

SURVEY OF INFORMATION TECHNOLOGY AND THE STRUCTURE OF THE SAUDI ARABIAN CONSTRUCTION INDUSTRY

The Saudi Arabian construction industry

M. J. O'BRIEN and N. M. AL-BIQAMI

The School of Computer Science and Information Technology, University of Nottingham, Nottingham, United Kingdom

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. 2327-2337.

© National Research Council Canada 1999

Abstract

While technical advances are the main drivers in the adoption of Information Technology (IT) in the construction industry, such advances can only be incorporated through a due appreciation of the structures of the industry. Earlier work has shown how the organisational structure of the industry is in large part determined by the nature of the economic and financial exchanges which takes place. New IT initiatives succeed to the degree to which they are congruent with those financial exchanges. In short, economic benefits must accrue. This in turn begs the questions: who benefits, and how are the benefits to be distributed amongst the various parties? The answers to these questions provide the basis for establishing a successful implementation. This short-term 'economic benefits' argument does not, however, preclude a more substantial organisational shift at some later point. In this paper we provide an analysis of the economic structure of the construction industry in Saudi Arabia, and in particular the degree to which IT has established itself in that industrial sector. The Saudi Arabian Construction industry is one of the largest in the world, being devoted to the provision of a large-scale infrastructure. However, in many of its characteristics it is unique. It is these elements of uniqueness which make this particular industry interesting: the uniqueness poses new problems for the developers of novel and innovative IT construction systems. Yet despite these aggregate figures and anecdotal facts the small-scale nature of the construction industry has been poorly researched and documented. The analysis of the economic and organisational structure of the Saudi Arabian IT construction industry provided in this paper provides the fine-grained matrix within which new IT systems can be built. The paper describes an ongoing study of the Saudi Arabian construction industry. It draws together existing facts on the industry and new ones which are being elicited through a large survey of the industry. Finally, it is envisioned that tentative conclusions will be provided on the economic and organisational structure of the industry.

Keywords: Information Technology, Internet, EDI, Construction Industry, Saudi Arabia.



1 Introduction

The nature of the construction industry is such that virtual enterprises (VEs) are made up of members of the project team working jointly on the design and construction of a facility. A typical project involves the participation of different stakeholders such as the client, architect, structural engineer, building services engineer, quantity surveyor, main contractor, sub-contractor, materials suppliers, and other specialists. Therefore, it can be argued that each project can be considered to be a virtual enterprise and the participating construction companies, which are geographically and functionally distributed, can be considered to be the business units (O'Brien and Al-Biqami 1998).

The application of the virtual enterprise strategy can be seen as a promising approach, since it offers construction firms the opportunity to perform their business without losing their flexibility and their economic independence within traditional and very rigid co-operations.

The successful application of the virtual enterprise strategy relies on the existence of an appropriate IT infrastructure. This paper focuses on a more specific analysis of the IT infrastructure in Saudi Arabia in a particular industry, the construction industry. We provide an analysis of the economic structure of the construction industry in Saudi Arabia, and in particular the degree to which IT has established itself in that industrial sector. The analysis of the economic and organisational structure of the Saudi Arabian IT construction industry provided in this paper provides the fine-grained matrix within which new IT systems can be built. The paper describes an ongoing study of the Saudi Arabian construction industry. It draws together existing facts on the industry and new ones which are being elicited through a large survey of the industry. Other surveys are ongoing at the time of writing the most interesting being the IT Barometer in Scandinavia (Howard *et al*, 1998).

2 Saudi Arabian construction industry

Saudi Arabia has experienced a construction boom of unprecedented volume during the past two decades, as the country's infrastructure has undergone rapid expansion (including erection of new cities, airports, public and private buildings, highways, etc.) attracting construction professionals from all over the world. The development of the Saudi Arabian construction industry was synonymous with the rapid growth of the domestic economy, which was fuelled by enormous oil revenues. The construction sector is one of the most important contributors to the gross domestic product (GDP) accounting for about 9% of its total value (Ministry of Planning 1991). Companies of all size, involved in this important sector, were established during this rapid growth period.

In Saudi Arabia, the government (Figure 1) is the major source of construction expenditure, accounting for approximately 67% of the nation's construction industry volume (Bubshait 1992). During the second (1975-80), third (1980-85), fourth (1985-90) and fifth (1990-95) Development Plans, the construction industry received 48.7% (SR 295 Billions), 54.9% (SR 674 Billions), 28.2% (SR 231 Billions), and 30.4% (SR 108 Billions) respectively, of the total Governmental expenditure (3.75 SR = 1 US\$) (Ministry of Planning 1991).

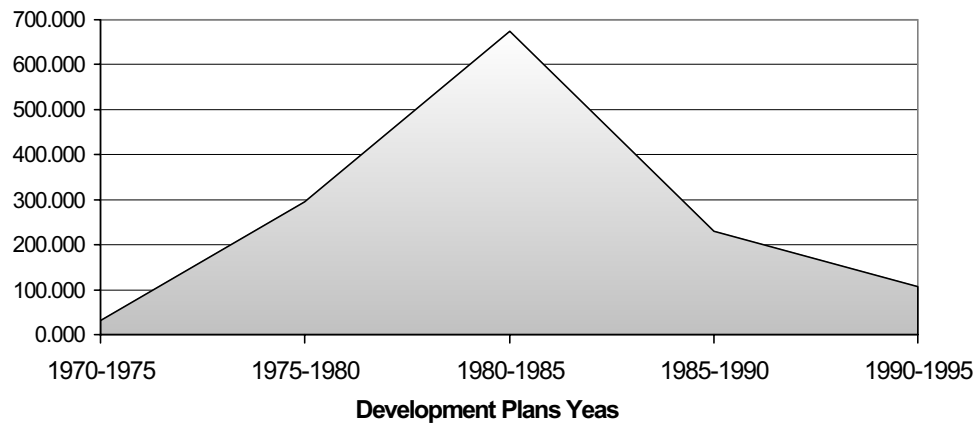


Fig. 1: Governmental actual expenditure on projects during the development plans (from 1970-1995)

A study conducted last year by Riyadh Chambers of Commerce and Industry (Riyadh Chambers of Commerce and Industry 1997) has attempted to estimate the amount of private and public sector projects to be generated in the coming years. The private sector is expected to generate about \$50 billion worth of construction projects between 1997 and 2006. The study estimates that the private sector will be responsible for about 70% of new contracts over the next 10 years, which is seen as a considerable increase from the previously estimated contribution of 43%.

The public sector contribution to construction contracts is expected to diminish over the coming years, as its share drops from 57% to 30%. However, the government role will still concentrate on operation and maintenance projects, where it is estimated that the value of new construction projects will be worth about \$63.8 billions, of which \$24.3 billions will be allocated for operation and maintenance, and \$39.5 billions for new projects.

Also the construction industry in Saudi Arabia employs 15% of the total labour force and uses 14% of the total energy consumption in the country (Al-Jarallah 1983).

As can be seen, the Saudi Arabian construction industry is one of the largest in the world, being devoted to the provision of a large-scale infrastructure. However, in many of its characteristics it is unique. It is these elements of uniqueness which make this particular industry interesting: the uniqueness poses new problems for the developers of novel and innovative IT construction tools. Yet despite these aggregate

figures and anecdotal facts the small-scale nature of the construction industry has been poorly researched and documented.

3 IT and construction industry in Saudi Arabia

The construction industry in Saudi Arabia has been slow to employ IT. There appear to be no official statistics or comprehensive studies on IT use in the Saudi construction industry. To this point, there has only been a limited survey carried out by Shash and Al-Amir (1997). This survey focussed on the extent of computer use and their applications in construction contractor firms in Saudi Arabia. The findings indicate that computers are not widely used by construction contractors, especially in relation to those who are classified as small and medium-sized contractors. The use of computers is directly proportional to the size of the contractor firm. While, all large contractors use computers, only 41% and 62% of small and medium-sized contractors use them. When computers are used, they are limited to administrative operations such as accounting and databases.

The capability of information technology commonly used by business and the public has changed significantly. Electronic Data Interchange (EDI), the Internet and the World Wide Web (WWW) have had a significant impact and most industries are evaluating how to avail themselves of the opportunities they offer. While, the last survey of large construction firms "Building on IT for Quality Survey" in 1993 conducted by CICA and KPMG (1993) did not even include the Internet, by 1996, a significant number of firms in construction were connected; 25% of UK architects were connected in 1997 with a further 15% intending to open an account (Barbour Index plc 1997).

According to the Barbour Report (1997), about 75% of the industry's professionals have a PC as their workstation, 50% use CD-ROM and 25% have access to the Internet. The report suggests that the take-up of the Internet has doubled from 1996 to 1997 and about 50% of manufacturers have stated that they will publish some or most of their product information on the Internet's World Wide Web.

As indicated above, the feeling is that a good proportion of the Saudi Arabian construction industry is not keeping up with the developments in the use of IT. However, identifying the Saudi construction industry's slowness in adopting IT is only a first step. It is necessary for our study to carry out a comprehensive survey on the use and future development of IT in the Saudi construction industry.

4 Survey description

The survey questionnaire was structured to encourage the relevant organisations to participate in the study; to help them to provide the necessary information easily.

To encourage potential survey participants response, a cover letter was included with each mailed survey. Such letters were signed by both authors. Also, the questionnaires were produced in both English and Arabic languages to suit the needs of the construction community in Saudi Arabia which adopts Arabic as the official

language but relies heavily on English as the technical language and the language widely spoken by the dominant expatriate component of construction manpower.

The questionnaires were distributed by post to over 500 organisations within the Saudi Arabian construction industry early in October 1998. The organisations' names and addresses were selected randomly from:

1. The Directory of Engineering and Consulting Offices issued by Engineering Committee, a professional-like association established by the Council of Saudi Chambers of Commerce and Industry in the early 1980s to enhance the engineering profession in the country.
2. The Directory of Classified Contractors prepared by the Contractors Classification Deputy in the Ministry of Public Works and Housing (MPWH).
3. Trade Directory for the Eastern Province prepared by the Chambers of Commerce and Industry for the Eastern Province. This directory includes information concerning 12000 establishments from all sectors, including construction sector, registered as members in the chamber.

The scope of the survey included all participants involved in the industry since the communication technology will eventually tie them all together. Therefore, it was decided that no specific targeting should take place on the basis of organisation type. There is no geographical restriction on the selection of participating organisations – The Kingdom of Saudi Arabia is divided into five regions: East, West, South, North and Central. The survey was sent to top management to assess current use of information and communication technology in their organisation.

The questionnaire established by O'Brien and Al-Soufi (1994) laid the foundation for the development of the study questionnaire. An intensive literature review coupled with comprehensive awareness of the characteristics of the Saudi construction helped to modify and restructure the survey to suit the Saudi construction industry.

The survey was divided into eight sections. The first section contained questions seeking information on the characteristics of the firm, such as size, capacity and type of work performed. The second section contained questions seeking information regarding hardware and software platforms used by the organisation. In the third section, the survey enquired about communication technology that exists within the organisation and asked questions pertaining to the communication between organisations. The fourth and fifth sections asked about the technology used, particularly the Internet and EDI, and the types of data exchanged. The sixth section enquired about computer applications used in the organisation and how they are rated. In section seven, a list of suggestions was offered as to why computer use would be hindered. The last part of the questionnaire was included to encourage respondents to participate in the survey by allowing them to supply their names and address in case they were interested in receiving a copy of the survey results.

5 Characteristics of survey respondents

The response rate to the survey was approximately 10% (46/500). Of responses received, the majority came from building contractors (See Figure 2). The categories of A&E joint practice and manufacturer exhibited as similar response rate at 15.2% and 13%. The remaining categories of consultant, suppliers and engineering all fell below 11%. As far as can be established all the respondents were Saudi Arabian organisations; 12.7% of them engaged in partnerships with overseas firms.

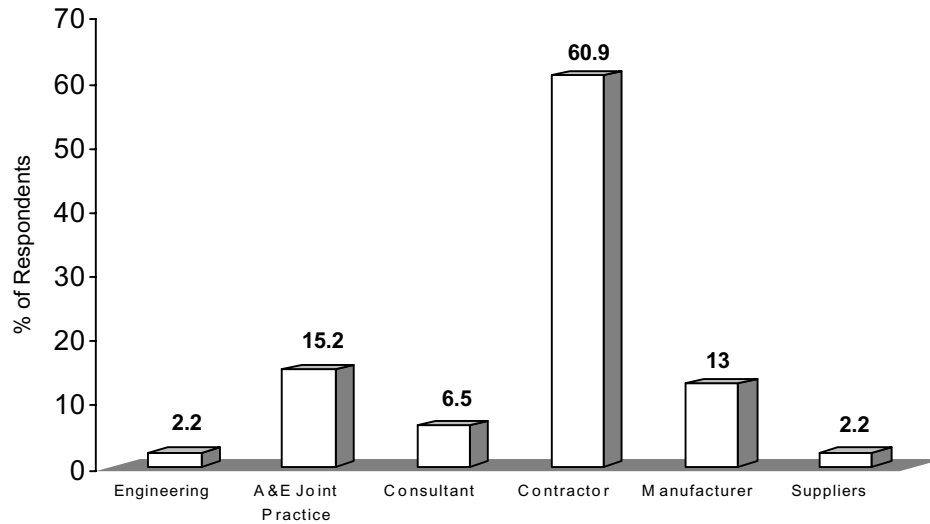


Fig. 2: Type of participating construction organisations

In order to comprehend and analyse the use of information technology in the construction industry in Saudi Arabia, the relevant organisations (See Figure 2) were classified into small, medium and large sizes in relation to their annual turnover.

For the purpose of our study, the construction organisation size is determined according to the following:

1. An organisation is defined as small if its annual turnover is SR20 millions or less.
2. An organisation is defined as medium if its annual turnover is greater than SR20 millions but less than SR50 millions.
3. An organisation is defined as large if its annual turnover is greater than SR50 millions.

This classification is in line with the classification of contractors by the Chambers of Commerce and Industry and the Directory of Construction Contractors in Saudi Arabia. The application of our classification system can be seen in Figure 3. According to our figures, approximately 45% of the participating organisations can be classified as small. Medium-sized organisations accounted for 26.1% while large organisations constitute of 19.6 % (8.7% of respondent were unwilling to provide their annual turnover).

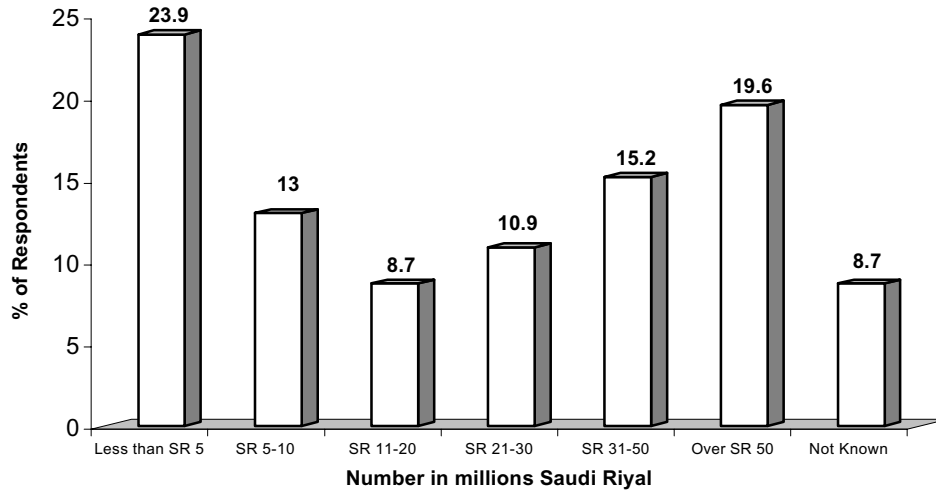


Fig. 3: Construction organisations group distribution

Also the survey attempted to compare the construction organisation's annual turnover with its annual spending on IT. Approximately, 64% of the large organisations and 36.4% of medium organisations spend more than SR100,000 every year, while the small size organisations that have less than SR5 millions annual turnover, spend less than SR1000 every year.

6 Extent of information and communication technology use

The vast majority of respondents to the survey have computers in their organisations. Of construction organisations who do utilise computer, most have PCs (95.7%). A quarter of this figure reported that to have over 50 PCs in their workplaces.

The survey also attempted to determine where computers are located. The physical distribution of computers is a key element in determining the character of internal communication. According to our figures, the vast majority of organisations have their computers located in a main office (93.5%) (See Figure 4). Approximately, 40% also have computers at district offices.

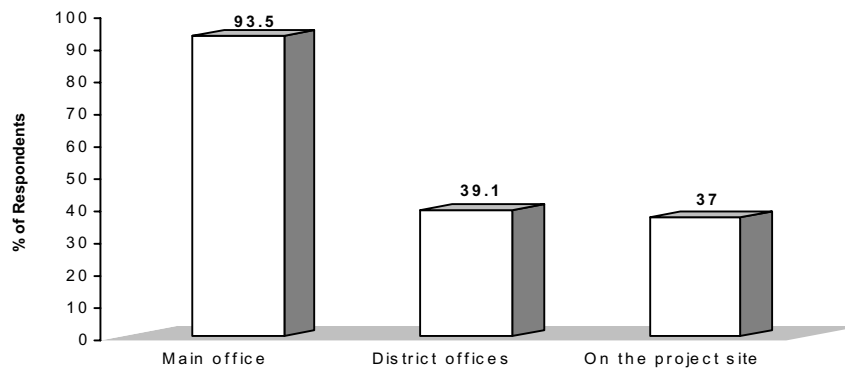


Fig. 4: Computer locations

The most interesting figure, however, is the high-use of computers on-project site (37%). This figure reflects the high computer use of large organisations. 40% of large construction organisations have computers on-project site (See Figure 5). This is most likely due to the ability of large organisations to invest in the computers use based on their high annual turnover.

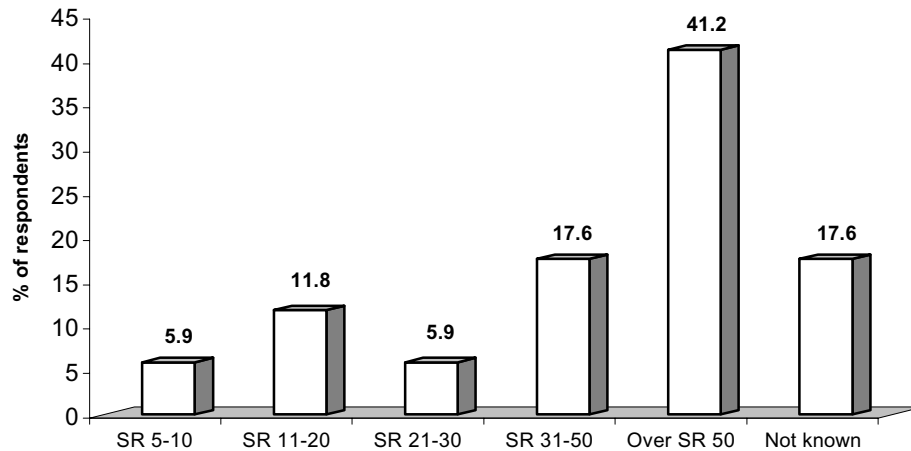


Fig. 5: Computers on-project site and organisations' annual turnover

The survey also examined the level of computer networking *within* the relevant organisations (See Figure 6). The survey revealed that 25% of respondents had all their computers connected together via Local Area Network (LAN), while 22.7% had some LAN infrastructure. Most importantly, 52.3% had no communication infrastructure at all.

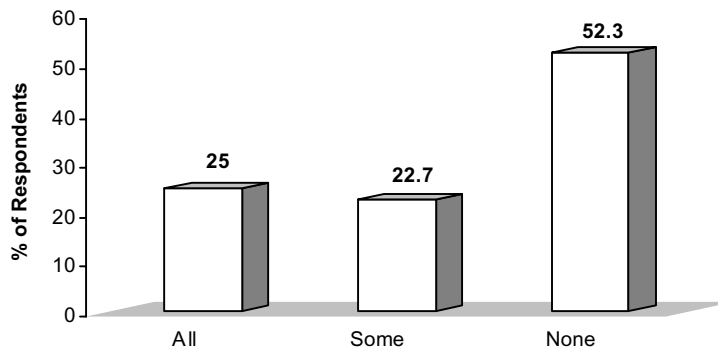


Fig. 6: LAN usage

As for connection between computers in different locations (See Figure 7), 4.8% used Wide Area Network (WAN), while 28.6% utilised modem and telephone lines to exchange data within the same organisation. However, approximately, 67% had no means of communication whatsoever.

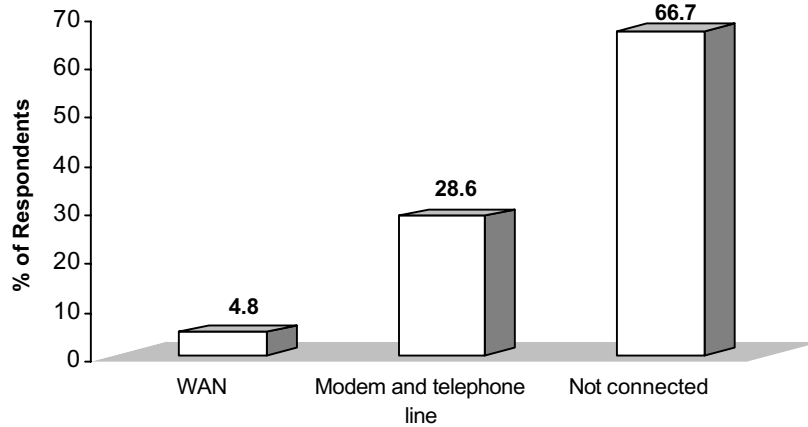


Fig. 7: Inter-organisation communication media

The study also addresses communication *between* different construction organisations (See Figure 8). 76.7% of respondent organisations had no means of connection with other organisations at all (the remaining 23.3% were connected with other organisations).

Of those that were connected, 16.7% used modem and telephone lines, 25% used EDI and 58.3 used alternate methods such as the Internet.

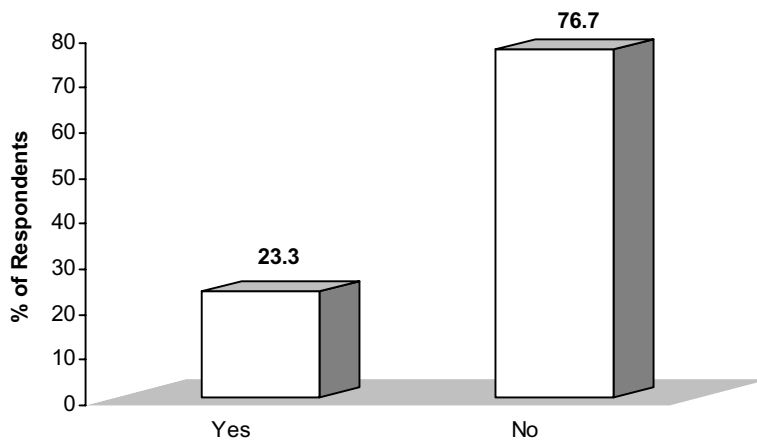


Fig. 8: Communication between different construction organisations

The survey indicates that 28% of organisations have access to the Internet. It is important to note that this access is not provided in Saudi Arabia, but rather comes from surrounding Gulf States (Bahrain, Kuwait, United Arab Emirates, etc.). The majority of respondents that do have access are large organisations. Of the 72% of respondents that do not currently have Internet access, current trends indicate that Internet connection is a priority given the fact that Internet is only now being

introduced in Saudi Arabia.

As such, Figure 9 demonstrates that 63.7% of respondents intend to become connected within the next year.

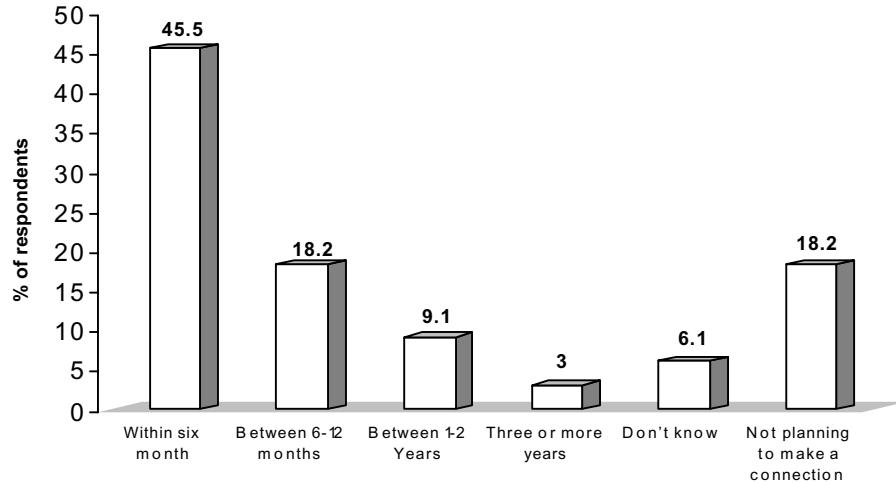


Fig. 9: Construction organisations intend to become connected to the internet

Of the 18.2% that are not planning to make connection, 75% of these state that their business does not require Internet access. The remaining 25% cite lack of expertise as the main reason for not planning to have Internet connection.

Finally, the survey also examined organisation awareness of the EDI. Shockingly, just over 40% of respondents had never heard of EDI technology. In contrast only 8.7% of organisations had implemented it (See Figure 10)

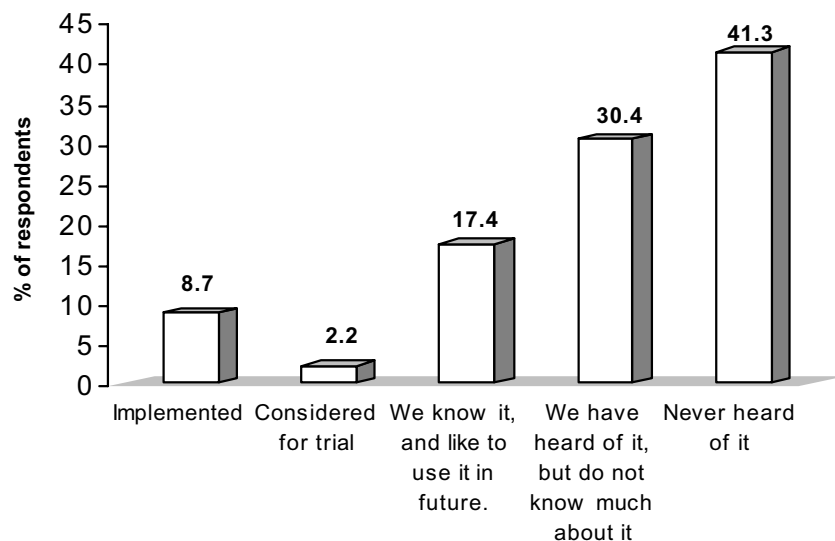


Fig. 10: Construction organisations and EDI awareness

7 Conclusion

This paper has provided a description of the current state of IT and communications in the Saudi Arabian construction industry. The paper first considered the overall and general knowledge that exists, where as the latter part has presented some preliminary results from a survey conducted in October 1998. This survey is probably as current as it can be – questionnaires are still being returned at the time of writing (December, 1998). While the figures have yet to be analysed in detailed, the survey has provided some striking results. Saudi Arabian construction companies are reasonably well advanced with regards to the use of PCs on their construction sites. Yet at the same time the communication structure appears to be poor. The widespread ignorance about EDI does not suggest a bright future for E-Commerce. Yet at the same time the awareness of the Internet suggests exactly the opposite. Indeed, the timing of the survey has been fortuitous. While there is, as yet, no Internet provided within Saudi Arabia – and consequently there is little use – a large proportion of the survey respondents are ready to embrace the technology. But given the relative lack of awareness of EDI it is unclear what use the Internet will be put to. One suspects though this is only a hypothesis, that the “hype” associated with the Internet outweighs the future practical uses, and that companies are embracing it with little thought. Certainly, EDI is more mundane, indeed boring, yet from a business perspective it is of much greater immediate use. A further survey two years from now would make interesting reading.

8 References

- Al-Jarallah, M. (1983). Construction Industry in Saudi Arabia. *Journal of Engineering and Management*, **109**, 4, pp. 355-168.
- Barbour Index plc. (1997). *The Barbour Report 1997: Electronic delivery of product information*: Barbour Index plc.
- Bubshait, A. A. (1992). Owner involvement in construction projects in Saudi Arabia., *Journal of Management in Engineering*, **8**, 2, pp.176-185.
- CICA and KPMG (1993). Building on IT for Quality Survey.
- Howard, R., Kiviniemi, A. and Samuelson, O. (1998). Surveys of IT in the Construction Industry and experience of the IT Barometer in Scandinavia, *ITCon*, **3**, pg 45.
- Ministry of Planning (1991). *Achievements of The Development plans 1390-1410 A.H (1970-1990 A.D), Facts and Figures*. Riyadh: Ministry of Planning.
- O'Brien, M. and Al-Soufi, A. (1994). A survey of data communications in the UK construction industry. *Construction Management and Economics*, **12**, pp. 457-465.
- O'Brien, M. J. and Al-Biqami, N. (1998). *Virtual enterprises in practice*. Objects, Components and the Virtual Enterprise, An interdisciplinary workshop at OOPSLA 98, Vancouver, CA.
- Riyadh Chambers of Commerce and Industry (1997). Riyadh: Riyadh Chambers of Commerce and Industry.
- Shash, A. A. and Al-Amir, M. (1997). Information technology in contractors' firms in Saudi Arabia. *Construction Management and Economics*. **15**, pp. 187-200.