

A SURVEY OF INFORMATION TECHNOLOGY IN THE CANADIAN CONSTRUCTION INDUSTRY

Information technology survey in Canada

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Durability of Building Materials and Components 8. (1999) *Edited by M.A. Lacasse and D.J. Vanier.* Institute for Research in Construction, Ottawa ON, K1A 0R6, Canada, pp. 2338-2347.

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Abstract

A survey regarding the current and planned use of information technology in the Canadian architecture, engineering and construction industry has been conducted at the end of 1998. The preliminary results of this survey presented here shows the current use of information technology within the firms of the respondents. CAD software has become ubiquitous and is used in most of the drawing work. Even though most firms have adopted e-mail and the Internet, most processes are still not computerized and most documents are still exchanged in a traditional fashion. In general, the adoption of information technology has been beneficial but at a cost. The findings of the survey presented here provide directions in research, development, training, and strategies that will respond to the needs of the industry.

Keywords: Information technology; computers; architecture, engineering, and construction; survey.

1 Introduction

Computers have revolutionized the way documents are generated and information technologies are bound to revolutionize the way people exchange information and documents. These recent technologies have had profound impact on how organizations operate on a daily basis. In order to assess this impact on the architecture, engineering and construction (A.E.C.) industry in Canada a survey was prepared and sent at the end of November 1998. Answers were collected during the months of December 1998 and January 1999.



The survey was targeted to executives and managers in the A.E.C. industry. The purpose of this research is to reveal the current and planned use of computer-based and telecommunication technologies in the industry. This paper presents only a preliminary analysis of the answers to the survey as answers are still being collected. The paper commences with a brief overview of the A.E.C. industry in Canada. This is followed by a description of the survey and methodology used. Then the paper presents the profiles of the respondents and the findings of the survey.

2 The Canadian architecture, engineering and construction industry

The Canadian A.E.C. industry employed 933 000 people in 1991 out of a total labour force of 14 475 000 people according to the Canadian census (Statistics Canada 1994). The total value of construction work that was purchased in Canada in 1993 amounted to 94 Billion \$Can (Statistics Canada 1993). 65% of this amount corresponds to building constructions while the remaining corresponds to engineering works (e.g., roads, dams, power lines and sewers).

The construction industry is usually considered an important indicator of the health of a national economy. In Canada, the construction output has remained relatively constant in the last 30 years. Since the national gross domestic product (GDP) has steadily grown during this period, the contribution of this industry to the GDP has fallen from 9% to 5% (Statistics Canada 1996). Furthermore, this industry is facing several important challenges such as a steadily decline in productivity since the 60's, high unemployment, a decline in national as well as in foreign markets, little long-term investment, and an "inability to implement crucial competitive policies" (Momaya and Shelby 1998). How does this industry face the added challenge of a paradigm shift in document production and information exchange? This is what the survey presented here tries to answer.

3 Survey's origin and methodology

The questionnaire used in this survey is a slightly modified and improved version (for the Canadian context) of "The IT barometer survey" which was created at the Royal Institute of Technology (Kungl Tekniska Högskolan) of Sweden, in 1997, by Olle Samuelsson (Samuelsson 1998). This survey has since been used in different countries, and thus makes comparison among countries possible. Such results have already been published for Scandinavia in (Howard et al 1998) and (Howard and Samuelsson 1998). The survey is twelve pages long and covers the following topics: company information, computer information, computer use, computer-aided drafting, communications, and information technology.

The survey was sent by mail to executives of a statistical sample of 1000 firms in the A.E.C. industry across Canada. These firms are involved in building construction as well as engineering work. This sample of firms was split in three equal categories: architectural firms, engineering firms, and construction contractors. The only incentive offered to the respondents was to send the findings of the survey.

4 Respondent profiles

The typical return rates for mail surveys in this industry oscillate around 10%. The findings presented here are based on 177 returned questionnaires that represent an 18% return rate. In general, a mail survey cannot be considered reliable under a 50% return rate (Erdos 1983). Even though a low-response was obtained, the findings of the survey still present useful information about the respondents and may show tendencies within the industry. The distribution of responses with respect to the three disciplines surveyed is shown in Figure 1. It seems to be more difficult to interest contractors' executives in filling surveys. The category "Other" consists of manufacturers and distributors. 80% of the respondents were senior management.

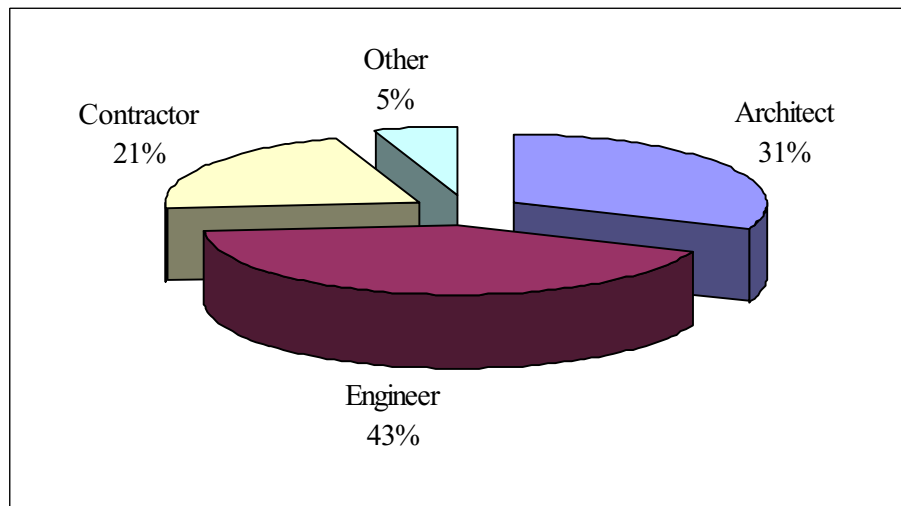


Fig. 1: Distribution of responses for the types of company surveyed

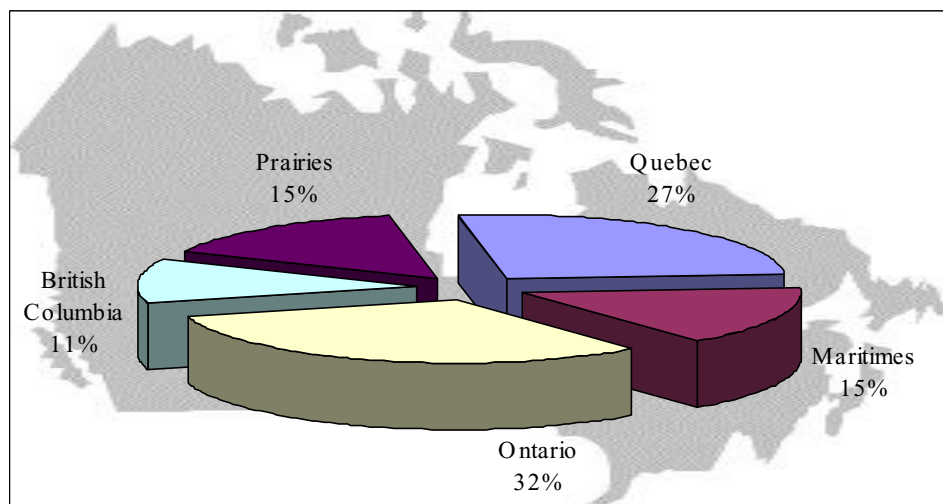


Fig. 2: Distribution of responses within Canada.

The distribution of responses with respect to the five regions of Canada (i.e., British Columbia, the Prairies, Ontario, Quebec and the Maritimes) is shown in Figure 2. This distribution correlates well with the population distribution of Canada except for the Maritimes. The proportion of the responses from the Maritimes is actually twice that of its contribution to the overall population of Canada.

Computers are used by 97% of the firms surveyed. This kind of survey has the deficiency of appealing to people who are already using IT while it rebuffs those who are not. Compared with another survey of technology diffusion in service industries which was conducted by Statistics Canada on behalf of Industry Canada between October and December 1996, at that time, 65% were using personal computers while 5% were either implementing or considering using PCs (Industry Canada 1997).

5 Results

The results of the surveys collected confirm that Microsoft is the dominant brand of operating systems used in the construction industry as shown in Figure 3. Almost 90% of all operating systems installed were sold by Microsoft. The next contender is the Mac OS with a meager 7%.

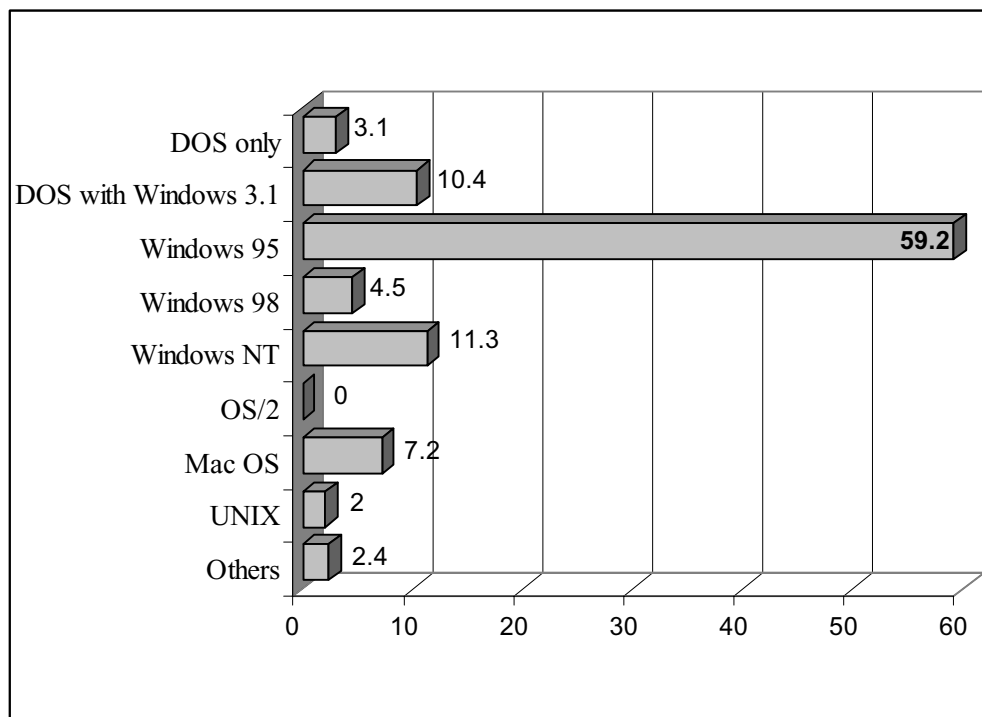


Fig. 3: Distribution of operating systems used in the industry

The survey identified the types of office software used in the industry. Figure 4 shows that almost all firms surveyed use word processors and spreadsheets. E-mail has reached an 84% penetration with an additional 8% implementing it. This is in sharp contrast with the results obtained by Industry Canada in 1996 when only 15% of the A.E.C. firms were using e-mail and 17% were either implementing or

considering it (Industry Canada 1997). A similar penetration was achieved with the Internet and the World-Wide Web where now 79% of the firms surveyed are using web browsers while only 15% had access to the Internet in 1996 (Industry Canada 1997). Project planning packages are used only by 43% of the companies surveyed.

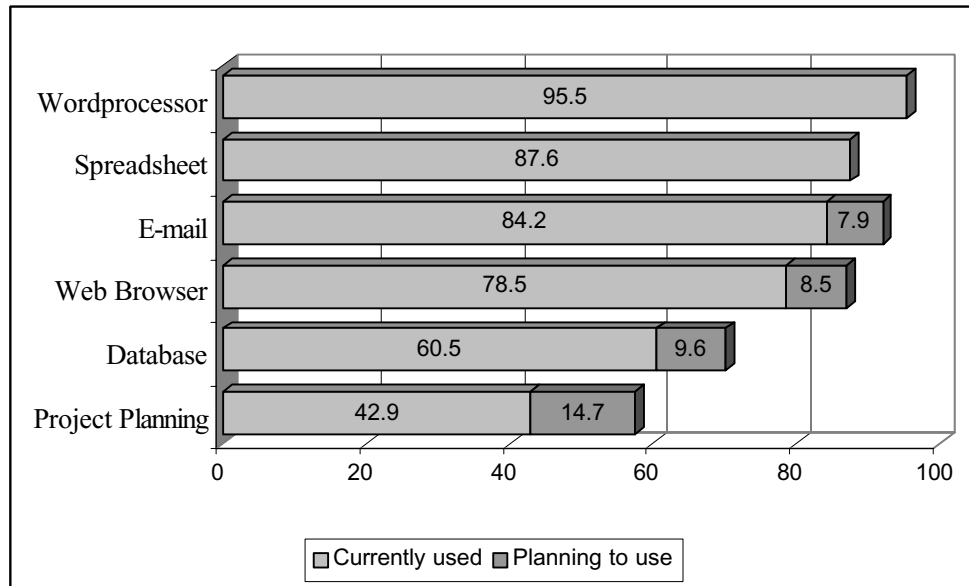


Fig. 4: Types of software used in the industry

The survey evaluated the extent of computerization of some business processes. Figure 5 shows that on one hand invoicing and bookkeeping are largely computerized, while on the other hand, purchasing, tendering, and materials control are mostly manual. The lack of computerization of these processes may indicate a need for efficient software tools in these areas.

An important capability provided by information technology is the transfer of documents in electronic forms. Figure 6 shows that most documents in the industry are not exchanged digitally. Based on these results, design documents are the type of documents with the highest probability (only 25%) to be exchanged often or always in an electronic form. These proportions are bound to augment as more companies are adopting the Internet.

Computer-aided drafting (CAD) is used in 72% of the firms surveyed. As expected, Autodesk is the dominant brand of CAD software used in the industry. Figure 7 shows that 55% of all packages used in the firms surveyed were sold by Autodesk. The next most popular brands are Microstation with 21% and Visio Technical with 14%.

Most of the firms that own CAD packages use them to do the drawing design work. Figure 8 shows that 77 % of these firms use CAD to prepare drawings in 80% to 100% of all drawings. This diagram clearly shows how essential CAD software has become in the industry.

There are several ways to represent drawing information within CAD software. Figure 9 shows that most of the drawings are two-dimensional drawings (i.e., 69% of all drawings). 25% of all drawings integrate databases with two-

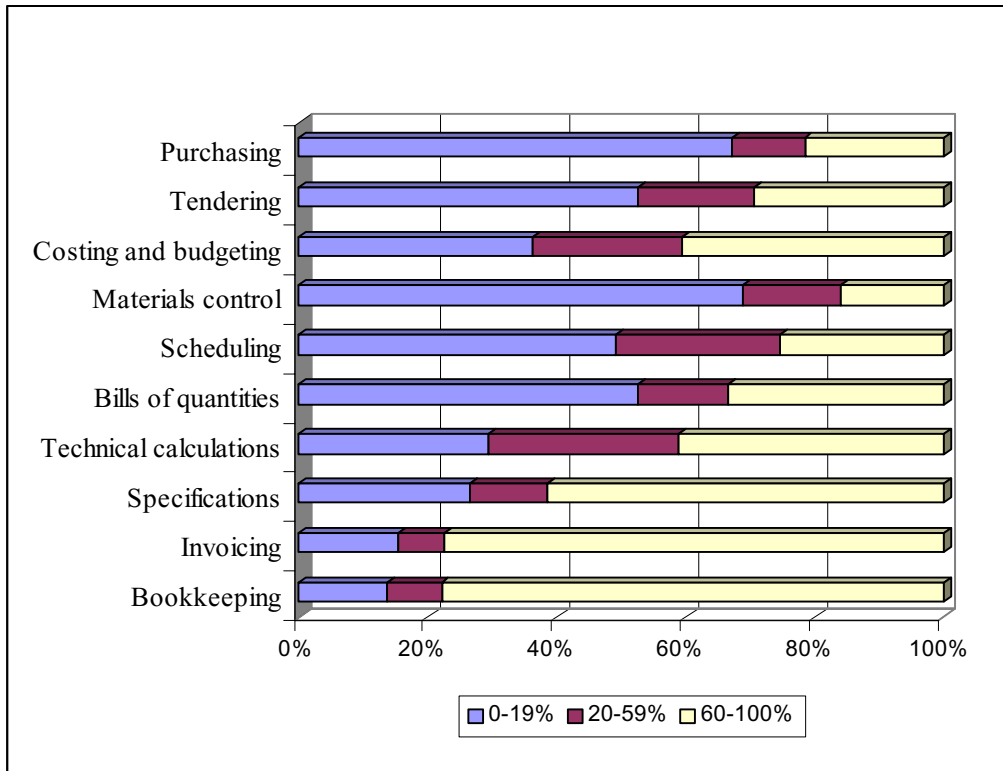


Fig. 5: Extent to which processes are computerized

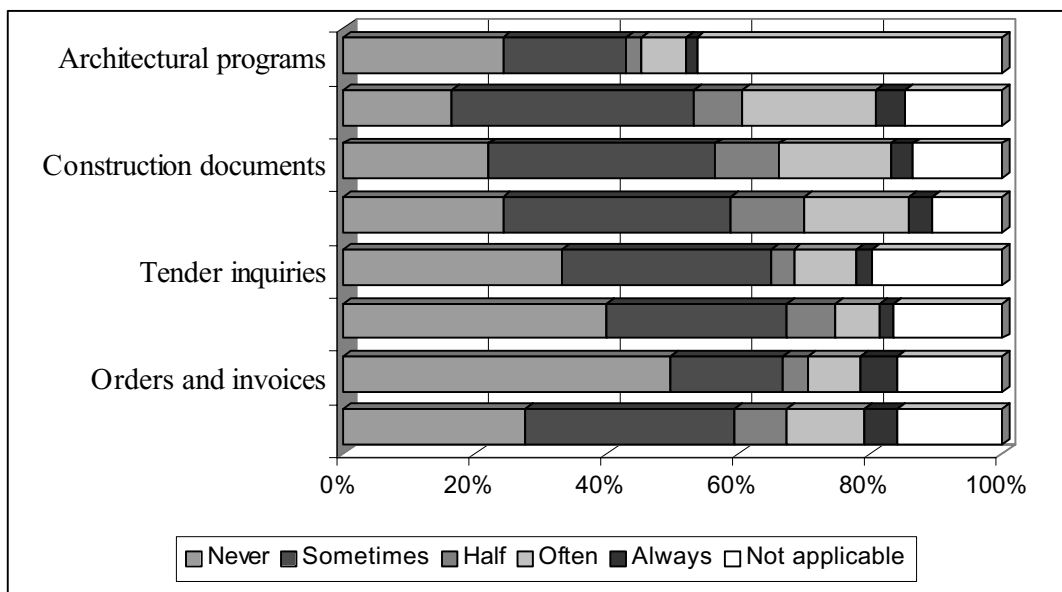


Fig. 6: Digital exchange of information

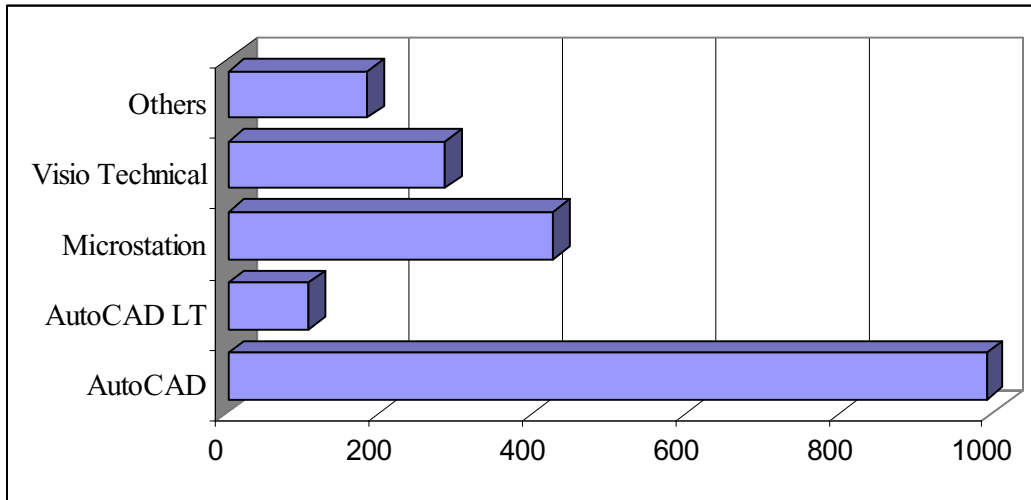


Fig. 7: Number of CAD packages in terms of brand

dimensions. Only 6% of all drawings are done in three-dimensions. Even though product models hold the promise of standardized information exchange and more meaningful design information, its use in Canada in generating drawings is negligible. Canada lags behind Scandinavian countries in the adoption of product models and structured 3D CAD. As a comparison, in Finland, drawings are prepared 13% of the time with product models and 22% of the time with 3D CAD (Howard et al. 1998).

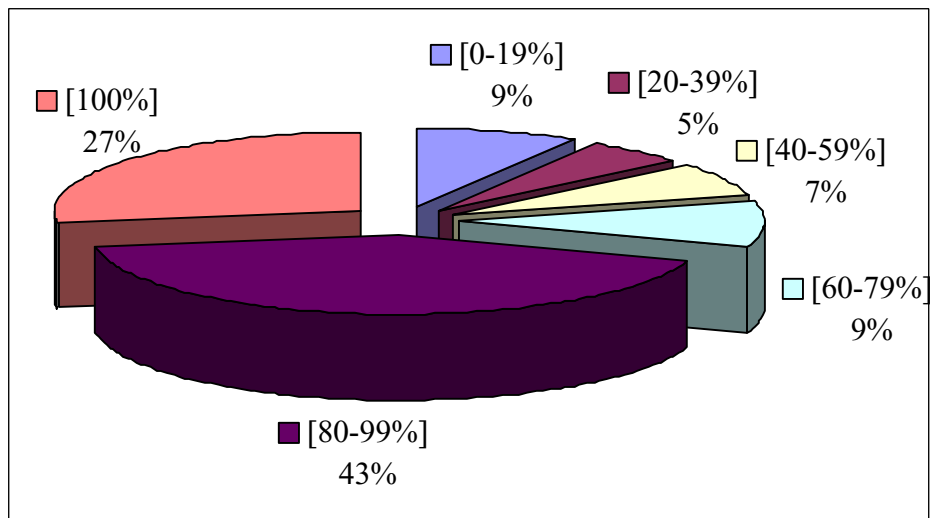


Fig. 8: Estimation of the drawing design work done with CAD

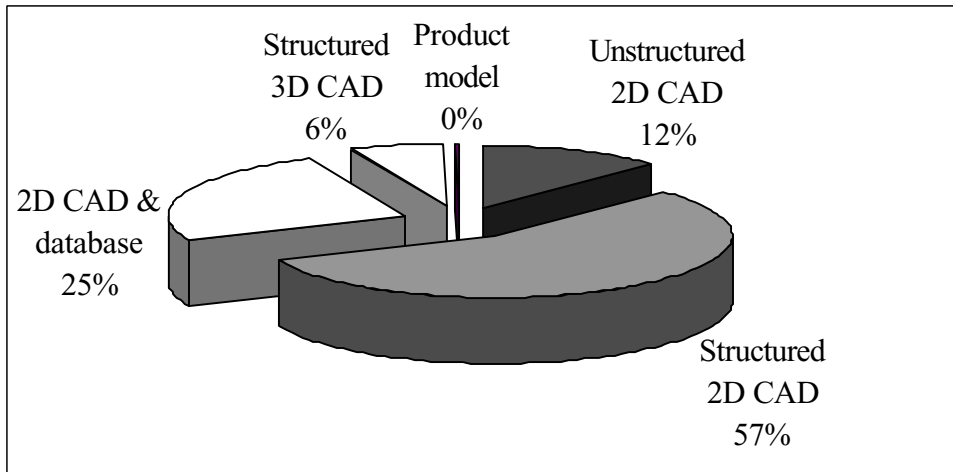


Fig. 9: Percentage of design time with five CAD approaches

One of the objectives of the survey is to find how information technology has changed the design and construction process. According to the results shown in Figure 10, these changes have been both beneficial and detrimental. On one hand, the number of mistakes in documentation has decreased, the number of construction errors has not changed, and the quality of documents and the speed of work have both increased. On the other hand, the complexity of work, the administrative needs, the proportion of new operations and the costs of doing business have all increased. The benefits of information technology come at a cost.

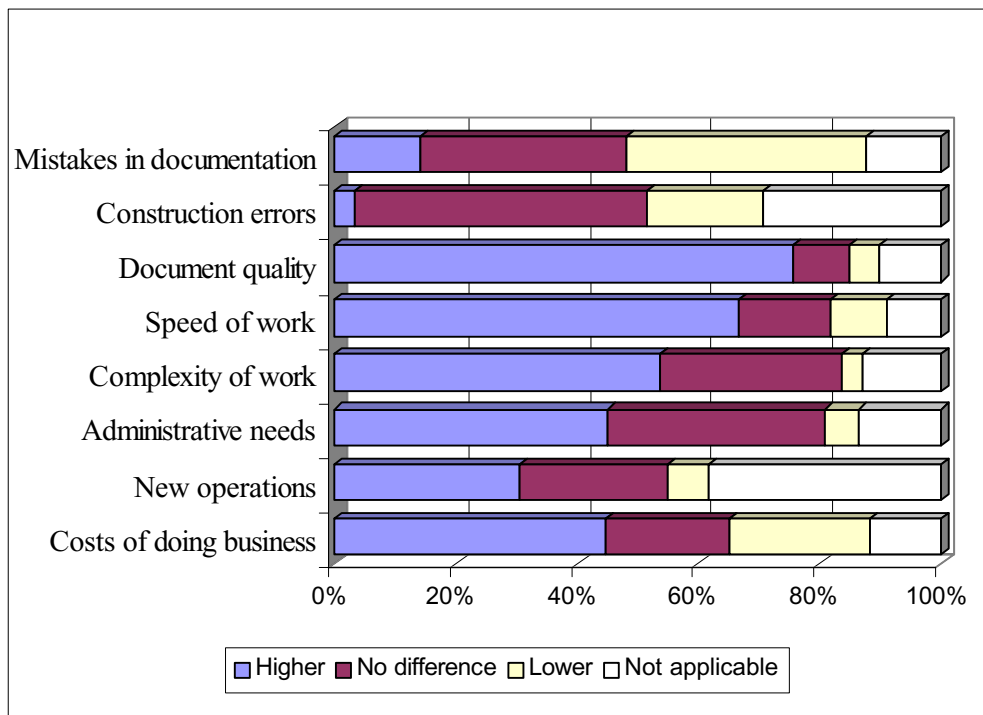


Fig. 10: Changes caused by the introduction of information technologies

The respondents were asked to select the research topics they considered the most important for their firms. Figure 11 shows the set of topics proposed along with their respective score. The results show clearly that the firms surveyed need a way to integrate their operations using computers since the two related topics computer-integrated construction and standard format for the electronic exchange of product data have both scored high. Two other topics that have scored high are concerned with design support. Design tools that would allow concurrent design and support conceptual design would be welcomed. On the other hand, most of the firms surveyed do not see the needs for robot-construction and virtual reality applications.

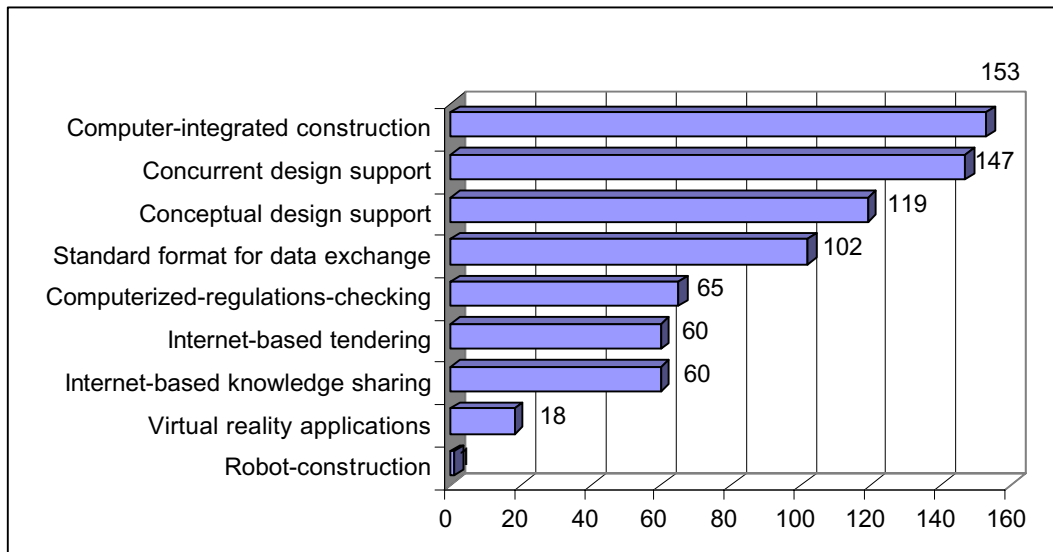


Fig. 11: Research needs identified by the industry

6 Conclusion

The preliminary findings presented here provide a glimpse of the current use of information technology within the Canadian A.E.C. firms that have responded to the survey. Even though most firms have adopted e-mail and the Internet, most processes within these firms are still not computerized and most documents are still exchanged in a traditional fashion. The fact that some data-intensive processes, such as purchasing, tendering, and materials control, are not fully computerized yet may indicate the need for the development of better software tools in these areas. In general, the adoption of information technology has been beneficial but has increased, as a side effect, the complexity of work, the administrative needs and the cost of doing business. If software was simpler to use and more reliable, these side effects would probably vanish. According to the firms surveyed, the most important area of research for the industry is the implementation of computer-integrated design and construction, which integrates data and communication among firms. With such an environment, A.E.C. firms would exchange much more information in digital forms. The next most important area of research is the development of new design

tools that would let several designers work concurrently on a project and that would assist them in exploring many alternatives during the conceptual stages of design.

7 Acknowledgements

The author is grateful to Concordia University and its Faculty Research Development Program for having made this research possible and to all the respondents who took the time to answer and return the long survey. This survey would not have been possible without the help of: Richard Drouin, Garrett Austin, Kene Meniru, Richard Tseng, and Philippe Brosseau. The author also wishes to thank Claude Bédard, Solange Richard, Thomas Froese, and Sheila Anderson for having reviewed the survey.

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