A Strategic Approach to Information Communication Technology Diffusion – An Australian Study


*RMIT University, Faculty of Business, and Cooperative Research Centre in Construction Innovation, Melbourne, Australia
**RMIT University, Department of Building and Construction Economics, Melbourne, Australia

Abstract
The construction industry can be characterised as fragmented as a consequence of its project-based nature and its quasi-firm supply chain (Eccles, 1981). Industry fragmentation may be decreasing with a shift from projects being regarded as independent entities towards an industry with an integrated activity flow through the supply chain. Information Communication Technology (ICT) forms the ‘glue’ that binds the project supply chain members together, enabling closer and more effective coordination of project teams. A closer virtual engagement through ICT, together with increased acceptance of relationship based procurement systems such as Project Alliancing, has further cemented the shift towards supply chain activity integration.

In this paper, we outline four case studies of Australian construction companies that have effectively embraced ICT as a tool for more productive coordination of their project teams. Through their use of ICT, these companies are preparing to embrace the concept of a virtual organisation linked by ICT to facilitate efficient project communication and information exchange for decision-making. These case studies identify how senior management has directed global strategy for change and the extent to which they have empowered team members at multiple-levels throughout their organisations to shape strategy and its implementation.

This study is part of a wider ICT diffusion research project in which a theoretical framework of ICT diffusion, change management and knowledge management literature, was drawn upon to better understand ICT innovation in the construction industry. In this paper we report upon progress on an ICT diffusion study of four out of approximately eight leading-edge construction contractors investigated during 2002. Findings demonstrate how effective a top-down and bottom up implementation strategy to this kind of change can be achieved.

Key words: Information and Communication Technologies, Innovation Diffusion, Strategy, Skills Development.

Introduction
The Australian construction industry is highly fragmented and competitive. This situation has resulted in an industry stratification whereby a top tier of about twenty highly capitalised contracting organisations has emerged as industry leaders. The implication of this for the construction industry and its leadership is reflected in this top tier’s awakening acknowledgement of, and capacity for, undertaking significant ICT innovation—a process not usually associated with this industry. The enabler of this innovation has been ICT that, in addition to facilitating the increased productivity of business processes, is also providing a platform for supply-chain integration.

The capacity of ICT to efficiently connect and coalesce the construction industry supply chain is being facilitated thorough the diffusion of ICT applications through a process of networked information exchange. E-collaboration and the creation of a virtual productive
environment is a progressive consequence of the capacity of ICT applications to facilitate efficient project supply chain management by effectively binding together the disparate and often numerous quasi-firm participants, and enabling more effective coordination of project teams.

Stratification of the Australian construction industry has lead to a mature and innovative environment, driven through the leadership of significant enterprises. Construction organisations strive for innovation leadership to maintain or foster a competitive advantage within their competitive marketplace. Along with strategic, evaluative, planning and financial attributes, leadership in ICT innovation reflects the effectiveness of the diffusion of ICT innovation within the organisation. This innovation leadership may also be reflective of a corporate culture of proactive change and change management enhancing strategic planning, process design and implementation, and productivity outcomes. Analysis of major forces of change that are driving businesses today (intense competition, demanding customers and shareholders and technology) will provide a rich understanding of how and why they impact the organization (Topping 2002, p27).

This paper examines case studies to explore the nature and level of ICT diffusion undertaken by four of Australia’s leading construction companies. In doing so we offer a framework for understanding and evaluating the relationship between the nature and level of the ICT diffusion processes, enterprise change culture and innovation leadership within the Australian construction industry. To facilitate its research objectives, we use the analytical framework of the ‘star’ model of change (Galbraith 2002) to reveal the nature and level of the organisations’ ICT diffusion processes. We also use the ‘adaptive model’ developed by Rogers (1995) to appreciate the concept of innovation leadership in order to determine the relationship between ICT diffusion as it was undertaken and revealed by the Galbraith model and innovation leadership and its relationship with, and implications for corporate culture. Adaptive challenges are the difficult issues that demand changes in attitude, behaviours, and values that are a part of many business problems (Senge et al. 1999, p213).

This paper reports upon a Cooperative Research Centre (CRC) in Construction Innovation research project ‘Delivering Improved Knowledge Management and Innovation Diffusion’, undertaken by RMIT University Australia and supported by CRC industry partners.

**Analytical Methodology and Framework**

Figure 1, plots the relationship between key factors facilitating innovation diffusion as developed by (Galbraith 2002, p10). These key factors, numbered according to their hierarchical and derivative relationships are: *strategy, tasks, structure, people, processes and rewards*. In the Star model *Strategy* imposes the *Task* of developing a vision and objectives, which are then prioritised. Next, a *Structure* is developed with people involved to actually implement the change using the developed organisational structure to define accountabilities, roles and responsibilities. This activity is undertaken in conjunction with the identification of implementation of the skills and development needs of *People*. These affect *Processes* to enable the development of change processes to take place—these include protocols or rules and regulations, communication means and coordination mechanisms. People and their skills and willingness make change possible. The *Reward* system motivates people to ensure that
required action takes place. The Star model is dynamic with each element self-adjusting, as the dynamic forces of implementation and diffusion shapes each response.

![Star Model Diagram]

Figure 1- The Galbraith 'Star' Model of Change Management: Source Galbraith (2002, p10)

We use the Star model in this paper as an analytical tool to better understand the ICT innovation process based upon the model developed by (Rogers 1995) to categorise innovation leadership.

![Innovation Diffusion Model Diagram]

Figure 2 - Innovation Diffusion Model: Source (Rogers 1995, p262)

The Rogers model (Roger 1995) defines innovation leadership according to innovation adopter categories and gives an indication of their likely distribution within a particular population. Innovators, according to Rogers are venturesome and the first 2.5% of the population in a system to adopt an innovation. Early adopters comprise the next 13.5% of the population to adopt an innovation and are a more integrated part of the local system than are innovators. The early majority again according to Rogers comprise 34% percent of the population and adopt new ideas just before the average member of a system and seldom hold opinion leadership positions. The late majority comprise the next 34% of the population to adopt an innovation, adopting new ideas just after the average member. Their adoption may be the result of increasing network pressures from peers. Laggards comprise the last 16% to
adopt an innovation and possess almost no opinion leadership. The point of reference for the laggard is the past.

The usefulness of our application of these two constructs is that the Rogers’ model categorises the ICT diffusion process stages for the case study contractors and Galbraith’s Star model provides an indication of the contractors ICT innovation adoption stage within the system.

The ICT Diffusion Case Study Methodology

Our research project aims to investigate the ICT diffusion practices of eight of the top tier of Australian construction contractors of the pool of approximately 20 such companies. We report on results from the first four of these significant contractors as work-in-progress. This tier of the construction industry manage projects of AUD tens of millions with an annual turnover exceeding AUD$1billion per annum and all four selected for this study also operate outside Australia on major projects. We selected these four on the basis of availability and opportunity to conduct interviews using an interview instrument design using Galbraith’s Star model. Semi-structured face-to-face interviews were conducted with a key ICT innovation champion from each organisation with the interview being recorded and later transcribed. Interviewees were requested to respond to the questionnaire specifically addressing the diffusion process of an ICT collaborative application with extensive organisational-wide usage.

Organisation A was a clear market leader, in terms of turnover, market profile and the depth and breadth of its corporate structure and associated business relationships. Organisations B, C and D shared similarities in terms of industry profile and activity and, although significant in their own right with extensive local and international operations, all were nonetheless clearly less substantive than Organisation A.

Case Study Organisation A Results – The Innovator

Organisation A revealed a proactive corporate strategy of ICT innovation and its diffusion. This strategy was facilitated through a deliberate and perceptible corporate culture of market and industry leadership with a rigid focus on the maintenance of this leadership. Innovation was regarded as a driver of this leadership culture and a foundation for its pursuit of leadership maintenance. Strategy was formulated using a best practice focus provided though a purpose-designed strategic and technical advisory cell structured for the active collaboration with, and encouragement of enterprise representatives and contributors as internal innovation resources. Internal innovation resources were supplemented though research using information gathered from numerous external sources, all in the pursuit of best practice.

Organisation A had undertaken an extensive rollout of an enterprise wide electronic document sharing application utilising its internal network. This rollout was part of an active implementation strategy and program to facilitate the introduction of a virtual productive environment. This innovation will utilise e-collaboration and corporate connectivity inclusive of supply chain management, project control and organisational administration utilising extensive internal and external networks and be facilitated by a wide range of purpose-built ICT applications.

Organisation A used a team of internal trainers to facilitate its implementation strategy and program with support from external providers of these services. Extensive skills audits of staff were undertaken to determine existing skills levels and capacities and training was designed in consultation with the outcomes of this process. Ongoing training and helpdesk facilities were established as support services and for new employee induction purposes. The
diffusion process was actively monitored. Analysis was undertaken to determine its effectiveness, mindful that the role of this program’s role was as a pilot rollout for a wider ICT implementation.

Individual rewards for participating in the ICT diffusion process were intrinsic. Remuneration packages were provided to Organisation A’s employees at higher levels than normal industry standards. This reflected its market leadership and indicating its pursuit of exemplar employees at all levels. Innovation was perceived to deliver increased profitability to the enterprise and enhance market leadership thus providing subsequent performance premiums to employees. This was an implied rather than an explicit remuneration policy but nonetheless, it was clearly understood throughout the organisation. Employees also were rewarded intrinsically through their upgraded skills with what were considered state-of-the-art applications reflective of the enterprise’s market leadership. This upskilling enhances individual’s career prospects. A strong culture of teamwork, and pride resulted in commitment to the organisation’s continued prosperity and leadership. This fostered an intrinsic reward to participate with this perceived industry leader in the ICT diffusion process.

Case Study Organisation B Results – The Early Adopter

Organisation B demonstrated a proactive corporate strategy of ICT innovation and its diffusion. Although innovative, this organisation tends to be innovative in terms of its organisational processes rather than as an industry leader in ICT. This reflects the financial capacity and limitations this placed on the level and nature of the innovations applicable and diffusion strategy deployed. Organisation B nonetheless had an ongoing and long-term strategic commitment to innovation with strategies and associated programs in place accordingly which were not dissimilar in intent and technical delivery to that of Organisation A. The difference in these strategies and programs was with the level and timing, with Organisation B following initiatives already undertaken and implemented by Organisation A—a reflection of their relative industry leadership and a consequence of financial capacity.

Organisation B had a formal structure established for determining and disseminating innovation within the organisation. This structure facilitated strategy and associated tasks using a best practice focus. This focus was provided though a technical advisory cell (a team of people from different business units). This cell actively collaborated with, and encouraged enterprise representatives and contributors as internal innovation resources, while also drawing upon outside sources of knowledge.

Organisation B also had undertaken a limited rollout of an electronic document sharing application on a project specific basis. This rollout was part of an active implementation strategy and program to facilitate the introduction of a virtual productive environment utilising e-collaboration and corporate connectivity inclusive of supply chain management, project control and organisational administration. To facilitate its application rollout, Organisation B used a small team of internal trainers with significant support provided by the application vendors.

Staff skills audits were not undertaken with training designed on a generic basis. There was some indication of an expectation of training being provided by colleagues, and to a limited degree, mentoring was informally encouraged. This informal focus on training and mentoring expectations reflected the staged project-by-project rollout of this application and the transference of acquired skills delivered through project and enterprise teams rather than through formal training initiatives. This outcome again reflects the financial limitations associated with diffusion at this level of implementation of pilot programs. Ongoing support services training and helpdesk facilities were established with supplementary vendor initiatives for new employee induction upon individual application. There was limited monitoring and analysis of the diffusion process effectiveness indicating the still, at that stage,
unconfirmed nature of the enterprise-wide rollout of the next generation e-collaboration and procurement system.

Individual rewards for the take-up of ICT through the diffusion process were intrinsic with project managers, as those responsible for project-specific implementation decisions, encouraged adopting the applications based on perceived productivity gains to be made on their projects. Employees were intrinsically rewarded though upgrading their skills with what were considered to be state-of-the-art applications reflective of the innovative, progressive culture of Organisation B’s market leadership—enhancing their individual competencies within the industry. Organisation B’s strong culture of teamwork and commitment to the enterprise and individual’s desire to foster its continued prosperity were regarded as intrinsic rewards to participate in the ICT diffusion process.

Case Study Organisation C Results – The Early Majority

Organisation C established a strategic focus on ICT innovation but had not yet fully implemented a structure to support and implement an active strategy. Nonetheless, this was a planned outcome of their strategy, reflecting the immaturity of its process and program. A significant constraint to strategic innovation implementation was the structure of its enterprise with its division into separate, state based autonomous business units, each with the capacity to veto proposals if they were considered financially insecure. This reflected an apparent short-term focus on return on investment assessment decisions. Organisation C was committed, however, to its organisation’s participation in a virtual productive environment utilising e-collaboration and corporate connectivity inclusive of supply chain management, project control and organisational administration. The organisation had devised an implementation strategy and program to facilitate the introduction and diffusion of this initiative. All business units had signed this off but Organisation C had not conducted any pilot programs for this innovation—being constrained by the business structure. It was, however, prepared to implement the ICT initiative collaboratively from this base position and on an organisational-wide basis, guided by the experiences of other similar companies and individuals in Organisation C.

A small Information Technology (IT) department undertook the rollout or upgrading of ICT applications. This group informally provided technical advise to strategists with introductory internal training to users. It also supported ICT diffusion through training and helpdesk services provided by application vendors.

A staff skills audit was not undertaken so a generic training program was designed. There was evidence of Organisation C’s ICT diffusion expectation being for informal training provided though colleagues, with mentoring being encouraged by individual business units to disseminate application training rather than an integrated organisation-wide strategy. There was no monitoring and analysis of application diffusion effectiveness indicating again the immature nature of its strategic ICT innovation program. Individual rewards for adopting ICT through the diffusion process were intrinsic. Users were expected to adopt ICT application initiatives to facilitate organisational productivity gains.

Employees were rewarded intrinsically through upgrading their skills with new ICT applications enhancing their individual competencies within the organisation. The decentralised, autonomous nature of the organisations business units diluted the level of teamwork and commitment to any enterprise-wide ICT diffusion. Intrinsic motivation and reward for innovation was driven by strong rivalry that existed between each business unit and through Organisation C’s competitive organisational cultural.
Case study D Results – The Late Majority

Organisation D had no active innovation strategy or associated business structure. This reflected a short-term strategic focus and concentration of the enterprise on business process efficiency. This organisation, although a significant construction organisation, operated actively to reduce productive infrastructure by outsourcing most undertakings. The ICT focus of this enterprise was directed to improve the operability of internal communication through upgrading the ICT networks technical capacity. Applications were designed or upgraded through vendors who provided most of the required training and helpdesk facilities. Informal training was expected by the organisation with some formal small-scale training initiatives provided by the organisation for new employees being inducted. Adoption of new applications, or new versions of existing applications, was deemed the ultimate responsibility of project managers who were expected to undertake this as part of their commitment to the project’s and organisation’s performance. There was a strong culture of enterprise commitment and loyalty providing intrinsic rewards for successful new technology adoption. Organisation D had no expressed interest in participation in a virtual productive environment utilising e-collaboration and corporate connectivity integrating supply chain management, project control and organisational administration. It indicated that the organisation would become involved in such ICT innovations only after perceived benefits became tangible and uptake costs were minimised through the learning from mistakes made by other users.

Case Study Results – Discussion

Table 1 – Case Study Comparison Using the Start Model. for ICT Diffusion

<table>
<thead>
<tr>
<th>Star Element</th>
<th>Organisation A</th>
<th>Organisation B</th>
<th>Organisation C</th>
<th>Organisation D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strategy and Task Action</td>
<td>Refined + proactive consensus on vision, many years experience</td>
<td>Refined + proactive consensus on vision, 2+ years experience</td>
<td>Active + developing vision + consensus X-BU fragmentation</td>
<td>Re-active to market, underdeveloped vision, low consensus</td>
</tr>
<tr>
<td>Structure</td>
<td>Well-defined, highly established, highly experienced</td>
<td>Well-defined, well established, developing experience</td>
<td>Well-defined, central, X-BU case-building, developing experience</td>
<td>Poorly-defined, outsource dependency</td>
</tr>
<tr>
<td>People</td>
<td>High level technical support + training, developing supportive culture</td>
<td>High level technical support + training, medium developed supportive culture</td>
<td>High level technical support @ centre + training, developing supportive culture</td>
<td>High dependency on external experts bought-in, low level developing supportive culture</td>
</tr>
<tr>
<td>Processes</td>
<td>Advanced and refined</td>
<td>Developing and refining high COP use</td>
<td>Advanced and refined @ centre, not in BUs</td>
<td>Ad-doc on JIT basis with outsourcing</td>
</tr>
<tr>
<td>Rewards</td>
<td>Intrinsic + career advancement. Reputation working with excellent ICT.</td>
<td>Intrinsic + career advancement. Reputation and gaining ICT expertise.</td>
<td>Intrinsic + career advancement</td>
<td>Intrinsic + career advancement. Tacit organisational expectations</td>
</tr>
</tbody>
</table>

X-BU = cross business unit, COP = communities of practice see (Wenger and Snyder 2000), JIT = just in time

Table 1 indicates the ICT diffusion attributes of each of the four case studies according to Galbraith’s Star model. The case study interviews conducted and reported on in this paper indicated definitive innovation characteristics according to the Rogers Diffusion of Innovations Model. Organisation A clearly appears to be an Innovator, as a consequence of its capacity for innovation facilitated by its industry leadership and associated relative financial strength as well as reflecting its long-term visionary culture. Organisation B clearly possessing a long-term innovation culture classified as an Early Adopter. While not possessing the financial capacity of an Innovator, it is respected by its peers, and supports the
adoption of successful, initiatives and new ideas. Organisation C fits the cultural profile of Early Majority as adopting new ideas just before the average member of a system but seldom holding positions of opinion leadership. Finally Organisation D appears to have a Late Majority innovation culture—being suspicious of innovations and change agents with resistance to innovations being entirely rational (as their resources are limited and they must be certain that a new idea will not fail before they can adopt).

Conclusions
This paper examined the ICT diffusion processes as undertaken by four significant Australian construction companies using the Galbraith ‘star’ model of innovation diffusion and Rogers’ model of Diffusion of Innovation. The analysis undertaken disclosed a variety of innovation diffusion profiles. Organisation A is an industry leader in innovation and diffusion with established strategies, programs and structures to implement and monitor their programs outcomes and an Innovator profile reflective of its market leadership. Organisation B also possessed an innovation profile with established structures reflective of its long-term visions and programs although not to the same extent or maturity as Organisation A. Organisation B indicated an Early Adaptor profile. Organisation C was undertaking an emerging innovation and diffusion strategy program and developing appropriate diffusion processes. It clearly trailed Organisations A and B in the maturity of its innovation processes and was described as an Early Majority innovator. Organisation D projected a short-term returns focus with no strategic or structural innovation or diffusion profile. Case Study D was a Laggard in innovation or at best described as a Late Majority innovator.

This paper used the Galbraith ‘star’ model to indicate that ICT innovation diffusion is practiced by substantial Australian construction enterprises to varying extents of maturity. One element of notable practice that becomes evident from the analysis is the substantial commitment to strategy and having a clear vision for ICT diffusion. Another element is the way that technical support units form communities of practice. While motivation appeared to rely upon intrinsic and career motivation this element should attract more future attention. These support the top-down and bottom-up approach advocated by (Nonaka and Takeuchi 1995, p125). These indications of current practice are reinforced by the classification of the innovation profiles of these enterprises according to Rogers model of Diffusers of Innovation. To further substantiate these outcomes, case studies of other substantial Australian construction enterprises will be undertaken using the analytical methodologies described in this paper, and others, to reveal best practice in innovation diffusion for the Australian construction industry. The study of which this is a small part, will also gather data from the instigators of diffusion and from those being subject to the ICT diffusion process.

These analyses will contribute to the development and adoption by the industry of an innovation diffusion best practice template and encourage the adoption of ICT innovation. This is expected to reduce industry fragmentation and enhancing enterprise and industry productivity through the supply chain by enhancing communication and coordination.

References
