

IT BAROMETER 2003: SURVEY OF THE SINGAPORE CONSTRUCTION INDUSTRY AND A COMPARISON OF RESULTS

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SUMMARY: *The IT Barometer 2003 has been conducted in Singapore, a country which aspires to become the IT and business hub of Asia. Singapore has an on-going IT development programme for the construction industry known as the CORENET which started in 1993. Several industry projects have been implemented to help the AEC firms adopt IT. The survey is a timely check on the levels of general adoption of IT and specific adoption of IT originating from the CORENET. The survey results of Singapore are compared with those of the countries surveyed, particularly, Denmark, Sweden and Finland, under the IT Barometer project. The response rate of the Singapore survey is 11.1% based on 84 returns from a total of 754 questionnaires mailed out. The data collected from the survey is analysed using the SPSS software version 11.0. The key findings on IT usage in Singapore and selected Nordic countries are summarised from the comparison. The four lessons for construction industries intending to adopt IT on a large scale are: (1) To avoid the “technology for the sake of technology” trap; (2) To develop standards, integrated databases and interactive applications; (3) Business strategy must support investments in information systems; and (4) To focus on people, their IT needs and ability to manage change.*

KEYWORDS: *IT Barometer project, Singapore, construction industry, comparison of results*

1. INTRODUCTION

1.1 Background

The IT Barometer project has been used in some Nordic countries since 1997 with the aim “to create a method and perform a survey for measuring the use of IT in the construction industry” (Samuelson, 2002). As a long-term strategy, the survey should be repeatable and comparable over time; be comparable between countries; and cover all categories of companies in the construction industry. Hence, a standard format for the survey questionnaire is developed to encompass wide-ranging questions on the extent of IT usage by AEC companies. So far, countries like Sweden, Denmark and Finland, in the Nordic region, have participated in the first survey, as well as a follow-up. They are the “IT Barometer 1998” and “IT Barometer 2000”, respectively.

The published results include the Swedish survey in the report “IT-Barometern 1998 – Läget för IT-användningen inom byggande och förvaltning i Sverige” by Samuelson (1998) and comparisons between the countries by Howard and Samuelson (1998), Howard *et al.* (1998) and Howard *et al.* (2002). In line with the strategy for the survey, the questions were the same in the three countries except for small changes to adapt to local variations.

The “IT Barometer 2003” had been conducted in Singapore. The same strategy was applied which entailed a coverage of all categories of companies and a comparison of results between countries in order to draw meaningful conclusions about IT adoption in the construction industry.

1.2 Rationale, Scope and Objective

Singapore aspires to become Asia’s IT and business hub. The IT2000 master plan for Singapore was initiated in 1991 by the National Computer Board, and the Construction and Real Estate Network (see www.corenet.gov.sg for details about the CORENET programme) is part of the plan for leveraging IT to re-engineer and streamline the fragmented work processes in the construction industry to achieve a quantum leap, especially in quality and productivity aspects. Since the commencement of the CORENET national programme in 1993, key IT initiatives

have been identified. The Building and Construction Authority (BCA), a government agency, is tasked to push ahead the CORENET programme in partnership with the relevant industry bodies. Appropriate incentive schemes including capital grants for IT development have been put in place to help the industry adopt IT.

It is noted there are comparable characteristics of Singapore and her construction industry with the selected countries, namely, Sweden, Finland and Denmark. Table 1 shows the similarities in relation to the size of population, GDP and construction output.

TABLE 1: Country statistics for comparison (Source: Relevant websites.)

Profile	Singapore	Sweden	Finland	Denmark
Population, 2002 (millions)	4.45	8.87	5.18	5.37
GDP, 2001 (US\$ billions)	106.3	219.0	133.5	149.8
GDP per capita, (US\$ billions)	24,700	24,700	25,800	28,000
Construction Output, 1998 (US\$ billions)	11.6	24.1 (1997)	15.9	11.0
Construction Output per capita, (US\$)	3,000	2,700	3,100	2,048

The survey in Singapore, which targets 1,000 architectural, engineering and construction (AEC) companies, will be supplemented by interviews. It aims to check on the levels of general adoption of IT and specific adoption of IT originating from the CORENET. Next, a comparison of the results from the various IT Barometer surveys will be carried out. Potential findings from the comparison include establishing the similarities and differences in the level of IT adoption in the construction industry of the countries concerned.

More specifically, the following objectives have been defined:

- i) To apply the "IT Barometer Survey" to Singapore.
- ii) To compare the survey results of Singapore with those of the:
 - Nordic Survey IT Barometer 1998;
 - Swedish Survey IT Barometer 2000; and
 - Danish Survey IT Barometer 2001.
- iii) To ascertain key differences in the level of IT adoption in the construction industry of the countries concerned.
- iv) To draw important lessons for countries intending to adopt IT on a large scale.

2. THE SINGAPORE SURVEY IT BAROMETER 2003

2.1 The Mailed Questionnaire Survey

The survey form was mailed to a total of 754 companies operating in the construction industry in the areas of (i) Architecture; (ii) Engineering; (iii) Quantity Surveying; (iv) Property Development; (v) Construction; and (vi) Product Manufacturing and Supplies.

Although the sampling strategy was to involve as many, if not all, companies in each category, the larger-sized ones were targeted, especially for categories with numerous companies. This pre-selection of companies for the survey based on size also meant that a weighting need not be applied to normalise the responses from companies of different sizes. They were selected mainly from the registers of the respective professional institutions and, hence, would provide an adequate representation of the industry. A breakdown of the sampling population is given in Table 2.

TABLE 2: A breakdown of the sampling population, in number and per cent

Category	No. of Companies	Per cent
Architecture	361	47.9
Engineering	131	17.4
Quantity Surveying	19	2.5
Property Development	23	3.0
Construction	129	17.1
Product Manufacturing and Supplies	91	12.1
Total:	754	100.0

2.2 Returns from the Survey

Responses from the survey were analysed using the SPSS software. The results showed that the largest group of respondents belongs to Architecture (45.2%). The other groups, in descending order of size, are: Engineering (17.9%); Multi-disciplinary (15.5%); Construction (11.9%); Quantity Surveying (6.0%); Property Development (2.4%); and Product Manufacturing and/or Supplying (1.2%).

In order to examine the rate of response from each category, an analysis in percentages is shown in Table 3.

TABLE 3: The rate of response for the survey, in number and per cent

Category	No. of Targeted Companies	No. of Respondent Companies	Per cent of Respondent Companies
Architecture	361	38	10.5
Engineering	131	15	11.5
Quantity Surveying*	19	5	26.3
Property Development	23	2	8.7
Construction	129	10	7.8
Product Manufacturing/Supplying	91	1	1.1
Multi-disciplinary*	-	13	N.A.
Total:	754	84	11.1

Note: These categories * only apply to Singapore. In other words, they are not on the original list of activities of the IT Barometer survey. For the category "Multi-disciplinary", it was created for responses that have indicated more than one category, for instance, Engineering and Construction.

3. RESULTS OF THE SINGAPORE SURVEY AND A COMPARISON

The results of the survey conducted in Singapore are discussed here and, where appropriate, some selected results from the comparison with Sweden, Finland and Denmark are highlighted. While a few comparisons are country-specific, others look at the Nordic region, involving the countries surveyed in IT Barometer 1998. It is also important to note the time lapse between the surveys. Hence, in the comparison with Singapore, the general approach is to refer to the more recent surveys as conducted in Sweden and Denmark.

3.1 Section A: General information

Architects consistently formed one of the largest group of respondents (see Fig. 1, 2a & b).

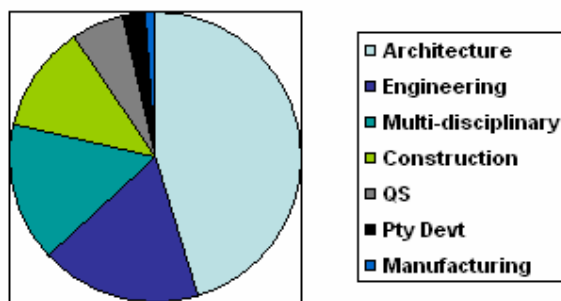


FIG. 1: Singapore Survey IT Barometer 2003

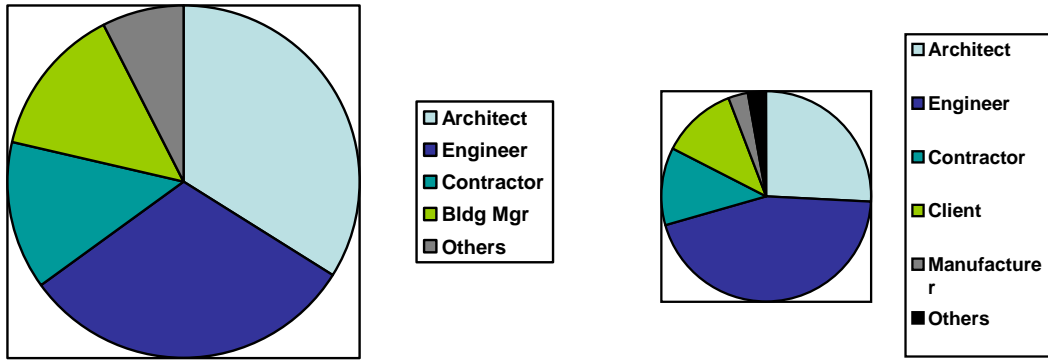


FIG. 2a & b: Nordic Survey IT Barometer 1998 (Denmark) Danish Survey IT Barometer 2001

3.2 Section B: Computers and software

In Singapore, the survey revealed a high percentage (97.6%) of construction-sector personnel who use the PC or terminal at work (see Fig. 3). While this figure includes both office and site staff, it does not necessarily include temporary site workers. However, in the Nordic surveys, it was noted that all construction workers in the construction companies had been included.

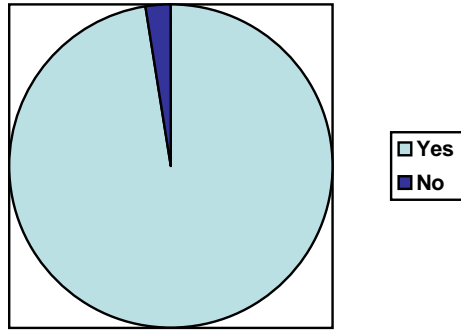


FIG. 3: Use of PC or terminals at work

For the common types of software used at work, namely, email, word processing and spreadsheet, Singapore has the highest percentage (100 %) for Email, as compared to Sweden (93.0 % in 2000) and Denmark (97.5 % in 2001). Singapore also leads the two countries in the use of word processing but ranks next to Denmark for spreadsheet usage (see Fig. 4).

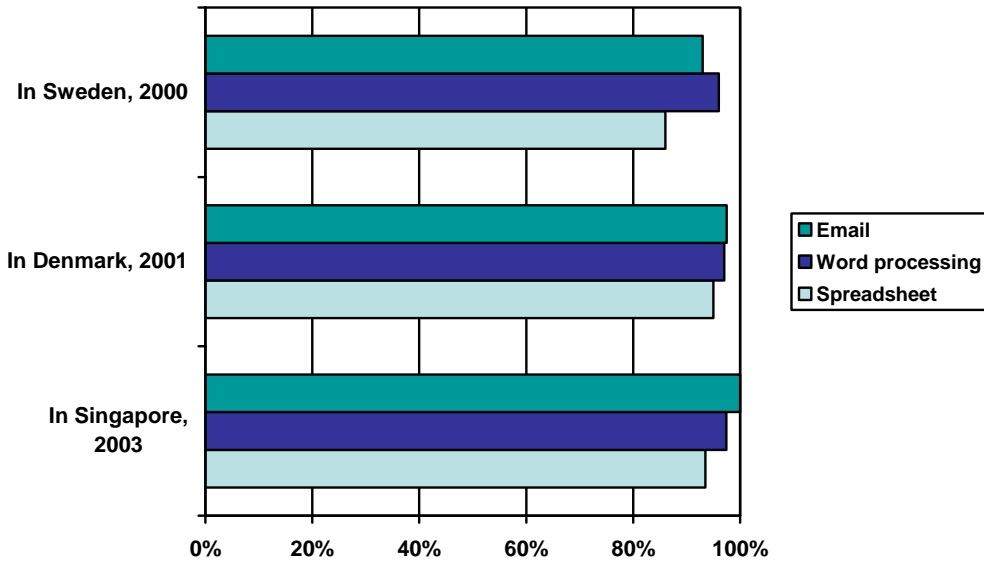


FIG. 4: Types of software used at work

On staff access to the IT equipment, Singapore has a higher percentage (94.7 %) of staff having their own PC, as compared to Sweden (54.0 % in 2000). The margin of difference is wide, almost double (see Fig. 5).

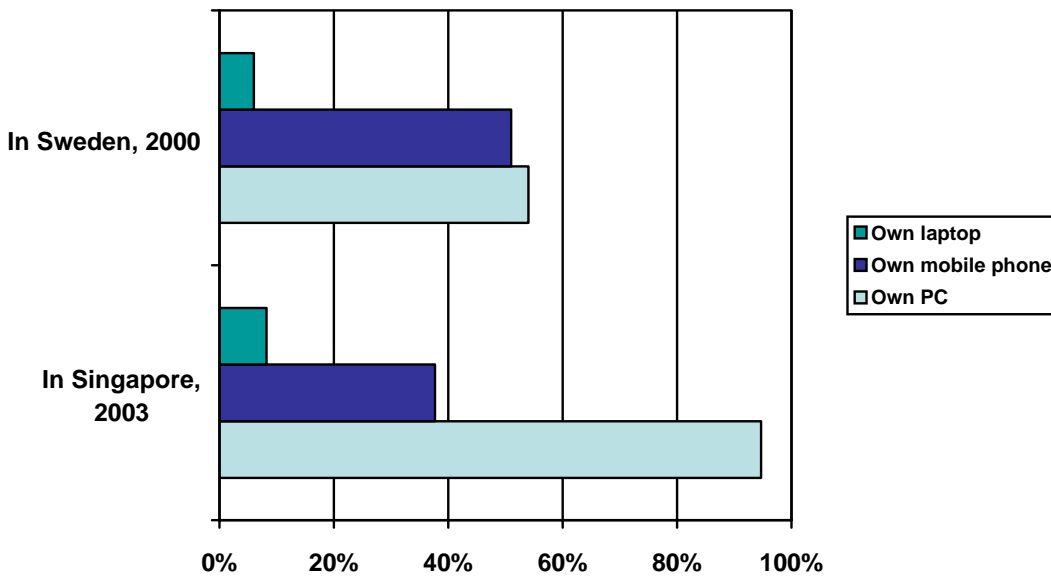


FIG. 5: Staff access to the IT equipment

On the use of CAD software at the workplace, Denmark has the highest percentages (97.0 % for Architects and 82.0 % for Engineers in 2001) as compared to the other countries. This is followed by Singapore, with 84.5 % of the surveyed Architects and Engineers using the software. On the use of GIS at the workplace, the Denmark survey indicated a much higher percentage (13.0 % in 2001) than Singapore's (4.8 % in 2003).

On whether design work is done by hand or software, the respective percentages are comparable across the countries surveyed. Generally, around 90.0 % of the respondents have indicated working by software while around 10.0 % by hand.

3.3 Section C: Use of IT systems

The results generally showed that Singaporean companies focus on computerising administrative functions such as bookkeeping and invoicing rather than core business functions. In Singapore, the types of operations that have been fully computerised are bookkeeping (38.1%), invoicing (39.3%), work descriptions (35.7%), technical calculations (27.4%), scheduling (23.8%), costing/budgeting (23.8%) and tendering (32.1%). In Sweden, more companies have computerised their core functions such as costing/budgeting, rental administration for real estate and maintenance for real estate.

On documents that are sent digitally, the Singapore survey indicated significantly fewer types as compared to the selected Nordic countries. Notably, the two types of documents relate to work descriptions and technical calculations. In Denmark, Finland and Sweden, they extend to main documents, building documents and specifications.

3.4 Section D: Data and telecommunications

There was a higher percentage of Danish firms (80.0 % in 2001) having one or more Local Area Networks (LANs) at the workplace as compared to Singaporean firms (66.7 % in 2003). See Fig. 6.

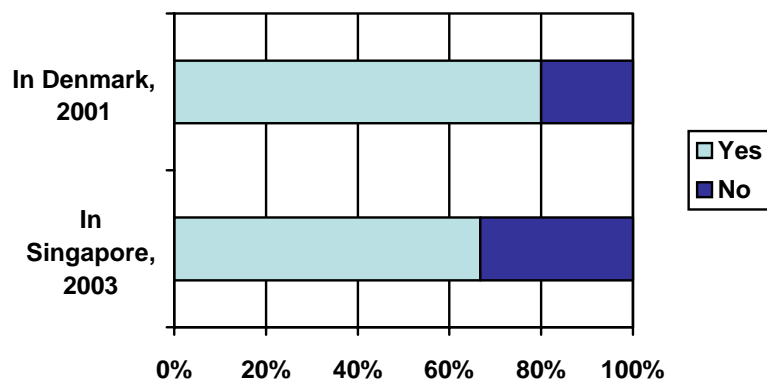


FIG. 6: Availability of LANs at the workplace

On access to the Internet at the workplace, there was a marginally higher percentage of Danish companies (99.0 % in 2001) having this access as compared to Singaporean companies (94.0 % in 2003), and this is followed by Sweden (83.0 % in 2000). On access to the Internet from staff own computer, there was a significantly higher percentage of Danish staff (90.0 % in 2001) having this access as compared to Singaporean staff (68.8 % in 2003) and Swedish (45.0 % in 2000). On having a Home Page on the Internet, 67.0 % (in 2001) of the Danish companies surveyed have it, followed by 60.0 % (in 2000) of Swedish companies and 45.2 % (in 2003) of Singaporean companies. See Fig. 7.

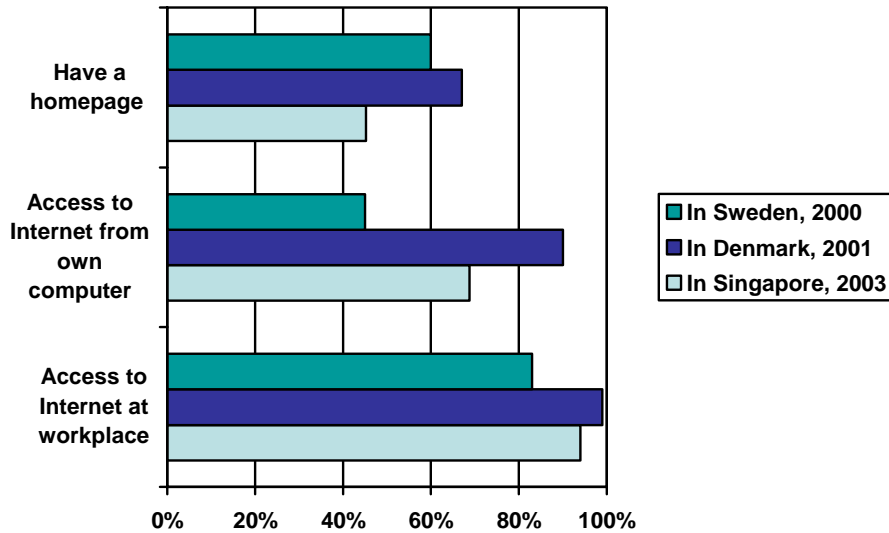


FIG. 7: Use of the Internet

In Singapore, the survey revealed the highest percentage of companies (35.7 %) having used an Internet Project Web for storage and transfer of project documents as compared to Sweden (25.0 % in 2000) and Denmark (23.0 % in 2001). However, on plans to start using it in two years, Singaporean companies have indicated a lower percentage (2.4 %) as compared to the Danish (12.5 %). See Fig. 8.

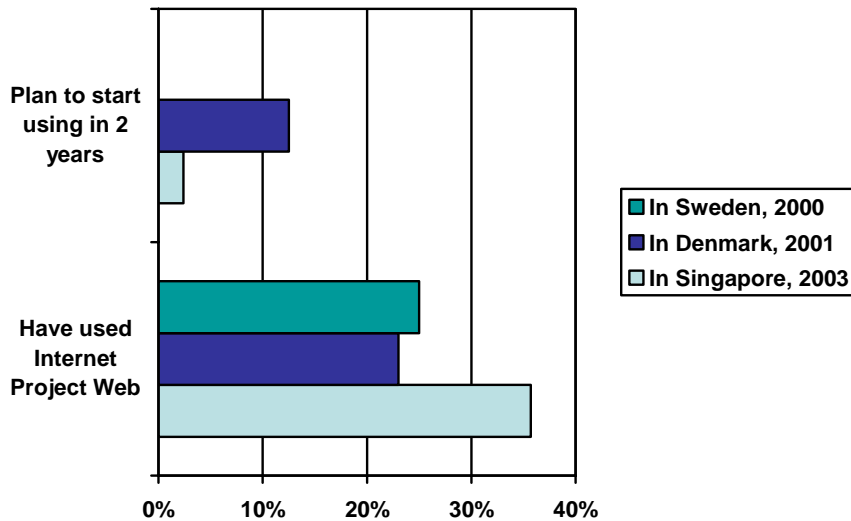


FIG. 8: Use of Internet Project Web

On the proportion of business that will be generated from Electronic Trading, the results of the Singapore survey showed a decreasing trend from a current 9.5 % to 0.0 % in five years' time. Similarly, results of the Danish survey showed a decreasing trend from 25.0 % to 13.0 % in five years' time. Singaporean companies use this electronic means primarily for online product sourcing.

On Intranet at the workplace, there was a marginally higher percentage of Singaporean companies (35.7 % in 2003) having it than the Danish (29.0 % in 2001). Correspondingly, it was noted that 40% of Swedish companies have it.

3.5 Section E: The part played by IT in the company

The survey indicated twice as many Swedish companies having an IT strategy that is documented in written form than their Singaporean counterparts. The percentages are 25.0 % and 10.7 %, respectively. See Fig. 9 for details about the other forms of strategy.

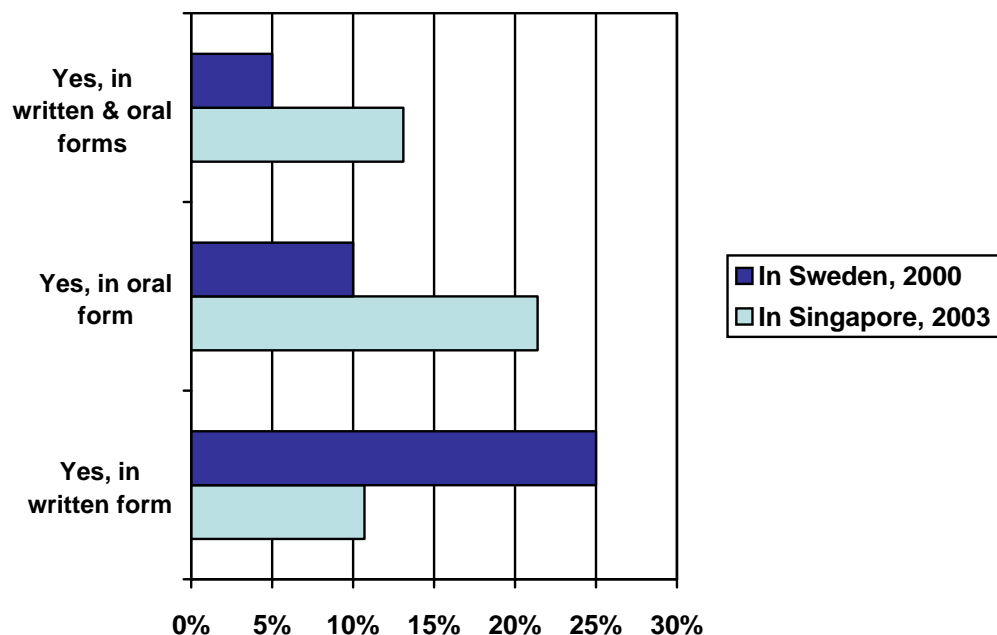


FIG. 9: An IT strategy at the workplace

On IT spending, 16.7 % of the surveyed companies in Singapore have indicated they spend 5.0 % of annual turnover on IT, 15.5 % spend 10.0 % while 9.5 % spend 1.0 %. Only 6.0 % spend 20.0 %. Also, 86.9 % have made investment in IT in the last two years. On how the IT investment has changed or will change in future, the percentages of surveyed companies that have indicated “Increase” are generally higher in the selected Nordic countries than in Singapore.

On ranking the top reasons in making decisions about new IT investments, the Singapore survey revealed a general inclination towards using IT to improve technical capability and increase competition, while the surveys of the selected Nordic countries revealed the preference for improving administrative capability, competition and customer satisfaction. The least important reason was consistent for all the countries surveyed, that is, to develop new products or business. See Table 4.

TABLE 4: Ranking of reasons in making decisions about new IT investments

In Singapore, 2003 Top 4 reasons ranked as “Very Important”	In Denmark, 2001 Top 4 reasons ranked as “Very Important”	In Sweden, 2000 Top 4 reasons ranked as “Very Important”
1) More efficient technical work. 2) For competition. 3) More efficient administrative work. 4) To be ahead technically.	1) More efficient administrative work. 2) For competition. 3) More efficient technical work. 4) Customer demand.	1) Desire to make administrative work more efficient. 2) Necessary means of competition. 3) Demands from customers. 4) Desire to make technical work more efficient.
The least important reason: - To develop new products/business.	The least important reason: - To develop new products/business.	The least important reason: - To develop new products/business.

On the impact of IT on work processes, the Swedish and Singapore surveys indicated the same characteristics for “Increased” as a change. These characteristics relate to Speed of Work, Document Quality, Complexity of Work,

Degree of Difficulty and Need for Administration. However, the ranking of these characteristics was not the same across the surveys. See Table 5.

TABLE 5: Ranking of changes in work process in the last 2 years due to IT

In Singapore, 2003 Resulted in "Increased" as a change (in ranking order)	In Sweden, 2000 Resulted in "Increased" as a change (in ranking order)
1) Speed of work. 2) Document quality. 3) Complexity. 4) Degree of difficulty. 5) Need for administration.	1) Document quality. 2) Speed of work. 3) Proportion of new operations. 4) Administrative needs. 5) Complexity of work.

On the effect of IT on productivity in the last two years, all the surveys indicated functions that have shown more than 10.0 to 15.0 % increase in productivity as General Administration, Design, Project Management and Site Management. See Table 6.

TABLE 6: Ranking of functions that have increased in productivity due to IT

In Singapore, 2003 Functions that have registered more than 10% increase in productivity (in ranking order)	In Denmark, 2001 Functions that have registered more than 15% increase in productivity (in ranking order)	In Sweden, 2000 Functions that have registered more than 15% increase in productivity (in ranking order)
1) General administration. 2) Design. 3) Project management. 4) Site management.	1) Design. 2) General administration. 3) Project management. 4) Site management.	1) General administration. 2) Design. 3) Purchase/ Selling. 4) Project management.

On areas the company plans to increase the use of IT in the next two years, CAD and Document Handling are areas consistently indicated in the surveys. Again, it is important to highlight that a direct comparison is not possible owing to the factors mentioned before and, especially, in relation to the differing proportions among the categories of companies involved in the surveys. See Table 7.

TABLE 7: Ranking of areas which company plans to increase the use of IT

In Singapore, 2003 Top 3 areas which company plans to increase the use of IT (in ranking order)	In Denmark, 2001 Top 3 areas which company plans to increase the use of IT (in ranking order)	In Sweden, 2000 Top 3 areas which company plans to increase the use of IT (in ranking order)
1) CAD. 2) Document handling. 3) Project management.	1) CAD. 2) Document handling. 3) Internet.	1) Document handling. 2) Systems for costing/ cost control. 3) Accounting systems. (CAD was ranked no. 7.)

The top three advantages that IT has provided at the workplace are consistent in Singapore (in 2003) and Denmark (in 1998). They are: Work Done More Quickly, Better Quality of Work and Faster Access to Information. However, the 2001 Denmark survey has extended the list to include Better Communications and Sharing of Information, which may also imply a certain level of interoperability among companies. See Table 8.

TABLE 8: Ranking of top advantages that IT provides at the workplace

In Singapore, 2003 Top 3 advantages that IT provides at the workplace (in ranking order)	In Denmark, 1998 & 2001 Top 5 advantages that IT provides at the workplace (in ranking order)	In Sweden, 2000 Top 5 advantages that IT provides at the workplace (in ranking order)
1) Work done more quickly. 2) Better quality of work. 3) Faster access to information.	<u>In 1998</u> 1) Quicker work. 2) Quality of work. 3) Faster access. 4) Financial control. 5) Handling data.	1) Better financial control. 2) Simpler/faster access to common information. 3) Better communications. 4) Possibility of sharing information. 5) Easier to handle large amounts of data.

	<u>In 2001</u>	
	<ol style="list-style-type: none"> 1) Better financial control. 2) Sharing information. 3) Faster access to information. 4) Better communications. 5) Satisfying customers. 	

The top two obstacles or disadvantages from the use of IT at the workplace are consistent in Singapore (in 2003) and Sweden (in 2000). They are: Need to Continuously Upgrade and Investment Cost is Too High. Incompatible Software ranked third in the Singapore survey but sixth in the Swedish survey.

On awareness or use of standards at the workplace, results from the Denmark (in 2001) and Singapore (in 2003) surveys showed that Danish companies know more about standards in general. On usage, Singaporean companies scored highly on national standards relating to CAD and Construction Costs. On IT training for staff, the Singapore (in 2003) and Denmark (in 2001) surveys showed comparable percentages across all types of staff at the “Too low”, “Sufficient” and “Excellent” levels.

4. KEY DIFFERENCES IN IT ADOPTION IN THE CONSTRUCTION INDUSTRIES SURVEYED

Owing to the time lapse between the surveys, a meaningful generalisation of the country-to-country differences can only be made by assuming that the status or condition remains constant in the construction industries surveyed. A summary of the key findings is given below.

Key findings on IT Usage in Singapore

1. A high percentage (97.6 %) of construction-sector personnel uses the personal computer or terminal at work.
2. Singapore leads in the usage of E-mail (100 %) and word processing at work.
3. Singapore leads significantly (almost double) in staff having their own personal computer (94.7 %).
4. Companies in Singapore do not primarily send documents digitally as compared to the selected Nordic countries.
5. There are fewer companies in Singapore having access to the Internet at the workplace and fewer staff having access to the Internet from own computer as compared to their Danish counterparts, but more when compared to the Swedish.
6. Companies in Singapore generally do not document their IT strategy formally as most do not think it is necessary to have one to begin with.
7. There are lesser companies in Singapore that will increase their IT investment as compared to those in the selected Nordic countries.
8. Companies in Singapore will consider new IT investments in the areas of improving technical capability and increasing competition.

Key findings on IT Usage in the Nordic Region

1. Denmark leads all in the use of the CAD software by Architects and Engineers at the workplace.
2. Most Danish companies have access to the Internet at the workplace as compared to their Singaporean and Swedish counterparts.
3. A significantly higher percentage of staff in Denmark have access to the Internet from own computer as compared to their Singaporean and Swedish counterparts.
4. Denmark leads Sweden and Singapore in companies having a Homepage on the Internet.
5. Better communications and sharing of information is the latest advantage derived from IT at the workplace, implying a certain level of interoperability among companies in Denmark.
6. Incompatible software, as a disadvantage, is less prominent among Nordic companies than their Singaporean counterparts.
7. Danish companies know more about IT standards than their Singaporean counterparts.
8. Customer satisfaction is an important reason for Danish companies to consider when deciding on new IT investments.

9. Companies in Singapore have noted “Work Done More Quickly”, “Better Quality” and “Faster Access to Information” as the top advantages.
10. Companies in Singapore have noted “Need to Continuously Upgrade” and “Investment Cost is Too High” and “Incompatible Software” as the top disadvantages/ obstacles.
11. Companies in Singapore have generally used national standards relating to CAD and Construction Costs.

Note: The results from the following surveys have been used in the comparison:

- i) Nordic Survey IT Barometer 1998;
- ii) Swedish Survey IT Barometer 2000;
- iii) Danish Survey IT Barometer 2001;
- iv) Singapore Survey IT Barometer 2003.

5. SOME IMPORTANT LESSONS FOR CONSTRUCTION INDUSTRIES INTENDING TO ADOPT IT

5.1 To avoid the “technology for the sake of technology” trap

The experience of the countries surveyed has shown that a high investment in IT does not automatically translate into higher productivity gains.

In Kanungo (1999), it was explained as the ‘empowerment myth’ where the idea that a state-of-the-art application is the best way to solve a business problem. With a few exceptions, however, empowerment usually ends up being nothing more than a euphemism for superficial change or even change for the worse. In such an instance, the application may end up taking longer to deploy, costing more than expected, or leaving users with less autonomy than they had before. Hence, empowerment efforts often fail because they deploy technology for the sake of technology’s or for the sake of some future promise rather than for current business needs.

Furthermore, it was explained that managers tend to focus on the achievable objectives and that a system installed is tangible evidence of computer use. But, little is it realised that it may take months and, sometimes years, to make an information system yield its true potential in terms of cost or time savings. *Technoholism* believes that the application of technology to an organisational problem is more likely to yield solutions than other approaches.

5.2 To develop standards, integrated databases and interactive applications

On standards and standardisation, Jakobs (2000) remarked that it is reasonable to assume that in the knowledge age, standards will play an even greater role as the cultures of business, technology and knowledge will demand more standards. Afterall, IT is intended to be a means to better and more efficient information management and exchange. And, a common language is required for machines to ‘communicate’. Standards are also critical for building integrated databases and interactive applications that are web-enabled. In this respect, companies must also take advantage of the Internet to interoperate as the survey findings have shown that the level of interoperability using IT is generally lower than expected. However, the low level of using the Internet to interoperate does not necessarily be a result of a lack of standards but the low level of interoperability does.

On a broader scale, there is a need to promote the continuous growth of the software and services industries. Essentially, it will help to create a large pool of local users who will benefit from products developed for the local market that meet the needs of local languages, culture and business environments. The continuous interaction between local users and providers will help countries realise the payoffs from IT use (Kraemer and Dedrick, 1998).

5.3 Business strategy must support investments in information systems (IS)

Public and private organisations, both big and small, must continue to strategise. They need a deeper appreciation of the generic strategies for developing and deploying information systems to maximise their business and/or operational potentials. This message clearly surfaced from the findings of the surveys.

As long as firms are not able to realise the potential of their IT investments, there will be little justification for further investment. But IT can only bring about quantum leap improvements when applied to re-engineered processes, and a change in any prevailing practice requires strategic thinking. Otherwise, this lack of direction can result in a lack of user interest, the dilution of top management commitment and the eventual failure of systems (Kanungo, 1999).

5.4 To focus on people, their IT needs and ability to manage change

The survey findings in Singapore and Denmark on staff training were consistent. But, as noted, the IT training is given to domain personnel, that is, those who practise architecture, engineering, quantity surveying or construction. Understandably, the impact, as an industry, would be superficial as the acquired skills are basic. A major shift from this training philosophy is necessary. Essentially, there is a need for manpower training to extend to producing people who are well-versed in both IT and business operations. They will design IT solutions and workflow processes that enable companies to run these functions remotely.

Understanding the power and interests of stakeholders is vital in sustaining their commitment to industry programmes. Standardisation and infrastructure development projects are some which requires long-term participation. The process of managing relations with them to gain their support or contain their opposition is continuous. Essentially, they will have the power to help and hinder the change. Hence, it is important to know what they will think and do about the change (Boddy *et al.*, 2002).

The chief executive officer (CEO) in an organisation plays a significant role in managing IT-enabled change. Essentially, the CEO has to maintain a balance between top-down control and bottom-up empowerment in order to manage IT investment effectively.

6. CONCLUSION

Technology will continue to be invented to assist humans at work and, even more apparent now, in their daily lives. The fundamental benefits to be derived are in speed and precision, as well as convenience. In this ideal arrangement, it only seems logical for humans to want to embrace technology in their best interests and motivation. But if this is not the case, perhaps the root cause is in the way humans manage change. Essentially, change is normal for any individual or organisation – the absence of change, external or internal, is unnatural.

The IT Barometer project is a good method for researchers to study how, when and why the process of change is taking place within a country and across countries worldwide. The current realisation is that the key focus should be on managing people and not developing technology alone. In other words, technology cannot advance without the sustaining support of users – otherwise the rate of diffusion will be slow. And, in order for users to embrace a new technology or system, it would have to have satisfied their primary expectations in terms of how it has produced real benefits for them, whether tangibly or intangibly.

7. ACKNOWLEDGEMENT

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8. REFERENCES

- Boddy, D., Boonstra, A. and Kennedy, G. (2002), *Managing Information Systems: An Organisational Perspective*, Pearson Education Limited.
- Howard, R., Kiviniemi, A. and Samuelson, O. (1998), “Survey of IT in the construction industry and experience of the IT-Barometer in Scandinavia”, *Electronic Journal of Information Technology in Construction*, Vol. 3. (<http://itcon.org/1998/4/>)

- Howard, R. and Samuelson, O. (1998), "IT Barometer – International comparisons of IT in building". In Bjork, B-C and Jagbeck, A (eds.) *The Life-cycle of IT Innovations in Construction – Technology Transfer from Research into Practice, Proceedings of CIB W78 Conference*, June 3-5 1998, Royal Institute of Technology, Stockholm.
- Howard, R., Kiviniemi, A. and Samuelson, O. (2002), "The latest developments in communications and e-commerce – IT barometer in 3 Nordic countries". In *Proceedings of CIB W78 Conference*, June 12-14 2002, Aarhus School of Architecture, Denmark.
- Jakobs, K. (2000), *Information Technology Standards and Standardisation: A Global Perspective*, Idea Group Publishing.
- Kanungo, S. (1999), *Making Information Technology Work*, Sage Publications India Pte Ltd, New Delhi.
- Kraemer, K.L. and Dedrick, J. (1998), "IT and Economic Development – Results and Policy Implications of Cross-country Studies". In *Information Technology, Productivity and Economic Growth: International Evidence and Implications for Economic Development*, by M. Pohjola, Oxford University Press, 2001.
- Samuelson, O. (1998), "IT Barometern 1998 – Läget för IT-användningen inom byggande och förvaltning i Sverige", Stockholm, KTH tryckeriet. In "IT-Barometer 2000 – The Use of IT in the Nordic Construction Industry", *Electronic Journal of Information Technology in Construction*, Vol. 7. (<http://itcon.org/2002/1/>)
- Samuelson, O. (2002), "IT-Barometer 2000 – The Use of IT in the Nordic Construction Industry", *Electronic Journal of Information Technology in Construction*, Vol. 7. (<http://itcon.org/2002/1/>)