

# Recent changes in the use of information technology by the Australian Construction Industry

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## ABSTRACT

The construction industry in Australia has undergone significant restructuring in the past three years, and many companies are introducing information technology to displace labour and reduce operating costs. CAD systems are now being used widely, and the exchange of data is occurring at an increasing rate between all disciplines. This period of change provides the industry with an opportunity to introduce a rational approach to the exchange of information, and the possibility of collaboration on computerised systems that would have application across the construction industry.

### Keywords

information technology;CAD;data exchange;information model;quantity surveying

## Introduction

Since the late 1980's the construction market in Australia has withered with the consequences of financial deregulation and the impact of the global economic recession. The impacts have been evidenced by large reductions in employment and activity levels, and a large stock of vacant office space in the major capital cities. A number of construction companies and consultants have been forced to cease or substantially reduce their operations. The resultant losses have been typically measured in terms of increases in unemployment or as the cumulative losses of years of construction experience. However these changes also afford an opportunity for review and the building of new value added services to clients.



## Types of information technology

The majority of developments, in the area of information technology, proceed regardless of the use made by the construction industry so low levels of investment will generally only impact on industry specific hardware or software. As each new technology gains widespread use then we could describe them as *stable* and relatively *low (commercial) risk technologies*. For a short period the relatively new technologies could be described as *evolving*, and potentially *high (commercial) risk technologies*, however they offer strategic advantages to companies who elect to accept the risks. The latter category includes technologies such as the application of Electronic document interchange (EDI) to construction or introduction of integrated computer systems with proprietary data interchange standards. They can also have high commissioning and operating costs that will be beyond the grasp of a large proportion of the stakeholders in the construction industry.

There is much anecdotal evidence that these types of developments are being made at an increasing rate, and that the construction industry is embracing both stable and evolving technologies. For example a survey (AEC,1991) of the use of Computer aided design and draughting software (CADD) in architecture and building construction (AEC) in Australia reported that the technology being used by the AEC professionals was *leading edge* and *on par* with overseas technology. This survey also found that:

- more than 55% of the practices surveyed used CADD on at least half of their work
- over 70% of the practices surveyed reported using CADD to do at least half the drawing work on each project
- 60% of respondents were planning to increase their commitment to computing in the following 12 months by purchasing more hardware and/or software
- over 70% of respondents felt that computers aided their creativity directly or indirectly

## Investment in new technologies

The last decade has brought a number of opportunities for the adoption of new technologies and computerised systems. Many industries have embraced these technologies and have utilised them within their manufacturing or resource production

activities. As might be expected, the impacts of new technologies have not been constant across all sectors of the economy. The construction industry for example could be considered to be slow, in comparison to most other industries, in the introduction of technology and investment in research.

The basis for these claims can be found in publications such as Building IT2000 Report. This report provides comparative ratios for investment in technology by sector in the UK. It shows that when IT expenditure is measured as a percentage of turnover, then the ratio for construction is less than 1.0%. This level is considered to be low when compared with 1.5% for process, and manufacturing, 3% for government and 5% for Utilities.( Butler & Cox, 1990) Although it would be possible to argue that a comparison of expenditure against turnover would not be accurate across such a diverse range of industries, it is obvious that even small differences in investment ratios translate to very substantial sums when the figures are calculated. Unfortunately there are no comparable figures for Australia but it is unlikely that local construction companies would have rectified the imbalances in expenditure on technology.

There are a number of reasons to forecast that investment in technology will increase during the next five to ten years. Firstly, clients and building owners have created a range of new opportunities for construction professionals. In 1991 the value of building stock in Australia was estimated to exceed \$500 thousand million, and much of this stock had been constructed before 1980. As standards and competition for tenants have increased there has been a consequent increase in restoration and rehabilitation activity. At the same time there has been a renewed interest, by clients and building owners, in Estate and Facilities Management techniques. The use of these techniques has generated a variety of database applications for asset management, expenditure and maintenance, also CAD is being used more frequently for storage of spatial information.

Secondly, estimates of annual expenditure on construction suggest that it has reached approximately one third (\$26 thousand million) of total gross fixed capital expenditure in the economy (CFC, 1990). Construction is therefore an important industry, comparable in economic terms with other major sectors in the economy. Many companies will introduce computers and software in the belief that a reduction in operating costs will lead to increased competitiveness.

The final and perhaps the most persuasive reasons are the results of studies dealing with the economics of investment in technology. These studies provide clear economic justification for the adoption of new technologies. For example a recent report by the National Committee on Rationalised Building (NCRB) provides estimates of potential returns from the development of a comprehensive information and data transfer system.

*"Based on the experience of the banking and finance industry and recognising the greater complexities involved, potential returns of the order of 1000% are realistic" (NCRB, 1992)*

Construction companies are only now becoming aware of the potential for such significant returns. Management now has considerable justification for investment in information technology, and must look towards introduction of this form of technology.

#### Measuring the impact of technology

The impact of technology on construction needs to be measured in a number of ways. We commonly describe the impact of technology in terms of the number of new computers or software licences, and related equipment eg facsimile machines and photocopiers. It is obvious that these simple measures neglect the fact that technology impacts on people, processes, etc. We must therefore use of a range of factors to measure the various types of impact and the changes to organisational structure and culture. We could, for example, include data communication and exchange levels within a construction project, or the levels of training and new skills introduced. Obviously one of the key areas for new research would be the development of a range of indicators for use in our industry.

As an outcome of the increased use of computers, companies have started to address the issues of integration both within an organisation and between organisations. There are a large number of construction companies and industry work groups striving towards the introduction of technologies and information sharing mechanisms. It appears however that competition between organisations and the fragmentation of the industry have prevented the implementation of industry wide initiatives. Fortunately in Australia we have had a at least two industry groups working towards resolving the problem of information transfer in the building industry.

## Developing an industry wide information model

In 1986 the NCRB began developing a national approach to the generation and maintenance of reference information for the construction industry. The first stage of this task, which was the generation of a discussion paper and information model, was completed and distributed in 1992. This paper describes a strategic model for information management, and suggests areas for further action, and parallels work being undertaken in Europe and North America.

One of the major reasons for the NCRB embarking on this exercise was their belief that information management and exchange within the construction industry was of critical importance. They also felt that a lack of integration and overall co-ordination was preventing the full realisation of full benefits from this type of technology. At a strategic level the model was designed to provide a context for the development of specific tools and a framework for information and decision support systems.

The model is described in Figure 1, and it displays two distinct components, i.e. the reference information providers and the information users. It then links each component using a series of reference databases eg GIS reference data, Building Code of Australia, etc. The NCRB have identified "*standard, industry wide terminology, classification and performance attribute labels..*" as being essential items if this system is to operate successfully.

NCRB suggest that any industry wide system will probably include a number of the evolving technologies such as EDI, Email and networks, and they go on to say that

*"Building is one of our more information intensive industries. The design delivery and operation of a building involves the application of knowledge from the social and environmental sciences through economics, building and material technology to human resource management, and law. To assure the quality and value of its product and accountability of its decision makers, the industry must come to terms with this mass of information, and the problems associated with the communication and coordination of project decisions."* (NCRB, 1992)

## Impact of technology on the professions

The previously described developments in technology have impacted on the activities of contractors, architects, engineers and other consultants including quantity surveyors. Many clients are now seeking multiple use of project data to increase the return for expenditure on project documentation and delivery.

The Quantity Surveying 2000 (QS 2000) report commissioned by the Royal Institute of Chartered Surveyors (RICS) makes the following points :

*"Information flows in construction will increasingly be made electronically. The development of new IT tools for Quantity Surveyors (and databases in particular) will need to progress alongside that of other systems used in design and construction, particularly CAD systems. The production of tender documentation will increasingly become automated."* (RICS, 1990)

This statement reinforces the critical aspects of information flow and the need for co-ordinated developments of new technologies and systems amongst the various disciplines involved in the construction industry. In Australia there has been a number of groups actively pursuing the area of integrated building product description. These groups include :

- Construction Industry Information and Computing Group (CIIC) which is attempting to improve the efficiency and effectiveness of computing in building procurement and operation.
- Built Environment Technologies (BET Focus Group) which is fostering data exchange standards
- ACADS Data Exchange Group is also looking at CAD data exchange issues
- Construction Industry Electronic Trading Group which is looking at the application of EDI and barcoding for material delivery.

The growing use of CAD in the past decade has generated a great deal of discussion within professions, particularly by those who believe that CAD could fundamentally transform their professional roles. For example the quantity surveying profession has become increasingly focussed on the value of technologies

and computerisation, and the impact that these changes will have on the production on bill of quantities and cost planning.

In 1986 Brian Atkin suggested that *"CAD will not necessarily signal the imminent demise of any profession or group, but it is clear that it will be an effective catalyst in bringing about much needed change."* . Atkin went on say *"CAD is not the preserve of designers, but has much to offer all members of the design and construction team"*. (Atkin, 1986)

The Building IT 2000 report forecast a changing role for quantity surveyors where the production of bills of quantities was reduced and where tendering was linked to CAD systems, This report concluded that :

*"It is not so much a question of whether bills of quantities will disappear - they will probably not - but whether Chartered Quantity Surveyors will continue to prepare them."* (IT2000, 1991)

In Australia the EDICON group of CIIC (Construction Industry Information and Computing Group) has been working towards the development of a standard interface format so that a bill of quantities can be downloaded into a range of estimating software. Although this is a relatively small step towards data integration it does demonstrate current moves in Australia toward integration and data exchange between contractors and consultants.

The implications for quantity surveyors and other professionals are therefore far greater than the current levels of debate would indicate. It is time to look beyond our individual professional roles and activities and to embrace a number of new and evolving technologies to enhance the position of all stake holders in the construction industry.

#### Increased use of CAD on construction projects

In the past few years there have been a number of construction projects in Australia where CAD has been used successfully to improve speed and quality of the design process while providing information for other disciplines. A recent example was the MCG "Great Southern Stand" project that was completed in 1992 at a cost of A\$150 million. The stand was designed by Daryl Jackson Pty Ltd, in conjunction with Tomkin Shaw and Evans, using a

number of different CAD systems. The design documentation was completed using MicroStation, APDP and Modelview. Sight lines were developed with the assistance of a US architectural firm, and by remote use of their GDS system. CAD data was exchanged between the design team and other consultants, using .SIF and .DXF data exchange formats and the following computer systems DOGS, MicroStation and Eagle. Data was exchanged to produce interior design schedules using a database manager, and also transferred to project scheduling software.

Obviously there is a great need to examine the impact of CAD in more detail since it has already become the medium for data exchange between design consultants. In the QS 2000 report the authors considered these issues and wrote :

*"Perhaps the biggest impact of computers on practice to date has been on improving the speed and efficiency of professional service. The impact is greater in the building design professions - architecture and engineering - where CAD (Computer Aided Design) is not only improving speed but revolutionising the nature of the design process and the quality of service" (RICS, 1990)*

Although these comments were made in 1990, the impact of CAD has now become apparent, with ACADS publications suggesting that CAD systems are becoming common for architectural and engineering consultants. One of the largest design offices, Australian Construction Services Group (ACS) is for example in the process of installing 250 work stations utilising the IBM AES software. ACS expect that over 2000 technical staff, from a variety of disciplines, in 10 major offices to use the software.

#### Impact on software development

The Australian marketplace is well serviced by local software development companies, and some of these have exported their products to South East Asia, UK and Europe. Their success has generally been predicated on providing the construction industry with systems that imitate the methods or approaches of existing manual tasks. The benefits of using these systems are normally limited to improvements in speed of processing or efficiency of undertaking tasks.



*"Generally computing applications for Quantity Surveyors have concentrated on relatively routine tasks of measurement, document preparation, cost reporting and so on. The emphasis has been on improving speed and efficiency by automating manual tasks." (RICS, 1990)*

Software companies are now recognising that the next generation of computerised systems will need to encapsulate knowledge, encourage data exchange and add value to the services provided by consultants. One of the major impediments that limits both the pace of development and the number of commercial computer systems is the relatively small number of construction companies who could become potential users of these systems. Also the high cost of developing and maintaining expert and integrated computer systems will prevent many companies from developing their own products.

There are a number of solutions to the problem of software development. The first solution simply requires the developer to create the software for both local and neighbouring markets. Products such as CLIENT produced and supported by CSSP have already demonstrated that the Australian software industry can produce software with international appeal and application. Another solution is the linking of research, production and market to produce products for industry wide application. In recent years the RICS in the UK has been able to exploit the benefits of collaborative research and development and the development of industry initiatives eg ELSIE. The results of these activities have been provided for the use of all members of industry while, ultimately, adding value to projects. If the model proposed by the NCRB is supported by industry then the potential for similar collaboration exists in Australia.

#### Challenges for the Australian construction industry

Perhaps one of the most important statements made in the QS 2000 report was

*"The challenge now is to exploit this to provide services of real value to clients as well as services of value to practitioners." (RICS, 1990)*

The construction industry needs to reflect on this statement and recognise that we have an ideal opportunity to review our

operations and to restructure companies to meet these challenges. The first of these is a shift from using technology for the purposes of "labour displacement", to regarding technology as a "value adding tool". Secondly the industry must recognise that clients need to manage data during the life cycle of a project, and that data produced during documentation and delivery phases must be available for later use by the client. The last challenge is for the construction industry to work together to ensure that the next generation of technologies is developed using a collaborative approach.

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