THE UTILISATION OF INFORMATION TECHNOLOGY BY THE
AUSTRALIAN QUANTITY SURVEYING PROFESSION

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ABSTRACT
This paper examines the utilization of Information Technology (IT) by the Australian Quantity Surveying profession since 1995. The paper is based on research conducted by a team from the Project Management & Economics Program at the University of Technology Sydney (UTS) involving a series of four national surveys spanning 1995 to 2001. Firms in all sectors of the construction industry will need to work smarter to gain competitive advantage and the use of electronic commerce provides probably the greatest scope for this to be achieved. More importantly, current project procurement trends strongly indicate that firms not capable of communicating electronically at all levels with project participants will find it increasingly difficult to secure work. The primary purpose of the UTS research was to examine and identify how Quantity Surveying firms are evolving to meet these challenges. The paper initially examines trends in the structure/size/nature of the profession and trends in general business practices and scope of services. This is followed by an in-depth examination of trends in the utilization of IT by Australian Quantity Surveying practices. Special focus is placed on the use of CAD and automated quantities. The survey responses are then used to examine current problems that the profession has in terms of IT utilization. The paper concludes with a range of recommendations and IT strategies that attempt to address these problems and ensure the relevance and importance of the profession well into the future.

Key Words: Information Technology, Quantity Surveying, Electronic Commerce

1. INTRODUCTION
Optimal use of Information Technology (IT) is now a fundamental requirement for achieving international best practice and competitiveness and ensuring long term prosperity. Given the increasingly global nature of construction activity, failure to invest in IT will not only result in an inability to compete on an international scale but will also place firms at serious risk of losing their domestic market share to overseas competitors more amenable to maximizing the benefits that IT can confer. This international threat is of serious concern to all participants in an Australian construction industry dogged by extremely high levels of domestic competition and resultant low profit margin levels. One of the keys to competitive advantage lies in the intelligent application of IT. Accordingly, whilst relatively slow on the uptake, the Australian construction industry is now undergoing significant and swift changes in terms of IT utilization and development. The impact of these changes, and concomitant changes in industry structure and procurement practices, on the quantity surveying (QS) profession will continue to escalate. As information flows increasingly become electronic QS computing facilities, software and databases will need to develop in a compatible manner. Compatibility with and the utilization of CAD systems is just the beginning. It is inevitable that documentation and data will be increasingly automated to the point where measurement and other technical processes will require minimal human intervention.

This naturally leads to speculation about the imminent demise of the independent quantity surveying consultant but the reality is that, at this stage anyway, IT advancement provides the profession with enormous opportunity to actually strengthen its position in the industry. Quantity surveyors are well placed to become the major information handlers on construction projects as the majority of information flow evolves around quantities and cost. Realistically though, no profession or discipline can legitimately lay claim to being best suited to take control of information management. It is likely that current opportunities will be taken up by others if the profession adopts a "wait and see" approach.

This paper examines trends and future directions in the services provided by the Quantity Surveying profession in Australia with a particular focus on the profession's utilization of Information Technology (IT). It is based on research undertaken by a team from the Project Management and Economics Program at the University of Technology Sydney (UTS) comprising four nationwide surveys of the profession carried out from 1995 to 2001. The author would like to acknowledge the assistance of this team, namely Assoc. Prof. Craig Langston, Rick Best, Gerard DeValence and Grace Ding, with the research for this paper.
2. THE AUSTRALIAN QUANTITY SURVEYING PROFESSION

Quantity Surveyors in Australia provide financial management services for projects predominantly in the construction/property industry. Traditional services include the preparation of Bills of Quantities, Builders’ Quantities, Cost Planning/Budgeting, Estimating and Contract Administration. The past decade has seen a marked rise in the diversification of services into non-traditional areas such as Feasibility Studies, Life Cost Analyses, Programming, Taxation Advice, Arbitration/Mediation, Expert Witness/Appraisal, Insurance Valuations, Risk Management, Quality Management, Value Management, Project/Construction Management and Facility Management. In the past five years, the profession has also made significant inroads in providing cost management services to other industries such as the Petro-Chemical, Manufacturing, Mining, Aeronautical, Shipping, Transport and Civil sectors. This diversification is a result of the profession adapting to meet changes in industry requirements.

The size of the profession is relatively small. Total membership of the Australian Institute of Quantity Surveyors (AIQS) is currently just under 3000 with only approximately 1200 corporate members (the rest made up of student/probationer members). However, there are no registration requirements for Quantity Surveyors and no requirement to be a member of a professional association. Therefore, the AIQS membership does not reflect the total number of practitioners in the industry but, nevertheless, provides a good indication. The majority of firms in the industry are small having five employees or less. It is of note that 25% of respondents to the 1999 and 2001 quantity surveying practice surveys referred to in herein were sole practitioners.

This is reflective of the extremely fragmented nature of the industry not only in Australia but globally. The industry in Australia is characterized by a large number of small organisations with over 100,000 small businesses operating in the industry. 98% of firms employ less than 20 people and 85% employ less than 4 people (Hutt 2000). 85-90% of construction work is subcontracted and project team consultants and contractors are typically assembled for individual projects in an ad-hoc "one-off" pattern with decisions on project team composition largely made on the basis of lowest price. Hence, project teams are assembled and disassembled on a project by project basis with little continuity of project team members over the long term. During the course of large projects, there are typically hundreds of firms (consultants, contractors, suppliers) involved during the various stages with a high level of "change-over" between the various trade contractors. Additionally, every project is a "one-off" prototype. Current initiatives to address these problems include alliance contracting, joint venturing and "single-source" delivery of services extending into the operational stages of projects.

Due to a lack of industry standards, each of these firms has their own organisational/management systems in place encompassing a wide range of technological capabilities and software usage. The wide range of software systems used and the incompatibility between many of these systems severely limit the scope for the industry to take advantage of the rapid technological advances surrounding it. Exacerbating this situation is the generally low profit margins in the industry which inhibit the ability of firms and the industry generally to make the necessary investment in IT systems, research and development. Other key problems include the complexities surrounding information flow on construction projects, the lack of information and process standards, the traditional "paper-based" mindset of the industry and legal and contractual issues relating to electronic documentation and records.

Nevertheless, IT utilization in the industry has gained significant momentum in the past few years. Weisburg (2000) argues that the next few years will see significant changes in how developers, designers, consultants and contractors manage the entire building process. These changes will result in not only substantial restructuring of how facilities are designed and supported but also a major reengineering of how these players do business. Weisburg further contends that the process will become substantially more information-oriented with participants being required to not only have the technological capabilities to be a part of this information flow but also, and probably most importantly, be willing to share their information. The sharing of intellectual property amongst project participants will, in itself, require major cultural and business shifts as firms are increasingly asked to "hand over" their valuable data.

This presents the profession with an amalgam of opportunities and threats. This technological revolution will enable the profession to raise its level of service to a much higher and professional "value-adding" level as the technical aspects of the quantity surveyor’s role increasingly become automated. The potential is there for quantity surveyors to be freed up from many of the time consuming technical aspects of their profession and focus on developing more sophisticated and professional services. Conversely, if firms fail to utilize and evolve with technological advances, particularly in terms of CAD and electronic transfer and receipt of information, they run the very real risk of being squeezed out of the virtual electronic project teams of the future. Accordingly, this paper will examine the results of research conducted on how the profession is evolving and meeting the challenges that IT advances are providing.
3. QS SURVEY RESULTS & ANALYSIS

This section examines the general practices of Australian Quantity Surveying firms over the past 6 years with a focus on the attitudes towards and utilisation of Information Technology. It is based on four nationwide surveys of the Australian QS profession carried out from 1995 to 2001 by the Project Management and Economics Program from the University of Technology Sydney in collaboration with the Australian Institute of Quantity Surveyors (AIQS). The 1999 survey was also carried out in collaboration with the Pacific Association of Quantity Surveyors (PAQS). These survey results enable evaluation of how the profession has reacted over the past six years to the challenges and opportunities that Information Technology advances and general industry changes have presented.

3.1 Survey Details

The surveys comprise a series of nationwide surveys of Quantity Surveying firms carried out in 1995, 1998, 1999 and 2001. 77 firms (out of 160), 65 firms (out of 126) and 42 firms (out of 148) responded to the 1995, 1998 and 2001 surveys respectively representing response rates of 48%, 52% and 29%. The 1999 survey was posted to all AIQS members with 38 firms responding. The surveys comprised a number of questions concerning general practice details, information technology capability and use and future directions of the profession. The questions were largely the same for each survey but some questions were added to the 1999 and 2001 surveys. Hence, it should be noted that where 1995/1998 results are not shown this indicates that the particular questions were not asked.

3.2 Respondent Profile

Figure 1 shows the location of respondents (question was not asked in the 1999 survey). This generally reflects the population sizes in the various states/territories of Australia. It is worth noting that approximately 90% of construction activity occurs on the eastern seaboard in the states of Queensland, New South Wales and Victoria. Additionally, despite its geographical size, Australia has one of the highest rates of urbanization in the world with the vast majority of the population residing in the capital cities of each state/territory. Accordingly, respondents from the capital cities of Queensland, New South Wales and Victoria dominate the survey. The respondents predominantly comprise small to medium sized organizations which is typical of the profession’s (and industry’s) structure. More than half had less than 5 employees and approximately 25% of respondents to the 1999 and 2001 surveys were sole traders. These are significant factors when analyzing the survey results. Nevertheless, more than half have been in business for over 10 years which suggests that longevity of firms, at least until now, is a feature of the profession.
3.3 Services Provided

The past two decades have seen Quantity Surveying firms expand and adapt their scope of services to meet changing industry demands. The use of the traditional "bread and butter" of the profession, Bills of Quantities, has declined markedly in the Australian construction industry over this time to the point where they are rarely used. Despite this, the volume of work carried out by firms has increased over the corresponding period. Builders Quantities, whereby tendering contractors themselves (rather than the client) engage and pay Quantity Surveyors to prepare quantities have now taken over from the traditional Bill of Quantities provided and guaranteed by the client. Builders Quantities are usually prepared in a concise form with firms using their own concise standards; no standard concise method of measurement has yet been developed.

Another major change has been that Quantity Surveyors are now used much more in the "front-end" stages of projects where their expertise is of most value. Cost planning and budgeting is becoming the new "bread & butter" of the profession. One of the largest Quantity Surveying firms in Australia¹ provides a good example of these changes; in 1980 Bills of Quantities accounted for approximately 80% of their total workload whereas in 2000 this had declined to little over 5%. However, rather than leading to the firm's demise, the firm has adapted accordingly and now provides a greater volume and wider range of services.

This section of the survey targeted the scope of services provided by firms. Figure 4 shows the percentage of firms providing traditional services (question not asked in 1995). Estimating/Cost Planning and Contract Administration are the main services provided by firms. Even though the use of Bills of Quantities has declined most firms still provide this service albeit to a limited extent. More firms prepare Builders Quantities than Bills of Quantities.

Figures 5 and 6 show the extent of non-traditional and non-building services provided by firms (question not asked in 1995). They provide a good indication of the great diversification in the scope of services provided by the profession. This scope is now clearly very broad with taxation advice (comprising mainly building Tax Depreciation Schedules) and valuations for insurance purposes the most common service.

¹ The identity of this firm is not disclosed for reasons of confidentiality
The growth of the profession’s role in the provision of feasibility studies indicates the increasing awareness of introducing quantity surveyors at the outset of a project where they can be of most value. Project management, value management and life cost analyses are now an integral service provided. The involvement in Facility Management and post occupancy services generally has grown and provides perhaps one of the greatest areas for long term growth. The role of Quantity Surveyors in resolving disputes as Expert Witnesses in Arbitration/Litigation actions has escalated markedly. Australia is one of the most litigious countries in the world (measured in terms of legal cases per capita) and its construction industry is dominated by a high level of dispute. Most disputes evolve around money so the cost expertise of the quantity surveyor is commonly sought.

Figure 6 shows that Quantity Surveying firms are increasingly venturing into non-building areas demonstrating that the cost management skills of the Quantity Surveyor can be applied in other industries just as is the case with Project Management. The results indicate that this trend is likely to continue. The civil, infrastructure, transport and mining sectors are the main sources of non-building work. A noticeable jump in 2001 was also evident for the proportion of firms providing research and publishing services.

However, the provision of these services does not necessarily mean that they account for a large proportion of a firm’s volume of work. Figures 7 and 8 indicate the percentage of income that these non-traditional/non-building services provide for firms. The results indicate a significant increase over the 6 year period.

The 2001 results show that nearly 30% of firms generate more than 10% of their income from non-building services and over 20% generate more than 20%. For 5% of firms this area generates more than 50% of total income.

These results provide evidence that Quantity Surveying firms have really taken on the challenge of diversification to better meet and serve industry demands. This indicates, in part at least, a proactive approach to change by many firms. They also demonstrate the very broad range of employment and business opportunities available for the modern day quantity surveyor.

In 1995, non-traditional services accounted for less than 10% of total income for over 80% of firms and no firm had a percentage higher than 50%. Non-building services were very limited; only 10% of firms carried out these services and, even then, they only accounted for less than 10% of total income. By 1998 this picture had changed significantly and has remained relatively stable since. For over approximately 60% of firms non-traditional services account for more than 10% of total income and over 20% of total income for nearly half of firms. For approximately 20-25% of firms these services actually account for over 50% of total income.

However, income from non-building services has shown the greatest rise over the past 6 years of the survey. In 1995 80% of firms did not generate any income from non-building services but by 2001 this figure had reduced to 35%. In fact, in 1995, no firms surveyed earned more than 10% of income from this area.
3.4 Computing Systems

Operating Systems

In order to ascertain current processing technology capacity, respondents were asked to indicate their hardware platforms with the results shown in Figure 9. This provides the basis for the analysis of the survey results. The use of multi-user systems comprising a mainframe and dumb terminals has declined from around 40% of firms in 1995 to zero in 2001. Whilst this change may be more a reflection of the large proportion of small respondent firms in the 1999/2001 surveys it does indicate that many firms are moving more towards networked computers. The use of laptop computers has remained relatively static being used by only approximately half of QS firms.

General Software Systems

The surveys revealed that the majority of firms use mainstream general office application software as indicated in Figure 10. One firm in the 1999 survey (sole practitioner) was still resisting change and had no computing facilities. The major change has occurred in the use of electronic mail (email). In the 1995 survey only 17% of firms used email but by 2001 this figure had increased to 92%. This provides a good example of how quickly email has been embraced as a major communication tool in business.

Specialist Software Systems

Figure 11 indicates that although the majority of firms use specialist application industry software for estimating, cost planning and Bills of Quantities (BQ) preparation the same may not be said for other specialist areas such as time management, facilities management and the like. However, many firms have developed programs for these specialist areas in-house (largely based on spreadsheets) and many project management style programs provide "all-encompassing" capabilities. In-house software is now used by over 70% of firms. The most alarming statistic in 1995 was that only 13% of respondents had CAD facilities. Over the ensuing 6 years this percentage has more than doubled to 28% which indicates that at least some firms are venturing into the CAD area. Nevertheless, this proportion is still low particularly if the profession is intent on remaining a key player in the project procurement cycle. Whilst some respondents cite cost as the main reason for the non-use of CAD, it is clear that the majority of Quantity Surveyors are incapable of communicating/transferring drawing information electronically with designers. This may well see these firms isolated from the chain of consultants in the not too distant future as information flow on construction projects increasingly becomes electronic.
Electronic Communication

In terms of electronic communication, access to on-line services has improved as shown in Figure 12. As previously mentioned, in 1995 only 13% of firms had e-mail/internet facilities but by 2001 this figure has increased to 92%. In 1995 none of the respondent firms had web sites but by 2001 58% of firms had one. This figure is likely to have increased further by now. However, the use of on-line cost and product data services remains at a low level.

Figure 12 shows that the level of external electronic data exchange, other than by telephone or fax, has improved in the 2001 survey. The 1995-1999 surveys showed that less than 10% of firms transferred or received architectural drawings electronically but by 2001 this figure had risen to 28%. Marked improvements were also evident with engineers’ and other consultants’ drawings.

However this level of transfer remains very limited. Figure 14 shows that, despite some improvements since 1995, the vast majority of firms do not transfer or receive any drawing documentation in an electronic form. Of those that do, the majority transfer less than 5% of documentation in this form. However, the latest results showed that two firms were heavily involved with CAD usage and transferred close to 100% of their drawing documentation electronically. These firms really stand out from the pack and clearly show that it is possible.

In terms of remote communications, the percentage of firms utilizing telecommuting by having at least one employee working from home hovers around 10-15%. However, this only involved 1 or 2 staff members for each of these firms.

Teleconferencing facilities are now used by approximately 45% of firms. Only one firm (in the 2001 survey) has videoconferencing facilities.
Measurement Tools

The 1999 survey introduced a question relating to the use of electronic tools to aid the measurement process. The results in Figures 16 and 17 show that the majority of firms still cling to traditional paper-based measurement with the use of electronic measurement tools quite rare. The majority of respondent firms remain averse to using CAD automated quantities – in 1999 85% were not using CAD for this purpose and by 2001 this had improved slightly to 74%. The 2001 survey showed a jump in firms using CAD for measurement, albeit seldom, from 8% to 19%. The most encouraging sign was in the 2001 survey which shows that 3 firms are now using CAD to measure on a daily basis. These firms and others like them who did not respond to the survey, stand out as pioneers in this area. Given the low proportion of firms with CAD facilities in the first place, these results are probably not surprising. The major reasons cited for not using CAD are the cost involved in investing in the necessary hardware/software and training of staff, the incompatibility of different CAD systems and problems with the automated capabilities of these systems. Many firms stated that there was no need or requirement for them to measure with CAD. There are still many problems associated with using CAD for measurement and the time when CAD systems can automatically produce a detailed Bill of Quantities for projects generally (rather than being set up for specific projects) is still probably a long way off. But the reality is that most CAD systems have the capabilities to, at the very least, automatically generate basic quantities in terms of areas, volumes and numbers of items.

Even the use of digitizers for measurement has been very low in the profession. In 1999, 79% of firms never used digitizers, 13% seldom used them, 3% used them often and only 5% used them daily. These figures have only improved marginally for 2001 although the proportion of firms using them daily has increased from 5% to 16%. However, with the firms using digitizers, they are not available to all staff with no firm having more than 3 in the office. Similar findings were made in the 1995/1998 surveys. Digitizers have been around for nearly two decades and are considered by many to already be obsolete due to the advances in CAD yet Quantity Surveying firms still resist their use. Inaccurate results are cited by many as being the main reason for non-use but, in the author's experience, digitizers (particularly those that have been on the market over the past 5-10 years) are extremely accurate. Many CAD systems themselves have digitizer capabilities but, once again, are rarely used by practitioners.

The results indicate that the profession is generally not utilizing and evolving with systems that can automatically produce quantities. There is tremendous scope here for quantity surveying practices to improve productivity and cost efficiency by utilizing such systems.

3.5 Future Expectations

The next section of the surveys asked firms to give their opinions on a series of propositions relating to the possible future impact of general industry changes and Information Technology advances. The propositions and results are shown in Table I. The predominant response for each year is shown in bold.
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<td>1 The role of the QS as an independent consultant will expand in the future</td>
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<td>20%</td>
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<td>2 Future QSs will mainly be employed as part of a professional team in multi-disciplinary practices providing integrated &quot;in-house&quot; services</td>
<td>1%</td>
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<td>34%</td>
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<td>3 The QS will be a key player in the construction industry in 10 years time</td>
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<td>13%</td>
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<td>4 The impact of IT on the construction industry will be minimal in the next 5 years</td>
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<td>5 The impact of IT on the construction industry will be minimal in the next 10 years</td>
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<td>6 Further advances in computing and IT generally will see the end of the technical QS measurer</td>
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<td>7 IT advances will lead to fewer but more highly skilled QSs</td>
<td>n/a</td>
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<td>8 CAD networking facilities and knowledge will be essential for the QS in 5 years time</td>
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<td>n/a</td>
<td>46%</td>
<td>39%</td>
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<td>9 The QS profession should be actively involved in utilising, developing and promoting the use of CAD automated quantities</td>
<td>n/a</td>
<td>25%</td>
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<td>21%</td>
<td>n/a</td>
<td>42%</td>
<td>55%</td>
<td>43%</td>
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<td>10 Only larger practices have the resources to take advantage of IT</td>
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<td>42%</td>
<td>43%</td>
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<td>11 Greater use of IT will enable the QS profession to provide better service to clients</td>
<td>32%</td>
<td>31%</td>
<td>32%</td>
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<td>43%</td>
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<tr>
<td>12 The QS is well placed to take advantage of the changes in the construction industry which will flow from the increased use of IT</td>
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<td>16%</td>
<td>14%</td>
<td>8%</td>
<td>3%</td>
<td>13%</td>
<td>12%</td>
<td>1%</td>
<td>3%</td>
<td>0%</td>
</tr>
</tbody>
</table>

* predominate response for each year marked in bold
The predominant response categories were largely the same for each year and indicate that attitudes towards IT and its effect on the profession have remained relatively unchanged. The responses clearly indicate that the majority of practitioners believe that information technology will have a significant influence on their future working environment. 74-82% of firms over the four surveys agreed that greater use of IT will enable Quantity Surveyors to provide better services for their clients. Despite this, the survey results indicate a relatively low commitment to the use of IT advances.

The main disparity in results between survey years lay in two questions relating to the possible demise of the technical measurer and the decline in practitioner numbers. In 1995 over 50% of respondents agreed that further advances in computing and IT generally will see the end of the technical QS measurer. However, approximately 60% of respondents in the 1998/1999/2001 surveys disagreed with this proposition. In 2001 19% strongly disagreed with this. This may be prompted by continuing problems with the development of CAD automated quantities. Nevertheless, approximately 60-70% of firms in each of the surveys believe that CAD networking facilities and knowledge will be necessary in the next five years and an even higher proportion believe that the profession should be actively involved in promoting, developing and utilising CAD automated quantities. This is clearly at odds with what firms are actually doing with the survey results show a low level of CAD usage by quantity surveying firms. Although 67-77% of respondents believed that the QS is well placed to take advantage of the increased use of IT in the construction industry, the survey results show that the profession is clearly not exploiting this advantage and is largely taking a reactive rather than proactive approach.

In each of the surveys, approximately 80% of firms were of the opinion that the QS will be a key player in the construction industry in 5 years time. Obviously that time frame has been reached for firms responding to the 1995 survey and whether the QS is currently a key player is debatable. It remains to be seen what the future holds for the profession given the continued low level of IT/CAD usage.

4 FUTURE DIRECTIONS

The last section of the survey asked firms to indicate what they thought the major threats to the profession would be over the next five years and what directions their firm was planning to take to be in a position of strength over the same time frame. The following is a summary of the main comments from the 2001 survey.

4.1 Major Threats

Fee Cutting

Fee cutting and bidding amongst firms is seen as the major threat facing the profession by the majority of respondents. Changes to Australian trade practices legislation in the mid 1980s resulted in professional associations being unable to compel firms to adhere to published fee scales. This was classified as anti-competitive under the new legislation and enabled firms to undercut each other to procure work. This was followed by a major recession in the economy from approximately 1990 to 1994 where firms became desperate for work and were prepared to reduce their fees to often unsustainable levels. This was not peculiar to the quantity surveying profession and had a big impact on all consultancy practices in the industry. The hangover from this period remains as clients became used to paying lower fees. The design professions were particularly affected and this is reflected in the decline in the quality of documentation that respondents have identified in each of the surveys conducted. This has prompted firms to diversify and specialize to gain competitive advantage. From the IT perspective, many firms state that squeezed margins have prevented them from investing in IT research and development.

CAD

The development of CAD and automatically generated quantities is seen by many firms as a major threat particularly in terms of the technical role of the quantity surveyor. However, the more enlightened firms believe that the greatest threat actually lies in not embracing CAD and CAD measurement and evolving with and being integrally involved in its development. The survey results clearly indicate that the vast majority of firms are clinging to traditional paper based measurement although the latest results do offer a glimmer of hope. It should also be remembered that not all firms responded to the surveys and the author is aware of a number of firms that are now utilizing this technology in a large way. The following comment from one respondent typifies this latest breed of quantity surveying firm:

"The QS profession and construction industry is conservative by nature. I have been using electronic measuring systems for quantity take-off for over 10 years. I now measure directly off CAD. Still people argue they can do it quicker with a scale rule using traditional methods. I find this amazing. I feel unless the QS industry takes the step forward into IT/CAD measurement systems, it will be left behind. One of the reasons I think this happens is that participants in the building industry are
generally ignorant of the use of IT applications and are unwilling to change their methods. They will not commit resources into R&D, rather, they chase the dollar which is short-sighted. While the industry does not demand the use of IT, the QS profession feels no obligation to use or provide it”.

Conservatism/Inability to Change
Whilst the construction industry is generally conservative by nature, the survey results indicate that the quantity surveying profession is perhaps more conservative than most in terms of IT utilization. Many firms felt that the inability to change and re-engineer processes to take full advantage of technological advances was dragging the profession down. Some felt that directors of many firms lacked motivation to embark down this path due to a focus on short-term profits. Some respondents felt that this was particularly the case with some directors who were nearing retirement and were not prepared to take the plunge into IT development that would have longer term benefits. Some respondents felt that too many firms focused on the traditional technical role of the quantity surveyor and were not prepared or capable of raising their services to a higher and more professional value-adding level.

Other Professions
Firms clearly recognize the fact that project cost management is not the exclusive domain of the quantity surveying profession and that there are a number of other professionals carrying out this service and many others with the potential to do so. Project management and large accountancy firms were seen as the main threats. In fact, one respondent felt that the prospect of a large quantity surveying firm joining forces with a large international accountancy firm was not far away. The packaging of services under a “one-stop shop” approach and more “in-house” service provision by larger firms was also identified by many respondents. Perhaps the greatest threat in this respect lies with professionals more amenable to utilizing IT capabilities.

Poor Marketing
Being a relatively obscure profession in Australia, effective marketing is perhaps even more important than is the case with other professions. However, many firms felt that the profession as a whole was poorly marketed and that the piece-meal approaches adopted by individual firms were of no real benefit to the profession as a whole. A clear message coming through from the comments was that smaller firms felt that they needed more support from the Australian Institute of Quantity Surveying in marketing their services.

4.2 Strategic Directions
IT/CAD Development
Despite the survey findings, the majority of firms recognize that one of the most important directions that they need to take in coming years is to embrace IT/CAD technology and all the benefits that it can confer. This also includes re-engineering work practices to take full advantage of these capabilities. The following response from one firm provides a good example of progressive attitudes emerging in the profession:

“I have been pursuing the use of CAD measurement for 3 years now and in the last year have been successfully using it to take off quantities and I will continue to pursue this direction. I would love to establish a set of labour, plant and material rates on a central server, available free on the internet, providing downloadable estimating software. This would encourage the QS and construction industry to get involved with IT and see its potential, especially if it is for free. If the AIQS were interested in funding such a program I would be very happy to discuss this further. Making use of data on the internet would put any QS firm in a stronger position, especially if you could add value to that information. For example, if other QS firms were willing to provide historical feedback on unit rates, life cycles on particular items of plant, labour constants and the like. Imagine all this information gathered from all over Australia (or the world). If this data was monitored by the AIQS and provided free of charge (the legal implications would have to be worked out) it would have the effect of:
1. Raising the IT ability of the QS and the construction industry.
2. Enhancing the efficiency of the QS Practice in providing services for their clients. i.e. it is quicker and saves arduous research in a multitude of applications/documents/publications
3. Raising the accuracy of budgeting/estimating due to the feedback mechanism to capture real data from the construction industry.
4. Attract other industries to see the QS profession as a leader in IT cost consulting. This could be achieved by making data available in a variety of formats (i.e. txt/csv ascii file types) for others to use on their own software. Financing of such a site in time could be achieved by suppliers who would advertise their products. I think there is a lot of potential in the QS industry but it takes someone to make the first step. I believe it would provide a great boost for the QS profession.”
Diversification/Specialization

Many firms felt that diversification of their services and specialization is essential for long term success. The survey results clearly show that firms have been very successful in this respect. Particularly encouraging is the growing trend of firms providing services in non-building sectors. Indications are that facility management and general post occupancy services present the profession with perhaps the greatest window of opportunity in terms of expanding service scope.

Internationalization

The expansion of services not only around Australia but overseas was an aim of many services. IT advances have made this a real possibility for all firms irrespective of size. In the past only the larger firms with branches around the country and overseas were capable of such expansion.

5 IT STRATEGIES FOR QUANTITY SURVEYING FIRMS

The following strategies flow from the findings of the research underpinning this paper. These strategies are not intended to be exhaustive and do not provide detailed examples of how these strategies might be achieved. Rather they are aimed at providing "food for thought" for Quantity Surveying practitioners to assist in determining the IT approaches that best suit their particular firm and circumstances.

5.1 Maintain and Develop Professional Expertise in Core Competencies

The first strategy for firms has nothing directly to do with IT. Firms need first and foremost to ensure that their quantity surveyors have sufficient professional expertise in the core competencies and skills of the profession and continue to develop this expertise. Adequate "on-the-job" training should be in place for inexperienced employees and to also complement tertiary education. Too much focus on the use of IT may lead to the deterioration of fundamental professional skills that will increasingly become necessary as technological advances continue to automate technical activities thus requiring practitioners to operate at a more highly skilled and professional level. The danger of inexperienced or incompetent staff utilising sophisticated but "user friendly" software is obvious. Nevertheless, practitioners need to be far more adaptable and willing to change their standard work practices than in the past. The pace of change will make this increasingly important. Weisberg (2000) points out that the most significant problems that firms are likely to face in implementing new technology and business changes will be people management, not technology. This may particularly be the case with older practitioners who worked through the relatively stable work environments of the 1970s and 1980s and are now confronted with unprecedented change in the workplace. In contrast, many young (but inexperienced) construction professionals are extremely computer literate and adaptable and, in many firms, are relied upon to lead the development of technological change within the organisation. The time is not far off when school leavers/university graduates entering the industry will have spent their whole schooling and education lives surrounded by computers and advanced technology with the result that this technology will be second nature to them. However, Weisberg (p. 12) contends that these computer "whiz kids" and the experienced "old heads" of the industry will have much to learn from each other. "Successful companies will recognise that today's graduates know more about computers than most of their more experienced professionals. On the other hand, these young people probably have disturbingly little knowledge (about the application of their professional training) in the real world. Experienced professionals and new computer hotshots have much to learn from each other: Companies that are going to win tomorrow's competitive struggles are those that recognise how to meld their experienced staff with the computer-hip newcomers".

Perhaps the time is not far away where a young quantity surveyor will ask "what's a scale rule?" and see no need to ever use one. Tremendous opportunities actually exist for young practitioners with CAD measurement skills. However, it is essential that, first and foremost, they have an understanding of how these quantities are generated, what they represent and what should be done with them.

5.2 Learn, Utilise and Evolve with CAD

There is no question, in the author's mind, that Quantity Surveying firms, and indeed all construction professionals, need to utilise and gain expertise in CAD sooner rather than later. CAD systems will be at the centre of future information management system and virtual projects and, consequently, professionals will need CAD capabilities and expertise just to be a player. Whilst 2D CAD currently predominates in the industry, the industry is moving towards 3D object oriented CAD and smarter firms looking to the future will embrace this CAD format. 3D CAD also offers far more possible uses for the Quantity Surveyor. The most obvious benefit for Quantity Surveyors lies in the use of automated quantities with enormous productivity gains already possible. The preparation of quantities in the traditional paper-based mode is tedious and time-
and cost plans. Rather than being a threat, automated quantities actually have the potential to provide tremendous opportunities for the profession. Removing much of the technical drudgery, albeit the traditional "bread and butter", of the profession will provide practitioners with more time to focus on developing sophisticated cost management systems and a wider range of value-added services. This will provide the potential for firms to be able to provide a wider range of value-added services on a larger number of projects. The important thing is not who or what prepares the quantities (as long as they are accurate) but more what is done with the quantities. Many practitioners are skeptical, with good reason, about the automated quantities capabilities of CAD systems. There are still many problems with utilising commercial "off the shelf" CAD software to generate quantities. However, these problems are being overcome and most programs, at the very least, are capable of generating basic lineal, area and volume measurements with most now able to produce quite detailed item quantities. Hence, it is possible now for practitioners to extract a large proportion of a project's quantities from automatically generated quantities in spreadsheet formats which can be linked directly to most estimating/measurement programs.

5.3 Invest in Necessary Technology

Many firms cite cost and the time required to learn CAD and other software/technology as the main inhibitors to investment in the IT area. However, the greatest cost for employers usually lies in their actual workforce. The average annual salary of a qualified Quantity Surveyor in Australia is approximately $55,000 per annum which equates to approximately $80,000 when salary loadings are taken into account. CAD software and the necessary hardware can be purchased for $6000-$10,000 for one licence with this figure decreasing for additional licences. Whilst time and money must be spent learning how to use these systems, the technology costs are actually relatively low when compared to salary costs. When one considers the potential productivity improvements the cost of investment in CAD may not only be negligible but may not be a cost at all in the long term due to the enhanced profitability of the firm's operations. Looking at the broader picture, CAD capabilities and expertise will more than likely result in increased business opportunities.

5.4 Form Strategic Alliances with Designers

Nevertheless, most firms remain loathe to invest in this technology due to the costs, the training required, the many problems associated with CAD and the uncertainty surrounding the level of return on investment. A strategy for these firms may be to use a small select group of employees to "test the water" and develop and explore the potential. Smaller projects could also be used to test new technology. It is easy to be dazzled by the sales pitch of hardware/software vendors but it is only through detailed "hands-on" use that firms can really evaluate the usefulness of the technology for their firm. A smarter approach may well be to form strategic alliances with design firms and "Design and Construct" organisations at the leading edge of CAD utilisation and development. There is considerable untapped potential with such alliances. CAD development has been typically led by designers whose main interests are not automated quantities. This component of CAD systems is often simply a by-product developed in an ad-hoc manner. However, as developments in information management systems become more sophisticated and awareness of the importance of quantities to such systems increases, the need for the input of cost management and measurement experts is being widely recognized. Alliances with organisations like the one outlined above would enable a firm to add value to their CAD learning curve and to develop niches in the marketplace.

5.5 Be Prepared to Share Information

As construction processes become increasingly automated and information management systems become more sophisticated the whole construction process will become substantially more information-oriented as we head towards virtual electronic procurement patterns. Participants will not only need the technological capabilities to be a part of this information flow but will also be increasingly required to share their information. The cultural shift that will be required of Quantity Surveying firms to allow access to their valuable cost data bases (often compiled over many years if not decades) will be considerable. This will not only be a major issue for Quantity Surveyors but for most construction professionals.

5.6 Diversification/Specialization of Services

The survey results outlined earlier indicate that Quantity Surveying firms are diversifying their scope of services to better meet industry/client demands and to secure their long term future. This diversification is seen by many as critical to the future of the profession as a whole. The survey results show that the proportion of income obtained from non-traditional and non-building work has risen markedly in the past 6 years. Facility Management and the push for more sustainable development in the built environment represent two huge new growth areas for the profession in terms of new services. The financial management skills of the Quantity Surveyor can be applied in many different areas both within and outside the property industry and many firms are beginning to realise the opportunities that this creates.
5.7 Multi-Skilled Team

Such diversification and specialisation will require firms to have employees (or consultants) with a very broad range of skills, expertise and professional training. Diversification represents considerable risk for firms without the necessary skill and expertise to carry out the new services. Accordingly, many Quantity Surveying firms are now employing construction professionals from a variety of “non-QS” backgrounds to augment their services. A multi-skilled and qualified workforce will also provide firms with greater opportunities to expand their scope of services.

5.8 Continuing Professional Development

Continuing Professional Development (CPD) is a requirement for members of most professional associations and the construction industry is no exception. Rather than relying solely on their employers, practitioners need to also take responsibility for their own professional development. IT is a classic area for CPD due to the regularity and speed of change and such personal development can significantly enhance an individual’s value to a firm.

6. CONCLUSION

Information Technology presents the profession with many challenges, threats and opportunities. Whatever direction the profession and IT advances take, the financial management expertise of the Quantity Surveyor will remain in demand. The uncertainty really lies in what capacity and for whom the Quantity Surveyor will be working and whether the individual independent Quantity Surveying firm will continue to exist in its current form. It is clear that computing and information management expertise will be a necessary component in the tool kit of the future Quantity Surveyor. However, any rush to embrace information technology should not be done blindly. The proper evaluation of the usefulness and application of IT tools and the development of appropriate systems to facilitate information transfer in a standardized format will always be of paramount importance. If not managed correctly projects may be overwhelmed with incompatible, inappropriate and/or erroneous information resulting in chaos and confusion. The use of systems by staff with the necessary expertise, training and experience in fundamental core skills and competencies is critical. Nevertheless, rapid IT advancement and procurement practice changes in the construction industry place the QS profession in a precarious position if it is intent on sitting back and waiting to see what happens. In the words of one survey respondent, “for the QS to survive it must establish itself as an independent source of cost knowledge. No one is looking to the future. We must support research, development and training. Otherwise our role will be overtaken by other professions”.

The greatest threat to the profession does not lie with IT; IT actually presents the profession with enormous opportunity. The greatest threat comes from other professionals capable of providing cost management services (albeit with possibly less expertise) but who are more amenable to utilizing and evolving with IT and entrenching themselves as key members of the virtual project team. Whilst the surveys indicate that the Quantity Surveying profession is starting to embrace and utilize Information Technology advances, the profession is still lagging behind other construction professions in this respect. Of particular concern is the lack of CAD facilities and usage by most of the profession. The profession is still largely adopting a reactive rather than proactive stance to the use of information technology. Although fairly typical of the industry generally at this point in time, perhaps the Quantity Surveying profession stands to lose more than most if it fails to keep in touch with developments and does not embrace the opportunities as they arise.

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