilitate designer’s decision-making are preferred in industry? In aiming for a six Green Star pilot project, and becoming the first office building project in Australia to achieve such a rating, as stated previously, the CH2 building has become a technology test-bed and provides opportunity for innovation and research. For example, DesignInc, The Centre for Design at RMIT University, EcoRecycle Victoria and the Society for Responsible Design - in combination with the developments of the Australian Environmental Labelling Association Inc. in setting up the Good Environmental Choice Label - have helped standardise and identify environmental products and environmentally-preferred materials for design and construction through internet portals such as EcoSpecifier. The Melbourne City Council and other project players have taken up the enormous research task of sourcing and providing a decision-making tool for hundreds of products that have had to meet increasingly stringent standards in order to possibly be ‘given the go-ahead’ for the high-profile CH2 project.

The following table represents the set of tools used throughout the project. Web portal development took place during the course of CH2. These online business tools are organized into the following categories:

- Design: EcoSpecifier
- Construction: ACONEX
- Facilities Management: LOGOMETRIX

This section discusses the use of Internet portals as a decision mechanism for the selection of products, materials, construction suppliers and service providers. In the case of CH2, a great deal of the process was completed through research involving internet web searches. A six star rating was achieved when the design team only aimed for a five star certification, and it is believed this was partially due to the principal...
consultants attending an initial two-week workshop, followed by weekly design meetings that ran for eight months, to ensure a truly collaborative effort and integrated design approach.

5.1 Scenario 1: Design

Material selection and other decisions that have an impact for the life of the building are taken at the design stage. Even as recently as 1999, very few Internet portals and search engine tools were available to aid design teams in their research into green materials. Portals with ecologically sustainable products are now on the rise. In the case of CH2, one of those portals had only about 80 products listed at the beginning of the project, and there were no other local resources available. At the beginning of the CH2 design process, it was claimed that no internationally successful program for labeling sustainable construction material had yet been achieved, despite several attempts. This led to intensive research and academic partnerships for the development of an Internet portal which has increased its database from 80 environmentally certified products to over 1000. Involved research parties undertook the enormous task of vetting all potential products and materials that might be used on the project. The site then became a joint initiative of the Centre for Design at RMIT University, EcoRecycle Victoria and the Society for Responsible Design.

A rolling research and development program was designed, commencing in 2000. The key elements of this program were to: (1) establish a methodology for side-by-side comparison of products through the environmental performance questionnaire (EPQ); (2) establish a peer-review process to ensure transparency and accountability, and limit liability, through the involvement of the Commonwealth Scientific and Industrial Research Organisation (CSIRO); and (3) shortlist potential products and issue a questionnaire as a condition of consideration to suppliers for completion. There would be ongoing issues of the EPQ to other suppliers throughout the project as relevant; (4) establish in-house systems that would enable effective storage, referencing and use of data through easy access and inter-personal communication; and (5) integrate data into effective decision-making in the project in a timely manner through coordination and project reviews.

By 2004, the EcoSpecifier website had received over 100,000 visits and feedback from industry has shown that the site is the industry’s leading resource on environmentally preferable materials. Currently, a commercial database of over 1000 building products exists that has been independently vetted against sustainability criteria, and provides guidance on the environmental impact of commonly available building products. As a brief summary, the tool is: (1) An online guide; (2) Used to source and increase use of environmentally preferred materials in the construction sector; (3) Helps architects, designers, builders, specifiers and consumers shortcut the materials sourcing process to find products that reduce environmental impacts and create healthier and more productive living and working environments; (4) The most comprehensive list of environmentally preferred commercially available in Australia; (5) Used to select materials with least environmental cost; and is (6) Used to gain an understanding of the principles of selection in order to identify, research, and develop alternative materials.

The site’s ongoing development has seen major upgrades including powerful new functionality in the site’s search engine, access to full product data, manufacturing details, and case study links for types of facilities. This includes education, commercial, health and aged care, industrial, laboratory, residential, and retail facilities.

5.2 Scenario 2: Construction

This phase of the project involved the selection of subcontractors and service providers. Issues that usually arise during this phase involve collaboration with suppliers and subcontractors and a good document management practice is paramount. Project members decided to use a web-based platform for collaboration throughout the design and construction process. Based on principles of trust and innovation, a commercial document management provider was selected. The chosen application was designed for use across various project phases. The key reasons the project team engaged in use of the tool was that the online collaborative information management service was secure and easy to use, it also promoted collaboration by allowing the reception, transmitting and management of construction correspondence, drawings, and other data, with limited printing and paper flow. Results indicated that the project extranet simplified document control, resources and project management; it also provided an easy way to save time and money on the project, technical support and training; and finally, it added confidence to the project. The firm, Aconex, is currently working with the Facility Management Association (FMA) to research current and future information management practices in the industry. For CH2, Construction Management was able to handle information more efficiently and improving project collaboration; as the Aconex tool could be used and designed for every phase of the project life cycle, minimising construction waste, and ensuring improved transparency, so that sustainable construction processed, techniques and materials would be timely implemented.

5.3 Scenario 3: Operations

An important phase of a project that often does not receive the attention it deserves is the commissioning phase (ASHRAE Guideline 0-2005). Personnel from CH2 and building users were involved in this phase for about six months and continue to be involved throughout the occupancy of the building. Understanding the initial operating of the building, post-occupancy evaluations, and monitoring of existing buildings is a meaningful world wide trend in the improvement of green buildings and facilities (Stumm 2000). In the case
of CH2, a great deal of learning from the eventual occupiers took place and FM staff have been involved in the early stages of commissioning in order to better understand the maintenance requirements related to the number of innovations and sustainable technologies adopted. Issues here, include the selection of building fitouts, contracting and efficiency of mechanical/electrical/plumbing systems, understanding how reused water moves throughout the building in terms of use for the innovative shower towers that cool the air and water through evaporative cooling, use of renewable energy systems (i.e. photovoltaic cells and wind turbines) on the building, as well as natural ventilation strategies related to providing optimal comfort levels year-round.

In CH2, over 2000 sensors are now installed and are informing building operators building behaviours on regular basis. Other innovations that facilities managers are willing to implement in the green building industry include electronic energy audit tools, sustainability checklists to improve operations, and web-based tools that record and collect data for benchmarking and historical purposes.

Another e-business innovation that members of the FM community have discussed implementing includes a list (i.e. describing “Five things the individual occupant can do to make the building more sustainable”) that can be updated on the intranet site, depending on the base data and real-time data available, that could display various sustainability indicators: on energy, waste, transport, health, and others. Although not thoroughly investigated in this case study, interviews also noted that Facilities Management may undertake a study comparing post occupancy surveys and operations surveys which had been collected by CSIRO for CH1, in order to better understand the performance of CH2 in relation to occupant use.

The web based system, Logometrix, developed by Hansen Yuncken was chosen as a sustainability tool for measuring key performance indicators (KPIs) of CH2 facilities and services. The system can be accessed by registered Local Government Authorities (LGAs) or city councils over the internet and allows for strategic decision-making based on monitoring of real-time data and measurements of facility performance (i.e. through key indicators including energy use, water consumption, waste collection, and other aspects of end-users and building occupiers’ behavior). The facilities manager can then set the building as a benchmark in facilities management against other participating councils, through use of a browser interface, that can ensure that a comprehensive survey is conducted within a consistent ‘best practice’ framework – using the tool to ensure data is collected on specified parameters related to service delivery, physical, community and environmental performance. For the development and principles underpinning the Logometrix tool (http://www.logometrix.net), see Brackertz and Kenley Special Issue: Sustainable Communities (2002a, b).

As noted by interviews, the Melbourne City Council Facilities Management team has been using this tool for two years allowing users to assess performance of buildings (i.e. CH2), and how they meet the environmental requirements and agreed upon goals of the users and designers.

6. Conclusion

This study has discussed the role of web portals to facilitate decision making during three building stages (1) the design process – especially on the selection of sustainable materials, (2) the construction process – especially on the collaboration between client, contractor, subcontractor and suppliers and (3) facility management – especially on building commissioning and occupation.

As a cause of the recently introduced green building and environmental legislation, new possibilities for energy savings, improved employee green practices are amongst the incentives and the areas adding market value of e-business within the industry. Although it is hard to ascertain whether CH2 will remain within its $51 million budget (including $11 million on sustainability features) due to delays in the completion of the project, the Melbourne City Council has claimed that up to $11 million could be recovered within 10 years due to energy cost savings and productivity gains. In this case study, e-business practices enabled informed and building performance decisions. Web-based tools were here reviewed and summarised.

Identified practices which are likely to accelerate e-business adoption include: (1) using case studies to demonstrate use of specific online tools; (2) facilitating training; (3) allowing time and space for error when introducing new practices; (4) increasing organisations awareness of research publications on e-business uptake; (5) offering follow up expert consultation; (6) establishing quantitative correlations on the use of specific e-business practices and improvements on green building performance; (7) highlighting collaborative decision-making; and (8) using e-business as a communication tool to ensure improved service to the client.

It’s been proposed that building projects like CH2 are the test-beds for innovation and in this particular case it certainly has been the catalysts for the development and uptake of the e-business tools and technology adoption model here investigated.

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