DIRECTIONS IN CONSTRUCTION IT STRATEGIES IN AUSTRALIA

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ABSTRACT: There is a growing awareness of the value of information and communications technology to bring together the major parties in the construction process and share information in a meaningful way.

A number of organisations in Australia are providing leadership and direction through the development and implementation of policies on the use of information technology in the construction industry. These include NSW Government, the Australian Procurement and Construction Council (APCC) and the International Alliance for Interoperability – Australasia Chapter (IAI-AC).

In April 1998 the NSW Government launched its discussion paper, Information Technology in Construction setting out propositions as to how information technology could be effectively used to provide value for money for NSW Government capital works procurement by improving communication and teamwork during all phases of design, construction and facilities management. A policy document is to be prepared during early 2000 to further develop and implement the ideas and strategies in the discussion paper.

The Australian Procurement and Construction Council, with representatives from Commonwealth, State and Territory jurisdictions in Australia, is drafting a framework to provide industry and government agencies with an awareness of issues and to develop directions for the take up of information technology.

The IAI-AC has adopted a new direction for a broader role in information technology usage rather than just concentrating on the technology tools. This strategy is taking shape should in February/March 2000.

The combined strategies of the NSW Government, the APCC and the IAI-AC crystallise time frames and objectives for the construction industry in terms of IT take up, and what can be achieved by effective communication and information sharing through the whole of a project's life cycle. This paper reviews the current aims and strategies of the three organisations in promoting IT uptake in the Australian construction industry and suggests how these aims and strategies might be applied outside Australia.

KEYWORDS: Government initiatives, directions, sharing learning

BACKGROUND

Information technology is fundamentally changing the way we do business. The building and construction industry is no exception. Government, as a major client, is an integral part of the construction industry in Australia.

Better value can be achieved in all phases of procurement, facilities management and disposal of built assets by sharing data, information and knowledge at an industry level and at a project level. This sharing is significantly enabled by emerging information technology.

Sharing knowledge is fundamental to making the construction industry more efficient and competitive, and, from a client's perspective, achieving better value from its built assets.

There is broad, world wide agreement, on the directions for the use of information technology as an enabler for improving the processes involved in the procurement and facilities management of capital works.

These directions include:

- recognition of the need to share learning and knowledge
- integration of information technology into the full capital works procurement process commencing at the briefing stage and continuing through to facilities management and the provision of feedback to the briefing and design phases.
- integration of information technology throughout the entire supply chain, including subcontractors and suppliers
- a growing demand to capture assumptions and reasonings as well as decisions in object oriented project databases

GOVERNMENT LEADERSHIP

The NSW Government and the Australian Procurement and Construction Council representing State, Territory and Commonwealth governments, are providing leadership and direction through the development and implementation of policies on the use of information technology.

Government leadership will raise the awareness of both industry and clients and facilitate a more rapid take up of technology than would occur without clear government leadership.

Governments are, either directly or through their suppliers, increasingly adopting a range of technology based approaches in the way they do business and engage with the industry. The use of information technology for dissemination of information, communications and business transactions is already widely adopted within Government and the business community.

The value of governments encouraging broad industry take up of technology in a consistent manner is widely accepted. Broad industry consultation is essential to confirming the validity and practicality of the directions set by government.

NSW GOVERNMENT

In April 1998 the **NSW** Government launched its discussion paper, *Information Technology in construction – making IT happen* (NSW Govt: 1998). This paper set out propositions as to how information technology could be effectively used to provide value for money for NSW Government capital works procurement by improving communication and teamwork during all phases of design and construction.

The discussion paper set out strategies for the effective take up of information technology by clients, consultants and contractors. The technology envisioned is shared project databases communicated through web technology. To bring about the cultural change required for the effective take up of technology a three tiered strategy was proposed, starting with communication of information in electronic form, followed by the development of client, product and project databases, through to the full project management of construction projects through virtual organisations.

The NSW Government is using its buying power to bring about cultural change and using its lead agencies to develop implementation strategies in conjunction with industry. The strategies apply not only to the procurement of capital works, or the design and construction phases, but also to the formulation of the brief, community consultation, commissioning, facilities management, refurbishment and, ultimately, disposal of a facility.

GOVERNMENTS NATIONALLY

The Australian Procurement and Construction Council is developing directions to provide industry and government agencies with an awareness of issues and directions for the take up of information technology. As the member jurisdictions have differing priorities and capabilities, the directions will allow for different rates of implementation while providing a consistent approach.

THE CONSTRUCTION INDUSTRY

The construction industry, both in Australia and world wide, is generally highly fragmented(Chen et al. 1993; RCBI 1992a; Leslie and McKay 1995), communicates poorly and operates on low profit margins (Higgin and Jessop 1963; Mortlock 1980; Latham 1994). Typically people move from one project to another and teams come together for the duration of the project, with decisions about which subcontractor, sub-consultant or supplier to use often made on the basis of lowest price. There is some movement towards more strategic alliances and long term relationships, but still with principle contractors or consultants reserving the right to choose from a number of favoured suppliers or subcontractors.

These characteristics are resulting in slow take up of technology, although the Australian construction industry has been rapid to take up mobile phones, facsimile machines, computers for basic business processes and computer aided design and drafting.

There is a growing awareness of the value of information and communications technology to bring together the major parties in the construction process and share information in a meaningful way. A number of major developers and construction organisations are using project webs to host

and manage all project information and manage the communication and document control processes.

For the construction industry to benefit from improvements in communications through the use of information technology, cultural changes must occur throughout the industry so that people share information more widely, thus communicating better and contributing to the whole construction process, in accordance with their expertise.

THE TECHNOLOGY

When used effectively, information technology enables improved decision making that contributes to higher quality and lower cost outcomes through access to relevant and timely information from any place, at any time and in a format to suit the user.

Existing technology that is most relevant to the construction industry include:

- **object based project databases**:

  A project database contains all the information about a project and is able to be accessed by any participant in the project, at any time, from any place, and in a form most suited to the participant. Rapidly developing project web technology is used as the communication media. Where the project database is object oriented, the information describes physical objects such as walls, doors or windows, and abstract objects such as design criteria. The physical objects have attributes or properties including dimensional information, material requirements, fire, thermal or noise ratings and authorship. Abstract objects have attributes including date of creation, authorship and dependence on related objects. The information in the database also has attached to it any intellectual property rights, the right to change information, restricted to its author, or the right to modify information for subsequent reuse.

- **communication networks**:

  The increasing use of the Internet and web browser technology provides access to project participants to the project database. It also provides access to client databases with generic information about their requirements and historic data and product databases with information about manufacturers, suppliers and service providers and their products. The Internet and dedicated networks allow for fast access to databases which allows for a single project database, rather than multiple copies of the data held by each project participant.

- **electronic commerce and electronic procurement**:

  Electronic procurement, in this context, involves using electronic commerce processes for procurement activities. It enables organisations to conduct their business using concepts, methods and cultures that are fundamentally different to those we have been accustomed to. Electronic commerce introduces new ways for organisations to communicate internally and externally, transact business deals and manage supply chains and alliances.

SHARING LEARNING AND KNOWLEDGE

Fundamental to the effective use of information technology as an enabler to improve the efficiency of the industry is sharing of learnings across the industry, with related industries and industries that are not related. This is in addition to sharing knowledge within the industry by such means as project databases, product databases and client databases.

Both of these aspects of sharing require cultural change in the industry. The sharing of project specific knowledge has immediate gains for project participants. The cultural change required is a move to openness, long term relationships and alliances, cooperative contracting, and sharing risks and rewards. This change is occurring independently of the use of information technology, although information technology is a powerful tool for the necessary communication between all parties which helps the cultural change.

The sharing of learning across the industry is hampered by concerns for losing competitive advantage. One way to avoid compromising competitive advantage but maximise shared learning is to share knowledge with other industries so that the construction industry can accelerate its own learnings and efficiency gains without the concerns of direct, intra-industry competition. For example computer graphics from golf course simulations, financial transactions in the banking industry and the developing fast and dynamic technology for computer games with low memory requirements, can be applicable to the construction industry for interactive client or site worker understanding.

PROJECT PROCESS RE-ENGINEERING

For significant benefits to accrue we need to achieve what is known as project process re-engineering, which is the fundamental rethinking and redesign of project processes taking into account such things as evolving technology. At a basic level it is about ensuring that non value adding steps are eliminated. The alignment of processes with information technology strategies will assist us to identify and eliminate non value adding steps. This re-engineering must extend to all project participants in the supply chain, including client, consultants, contractors and suppliers, so as to achieve the full benefits of process re-engineering as an enabler to better information technology usage.

Integral to process re-engineering is supply chain management. This involves the management of relationships, information flow and the supply of materials and services, both up and down the full supply chain.

The management of relationships includes the use of preferred suppliers and strategic alliances, and ultimately, the bringing together of virtual organisations for either particular projects or for a series of projects where there are advantages in keeping the team together. Information flow includes the open sharing of information so that all parties are able to reuse the information and add value, while managing their own obligations and responsibilities. An integrated supply chain maximises the potential for savings in the supply of materials and services through each party being able to deliver their input in a manner coordinated with related materials and services.

Information technology can enable improved supply chain management through access to accurate on line information on project electronic sites.

Whilst there will be a focus on long term relationships between supply chain partners there will be a greater range of choice of potential suppliers of goods and services which best suit the task in hand with suppliers having access to niche business opportunities through information available through the web.

Linking interested parties and stakeholders together via electronically based project sites will provide greater integration. This will replace the often fragmented supply chain management systems found today with resulting benefits, saving time and money.

INTELLECTUAL PROPERTY RIGHTS

A possible barrier to innovation is concerns about intellectual property rights. Intellectual property in our industry can be simply defined as unique products and services created by an identifiable source. Whilst the issue of intellectual property does not change with the format of information, the perception and reality exists that having a document in electronic form makes it easier to copy, modify and reuse than the same document in hard copy.

The sharing of electronic information which has intelligence embodied in the information will lead to reduced re-keying errors and resources used to re-enter data into subsequent processes. For the industry to share rich information that allows, for example, the take off of quantities directly from a database, implies that the information shared must be object based and that the attributes of the object, such as cost, must be shared. As individual firms develop the means to give objects intelligence and the client makes those objects available to suppliers further down the chain, particularly to contractors in a design development and construct contract, the objects and the intelligence in their attributes will can become available to competitors.

LEVEL OF INVESTMENT

The level of investment required for information technology take up has been questioned, with the perception that a high level of investment is required to take advantage of information technology, restricting the use of information technology to large firms and shutting out small to medium enterprises. Any organisation can start to be involved through access to the Internet and electronic mail where they can search for business opportunities through electronic tender notices and exchange information with their business partners through simple electronic mail and attachments. Low level computing power is needed for this and many small to medium enterprises use computers for bookkeeping and simple word processing tasks. As their level of comfort and sophistication grows, enterprises can invest more appropriately, but with some knowledge of where they are going and what technology can do for them.

Enterprises should also use their business partners to share investment in technology. Contractors can use consultants who have already invested in CADD or building simulation applications to prepare work-as-executed information, rather than invest themselves. Plumbing subcontractors could use mechanical subcontractors to prepare electronic shop drawings, thereby gaining the advantage of having a complete three dimensional services model without having to invest in the technology or training.

STANDARDS

Australian industry is asking Government to set standards to make it easy to share information with minimal investment, or at least without industry having to invest in a number of applications that perform the same task. Work is occurring nationally and internationally to develop interoperability. However, while open standards are being developed and implemented at a slow rate, some significant clients are requiring particular applications to be used by their suppliers. Fostering of open standards and interoperability will lead to innovation through competition between vendors. The ready exchange of information between applications such as building modeling and thermal load calculation, without re-keying data, can also readily occur.

SUCCESS FACTORS

There are a number of factors which are important to the success or failure of strategies adopted for the take up of information technology. On the positive side these factors include:

- the general availability of enabling technologies
- the significant agreement between participants about broad directions that exist in the industry
- the availability of projects which demonstrate the use of information technology and show potential benefits.

On the negative side they include:

- the patchy take-up and application of technology across industry today
- limited awareness and understanding of information technology and its potential benefits
- the traditional "paper based" mindset of the industry
- evolving legal and contractual issues

A further factor which is peculiar to Australia and can be considered as either positive or negative is the requirements of the recently introduced Goods and Services Tax (GST) for better record keeping systems, likely to be computer based. This can provide either a significant opportunity to extend the use of information technology, or be a factor that will distract people from thinking about introducing new ways of using information technology.

ELECTRONIC PROCUREMENT

Electronic procurement uses electronic commerce processes for the procurement of goods, materials and services, including internal and external communication, transactions and supply chain and alliance management.

APCC members have adopted a *National Framework for Cooperation for Electronic Commerce in Government Procurement*, (APCC: 1999) which fosters a consistent approach across all Australian governments to the technology involved in electronic procurement.

The NSW Government has recently released a discussion paper titled *Electronic procurement – taking up the challenge* (NSW Govt: 1999). The paper challenges suppliers and government agencies to think about how they might make best use of electronic procurement tools to enable more efficient procurement. Benefits envisaged include improved strategic planning through knowledge of buying patterns and market forces, reduced transaction costs, improved supply

chain management and improved delivery of Government social, environmental and economic development objectives.

Governments expect that electronic procurement will be used in all stages of project procurement and facilities management throughout the construction industry, as well as in their procurement of goods and services generally.

As a first step, work needs to be done with industry associations to provide greater confidence amongst stakeholders in the security of documentation and information contained within shared databases inherent in a virtual project site and in electronic procurement transactions.

Electronic commerce practices can be drawn from other business to business examples, for example competing car manufacturers in the U.S. working together to source components, without the construction industry needing to invent its own processes. It is important that electronic commerce is used to reduce transaction costs involved with sourcing, ordering, tracking delivery and payment for goods and services. Electronic commerce can also be used to reduce damage to materials by just in time delivery to site, rather than early delivery of materials to the construction site or shifting materials around the site. It may also lead to shrink wrapping of bundles of materials so that the construction worker has exactly the materials needed for the job without wastage.

In electronic tendering, governments are progressively adopting systems that go beyond the current advertising of tenders to allow the down loading of measurable documents and undertaking the complete tender process electronically. These systems will provide on line access to information to all interested parties, facilitating speedier interaction.

Early projects allow for tenderers and their suppliers or subcontractors to take linear and area measurements off documents available on the web. Concerns about the integrity of documents and long download times currently limit this capability. Further developments with three dimensional object based documents will allow for length, area and volume measurements and the take off of quantities.

REGIONAL AND SMALL TO MEDIUM ENTERPRISES

While the NSW Government is dealing with a limited number of large suppliers, it recognises the value of small to medium enterprises, but leaves the management and selection of these enterprises to the head contractor. Information technology should help supply chain management and participation by small to medium enterprises located near the work, or in other words regional enterprises, by providing ready access to information about business opportunities.

In Australia 85% of the work under construction contracts is carried out by subcontractors. Across Australia 94% of trade based enterprises employ less than 5 people, including management (ABS 1996-97). On the consulting side, 5,500 consultant firms employ around 30,000 people. From these figures it can be seen that small to medium enterprises play an important role in construction in Australia.

However, Governments are moving to the use of single service providers. An example is the implementation of twenty Schools Facilities Maintenance Contracts for the primary and secondary schools throughout NSW, as opposed to multiple short term contracts for individual schools. These contracts are for a three year period, extendable for a further two years, and encourage the contractor to plan maintenance over the full life of the contract. Information technology allows forward planning to be carried out on a large scale, as well as allowing information on condition assessment to be maintained in a database for easy retrieval.

The value of small to medium and local enterprises is their ability to be flexible, to fill niche areas and to respond quickly to operational or maintenance issues which arise during the life of the project, particularly in regional areas away from the large coastal cities. In Australia they are also a concern of governments because of the loss of jobs "in the bush".

INTEROPERABILITY

Sharing information in electronic form, particularly from a single source and in a form that suits the user, provides significant benefits, such as improved understanding, reduced face-to-face meetings, improved document control, and elimination of re-keying errors and resources. Significant to this sharing is interoperability.

An organisation that is working with governments in Australia is the International Alliance for Interoperability – Australasia Chapter. Its initial direction in 1997 was strong support for the development of Industry Foundation Classes at an International level while ensuring that the development was compatible with Australian needs and was influenced by Australian directions as appropriate. From February this year emphasis has been placed on the use of information technology on day to day projects, where effort is being put into demonstrating the practical use of interoperability on real projects as well as technology use generally.

The lessons learnt from these projects will be applied across the industry generally to ensure that business and process needs are met, rather than technology being adopted simply because it is being taken up by competitors without a real understanding of its benefits. This development will also allow resources to be allocated where there is the best balance between resources and outcomes.

LESSONS FOR OTHERS

Australia appears to be unique in having government clients with significant buying power working to a consistent national approach. Other nations should strive for this consistency of direction through cooperation between major stakeholders. This will enable a pool of well informed, technology enabled subcontractors, designers and suppliers to become available. A consistent approach should include:

- raising awareness across the industry as a whole, including clients, through publishing success stories as well as some of the pitfalls
- starting simple with the sharing of electronic information and knowledge on a project basis
- using leading edge practitioners to set directions, with the wider industry being early adopters of demonstrated success rather than bleeding edge adopters
- sharing learning across clients, designers, contractors and suppliers

- involving subcontractors and material suppliers, so that change is driven from the bottom up as well as top down

Another lesson is that information technology is just an enabler to improve the efficiency of design, construction and facilities management. Other factors such as electronic commerce, outcomes driven tendering processes, business relationships, contract conditions, project management, industry viability, performance measurement, training, environmental concerns and industrial relations are all a part of construction industry development in Australia. This broad approach by government gives the adoption of information technology enabled processes a greater chance of success.

WHERE TO FROM HERE?

While it is well accepted that information technology will play an increasingly important role in construction and facilities management, the majority of stakeholders are uncertain as to what that role will be, or what roles will provide the greatest benefit for a reasonable level of investment.

If we ask ourselves what areas concern us most about communication in this industry, forgetting about information technology for the moment, we can start to focus on business needs and where our real problem areas are. In this way we can start to develop ideas about how to overcome those problems, using information technology as an enabler, if appropriate.

The Australian construction industry is moving slowly with the take up of information technology to enhance information sharing between the diverse players in construction processes, including briefing, design, documentation, construction, commissioning, operation, maintenance, disposal and feedback into the beginning of the cycle. The factors that will accelerate progress are the directions being set by government and the use of real projects to refine processes and test them against real business needs.

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