A COMPARATIVE STUDY: WITH INSIGHT INTO THE USE OF IT IN LOCAL ARCHITECTURAL PRACTICES

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SUMMARY

This paper reports on the use of Information Technologies (IT) in the South African building industry. It offers an insight into the architecture profession, a profession that plays a major role in the construction sector. The analysis is based on the results of a survey conducted in the Western Cape Province during the year 2000. In an attempt to uncover the similarities and differences between the local context and the international one, this paper outlines a few elements of IT for comparison. After a brief introduction to the IT map of South Africa, the analysis concentrates on the following four issues: Response and Respondents, General IT usage, Use of Computer-Aided-Design (CAD) and Use of Networks. Each of these issues is framed in both the local and the international contexts. Despite the shortcomings of using different questions with different emphasis when referring to other surveys, it is still believed that reporting on local practices is not extremely meaningful in isolation. It is hoped that this type of analysis will serve to unravel the particulars of the construction industry in South Africa providing its counterparts with a new perspective.

IT AND ARCHITECTURE

There is an increasing Information Technology (IT) awareness and proficiency among the construction professionals that is manifested in various levels of IT applications in their practice. The integration of computer technologies in most aspects of production is constantly gaining momentum. Architecture, being one of the main professions in the construction industry, is also experiencing similar leaps in such integration and over the last decade, the architectural profession has seen a phenomenal growth in the use of computer technology. International surveys and research have indicated such growth in western countries like Canada and the United Kingdom, (Rivard, 2000; Howes, 2000). Also, on the local front, it is believed that computers when "fully and meaningfully implemented in an architectural practice… offer South African architects an opportunity to redeem their professional status, compete profitably … on the global market," (Illingworth, 1999).

There are many signs of the understanding of and belief in the potential of IT uses in the South African building industry. This claim is supported by the results of a comprehensive study of architectural practices in the Western Cape Province (WCP). Although the investigation did not include all provinces, the WCP - being a major and vibrant part of South Africa - could be considered as a good representative to trace national trends, (Arif and Karam, 2001). In the year 2000, a survey was conducted in the WCP and it was viewed as an initiative that would be complemented with others at later stages. Some of these results are presented in this paper, with emphasis on the professionals' current and actual, rather than intended or future, use of IT. They are viewed as local indicators in comparison with the developed and developing worlds.

BACKGROUND

The integration of IT into all aspects of life is certainly a revolution on its own. The developed world is moving in quick strides with such integration, while in third world countries the development of IT and
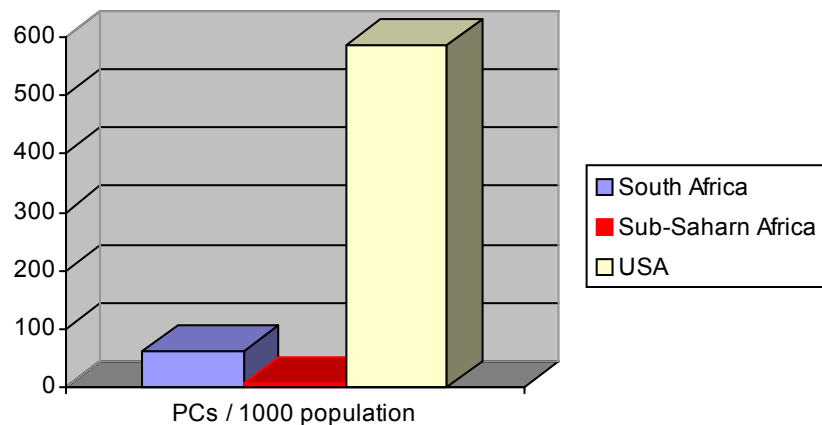
its use are lagging behind. Serving as a background, the following is a quick overview at the broader lines of comparison which highlights the IT characteristics of South Africa.

In general terms, South Africa is a country of considerable weight in the Sub-Saharan African region. It is a highly industrialised country with an emerging economy that accounts for 44% of the total Gross Domestic Product (GDP) of all Sub-Saharan Africa, and 52% of its industrial output, (Castells, 1998). Looking at its IT infrastructure using World Bank data (2002), there is a ratio of 62 personal computers (PC's) to 1,000 of the South African population, which is close to 7 times as much as the region's average of 9 PC's to 1,000. In the United States of America (USA), however, there are 585 computers for every 1,000 people and that constitutes more than 9 times the ratio in South Africa (see Figure 1).

Figure 1: Ratio of Personal Computers in S.A. compared to the Region and USA

Internet users in South Africa are 2.4 million in 43 million people while in Sub-Saharan Africa there are only 3.7 million users in 659 million people, (World Bank, 2002). This translates into 5.5% in South Africa vs. 0.5% in the Sub-Saharan Region. But again, this diminishes in comparison to the USA's figures of 95.4 million users of the Internet in 282 million people, which makes 33.8%, and that is a very dramatic variance indeed. Certainly, these figures imply generalities of IT development across all local professional sectors, the construction sector included. Hence, the analysis of the use of IT in the local construction sector will be more meaningful against a comparative backdrop of such use in other parts of the world.

RESULTS AND COMPARISONS

In this section, a selective review of the results of the aforementioned survey is presented. The selection is divided into four groupings: Response and Respondents, General IT Usage, Use of CAD and Use of Networks. Each of these topics and their sub-topics is observed in conjunction with the international findings in the same area of investigation.

Response and Respondents

• Response to the Questionnaire:
The survey used a mail questionnaire as the main tool to get the local firms' profile and an insight into their practices. From the target of around 300 firms in the WCP, almost 40% responded to ten detailed categories in the questionnaire booklet. That response rate is competently compared to other international surveys (see Figure 2).

In Canada, a survey of 1,000 Architectural, Engineering and Construction (AEC) firms was conducted in the year 1998/99 and the response rate was 22%, (Rivard, 2000). On the other hand, a 31% response rate was achieved in a Random Survey in New Zealand, (Doherty, 1997). That survey was conducted on 150 users in five industry-sectors (Architects/ Engineers, Building Owners/ Developers, Building Officials, Contractors/ Sub-contractors and Manufacturers/ Suppliers. Recently in Malaysia, a survey of 200 developers, contractors and professionals of the local construction industry had a 35% response rate, (Mui et al., 2002). In Sweden, a high answering rate of 49% was recorded in a survey conducted in the year 2000, (Samuelson, 2002). That survey, however, targeted a large selection of more than 1,300 workplaces of the Swedish construction companies.

As observed, these are different surveys in different countries and continents with different target groups, but are more or less comparable in the general sense and some specifics as will be demonstrated throughout the body of this paper. These surveys form the grounds for comparison to the local South African construction industry.

Figure 2: A Comparison of Response Rates

- Respondents Profile:

For purposes of relating the findings of this study to other studies, the word 'profile' here is limited to the size of the practice. The surveyed local practices are in fact a mixture of small, medium and large-sized offices. Noteworthy, the smaller-sized offices of no more than five employees represent a high majority of 62% of the respondents. This is an indicative of the nature of the profession. In the building and design industry, many professional practices are practically sustainable by a small team. A limited group of practitioners with a variety of skills and mixed competencies are capable of providing their clients with personalised services. They are able to outsource the needed skills when and if needed without resorting to hiring and firing, avoiding the unnecessary increase of their payroll and keeping their work environment stable. The other factor could be also related to the size of works offered and needed in the local industry as in any supply and demand context.

There are similar indications at the international scene. For instance in Canada, (Rivard, 2000), 56% of the total architectural firms are small-sized offices, i.e.: with less than five employees. Its comparison with the higher percentage result of the WCP might be interpreted as a function of the national setting versus the local provincial one.

**General IT Usage**

- IT Usage in Practice:

In response to a query about whether firms use the technology, a majority of more than 80% responded positively. This consensus puts the actual use of the technology at the forefront for the local architectural practices. It is an expected result especially with the recent changes in the South African education system promoting the use of technology and its integration within the curriculum, (DoE, 2002). There is a sincere commitment to respond to the demands of the new knowledge-based society, which is in turn translated into practical terms in the workplace.

However, the 20% who do not use the technology for their core work represent a considerable percentage when compared to their Canadian counterparts. Statistics show that architects in Canada have the highest ratio of desktop computers per employee (1.2%) among the national AEC industry, (Rivard, 2000). This ratio of more than one should be noted, as it indicates the availability of more machines than personnel in the practice. The use of the computer technology is not at all a question in many parts of the world. It is simply not perceived as a possibility, rather the extent of the use is usually queried.

- Areas of Main Use:

There are three areas where use of computers is very high. These are the areas of Office Administration, Communication and Construction Drawings Production. As expected, the technology provides efficiency and speed. Firstly, in administration, activities generally involve the production, alteration and storage of the written word in the form of letters, memos, reports and documents. Therefore, the use of word processors comes at a top priority in practice. It is "by far the most common application of PC's," (Phiri, 1999). In addition, computerised accounting - being part of the general administration of the practice - has significant advantages. One is accuracy, as "the automatic recalculation leads to error prevention," (Phiri, 1999), and the second is the quicker production of
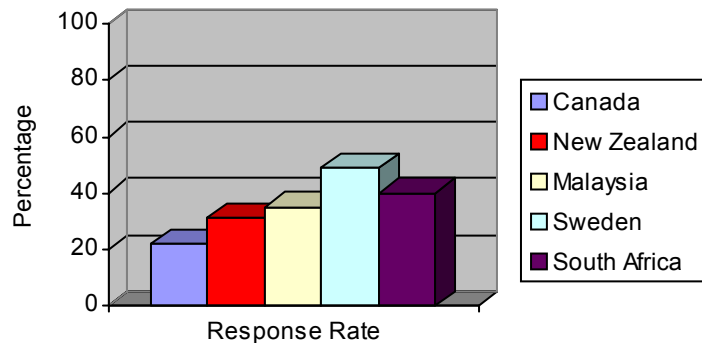
reports where they could be generated as frequently as necessary. Secondly, communication is another major area of use but will be further elaborated in the Networks section below.

The third area of high use of computers is a profession-specific area where it displays the use of IT at the core production at the workplace: construction drawings. The area of Design though was ranked average, and the area of Presentations was the least of all seven categories provided. One reason for such lower ranking in the Presentations area could be the demanding requirements for top quality software and hardware to put together and run a successful building project presentation. Also the complexity of such applications necessitates skilled staff that might not be easily available or affordable.

Similarly, from the provided 14 different functions in the New Zealand survey, (Doherty, 1997), there was greater emphasis on the importance of using computers for the Project Documentation function. There was a comparable finding in Canada, (Rivard, 2000), in surveying IT use in the business processes. Most processes are 20% or more computerised and close to 80% of the Bookkeeping, Invoicing and Specifications processes are 'highly computerised.' This means that using computers in such administrative areas is equally prevalent. Also, 71% of the surveyed Canadian firms use CAD to prepare 80%-100% of all drawings which again appears to constitute a major area of use.

Use of Computer-Aided-Design (CAD)

It is believed that the core activities of any architectural practice are design, representation and communication, (Pressman, 1997). In the first two core activities, the use of computers is based on CAD and its applications. CAD systems are proving to be essential in two main areas: as drafting tools and as design and presentation tools. They are particularly useful as an aid for the design and construction drawings of buildings with high degree of repetition, (Phiri, 1999). CAD then reduces drawing workloads and saves time in labour-intensive tasks.

- CAD Users:
The influence of CAD on design and construction is growing tremendously and the varied levels of application of CAD are evident in all offices of all sizes. Hence, higher levels of CAD proficiency are expected from the staff. In surveying the current literacy of staff in CAD, only 27% of the offices indicated a high level of staff literacy (of 80-100%), which is lower than expected. At the other end of the spectrum lies 20% of the architectural practices with "No" staff conversant with CAD, and that is a high percentage of illiteracy.

In Canada, 76% of the AEC offices that have computers use CAD, (Rivard, 2000). The lower percentage here is lowered by the contractors' use of CAD that does not exceed 30%. Looking at the statistics for the architectural practices reveals that 93% of them are CAD users, which is considerably higher than the South African indications.

- CAD Packages:
In a query about the CAD package of choice, respondents indicate that AutoCAD is the most popular package used in architectural offices of the WCP, with 44%. This practice is also shared with New Zealand and Sweden, where AutoCAD represents the most common software in use, (Doherty, 1997; Samuelson, 2002). Second choice software packages, however, that are being used locally are different from those used internationally. In South Africa, Caddie and ArchiCAD rank second and third, while ArchiCAD and MicroStation in Scandinavia are next in popularity. In Canada MicroStation and VisioTechnical are the next popular packages, (Rivard, 2000). Such variance is probably related to external marketing and distribution factors that are beyond the scope of this paper.

Use of Networks

- Local Area Networks (LAN):
There are several benefits to the use of a network environment. Some of which are: the sharing of data, sharing of expensive resources and peripherals, easy sending / receiving of data for central processing and the smooth communication between users. In a recent study by Phiri (1999) in the United Kingdom, he selected a number of architecture and engineering offices and organisations as case studies for an investigation of their use of IT. He suggests that the standalone PC application is

being in "severe decline." Despite its major disadvantage, which is security, the LAN environment offers an efficient platform in many respects.

Looking at the WCP, there was 56% of the offices that noted they are networked, using LAN. This is comparable to that in New Zealand, where 60% of the users are networked, (Doherty, 1997). It is much lower in Canada, as only 44% of the architects indicated their connection to a LAN, (Rivard, 2000) which is an interesting finding, (see Figure 3).

Figure 3: Percentage of Offices with LAN
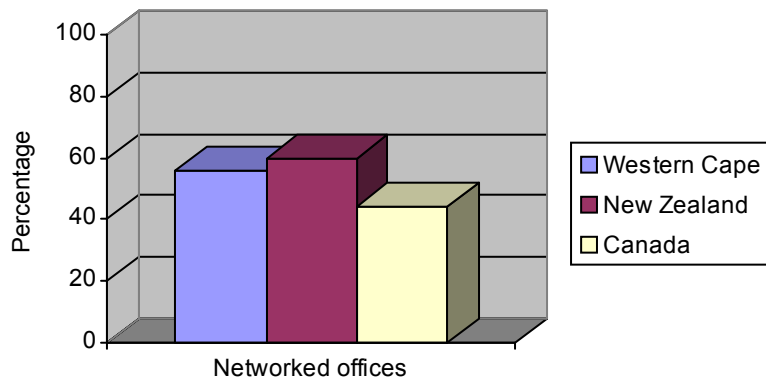
- Electronic Mail:

E-mail offers many advantages, in reaching a large number of people promptly and easily, and in improving productivity, (Phiri, 1999). By attaching documents and graphics to E-mail messages, users can essentially reduce phone and fax expenses. Messages are sent using inexpensive means. It certainly presents itself as a critical element of technology, but again lends itself to the disadvantage of the security issue.

In a question about the method(s) of communication used generally in the office, the respondents were provided with six choices. Among the six, the verbal announcement within the office was ranked highest, followed by the written memos. The use of e-mail came fourth in frequency of use, which is not the case in other parts of the world. In Canada, close to 84% of the architectural offices adopted e-mail in their practices, (Rivard, 2000), and 96% of the firms in Malaysia use the Internet mainly for e-mail purposes, (Mui et al., 2002). Although the cited surveys report on slightly different queries on that issue, but one can draw relative conclusions regarding the popularity of traditional methods of communication in South Africa more than in other parts of the world.

- Internet:

The Internet and its powerful accessibility from anywhere, anytime, have certainly changed and influenced the way work is accomplished in the various businesses and professions. Notwithstanding a number of major unresolved technology and system issues, such as security, privacy, bandwidth and network reliability, for the construction industry there are several benefits of being connected to the Internet. This global network of networks, which connects endless number of users world-wide, allows for: access to current data offered on the net by suppliers and consultants, a fast inexpensive means to communicate interactively with one or multiple users across the globe, and more importantly, an opportunity to make information about the organisation available to other net-users. Using the Internet for advertising replaces the previously used office brochures and business announcements by a web-site accessible to all, extending to the unknown clients in the world-wide network. Any person, institution or organisation with access to the Internet, through minimum investment in equipment, will have access to all relevant information about the practice.

Figure 5: Percentage of Offices with Web Pages on the Internet
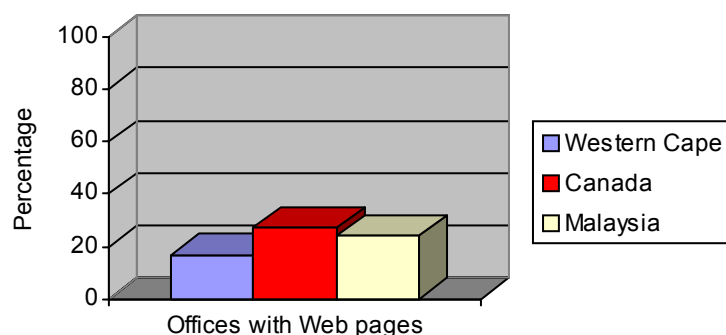
As shown in Figure 4, in the WCP there are only around 17% of the offices that have a Web Page published on the Internet. This percentage is not at all close to the international practices, as in Canada for instance, 27% of the architectural firms reported having a Web Page for their purposes on the Internet, (Rivard, 2000). Also in Malaysia, 24% of the firms indicated having their own web-sites, (Mui et al., 2002). The recent survey in Sweden, (Samuleson, 2002), indicates a total of 60% of the employees in the industry work at workplaces where the company has its own web-site on the Internet. At this stage, it is important to make reference to the IT infrastructure of South Africa mentioned earlier in this paper. It could be attributed to such low use of the technology in a vital and growing area.

South Africa, although a progressive industrial country, is still adjusting from previous political injustices and many resources are directed towards the more basic needs of the population. The expenditure on IT development is not at a higher priority. In the year 2001, while expenditures in Information and Communication Technologies (ICT) reached $2,924 per capita in the USA, (World Bank, 2002), it stands at $268 per capita in South Africa. While the national budget seems to be absorbed by other areas, the spread of IT is nevertheless apparent.

CONCLUSION

This is an attempt to study the use of IT in South Africa, with a focus on one main sector of the construction industry: Architecture. Research into such area is still in its early stages and there is an apparent need for further studies, especially at a national level. Using the outcomes of a survey conducted on architectural practices of the Western Cape Province, the study highlights a few trends that could be considered, to some extent, national trends. Among many issues queried, the use of IT represented a main section in the survey and, in this paper, selective results are presented. In order to produce a better picture, they are compared to international trends.

Among its neighbouring Sub-Saharan African countries, South Africa is considered to be fairly advanced, nevertheless there are signs of the wide technological gap which generally exist between the developing and the developed countries. As part of the developing world, South Africa has not reached far in the IT development and application. This analysis therefore offers an insight into local practices with relation to international practices. A better perspective is gained by using other surveys around the world and by comparing them with regards to specific elements of IT at the workplace. The results are purposely presented in a comparative manner.

The study mainly covers the areas of response rates and respondents profile, general use of IT, use of CAD and the use of networks. The data indicates comparable results to those extracted from other recent surveys in most areas. The local response rates are actually towards the higher end of the scale. The respondents profile is similar to other international findings. Areas of main use of IT are not dramatically different and so is the area of the CAD packages used. In the use of LAN's, the local practices fell around the average international trends as well.

More dramatic differences were obvious in the areas of: IT usage in practice, CAD users, E-mail and Internet use. Having a considerable percentage (20%) of local practices with no use of IT in their work is not experienced at the international scene. Similarly, there is a considerable number of practices with CAD-illiterate staff. Using electronic mail does not come as a top priority in the means of communication as abroad. Finally, the use of the Internet indicates much lower percentages in South Africa compared to the developed world.

In conclusion, this all serves to confirm that despite of the general progressive tendencies in the use of IT in the local construction industry, there are some large disparities between the local and the international settings in a few key areas. Even though great reductions of computer prices are currently perceived around the world and with the competition between manufacturers, investment in IT is still viewed as a major undertaking. The maintenance and upgrading expenses added to the training investments could be prohibitive for many of the local offices. In addition to the particular economic and socio-political circumstances of the country, this could be another interpretation to the variance between developed and developing countries when it comes to IT expenditure in general.

There are many gains in conducting more of such investigations where they will help in following and identifying the developing nature of IT use, locally and internationally. It is believed that extending this initiative to include more regions of the country and perhaps making a serious attempt to adopt some of the common international measures used in other surveys will greatly inform and enrich the architectural profession and the construction industry as a whole.

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