THE IT-BAROMETER – A DECADE'S DEVELOPMENT OF IT USE IN THE SWEDISH CONSTRUCTION SECTOR

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SUMMARY*: The IT-Barometer 2007 survey was carried out in the spring of 2007 in Sweden and Finland, as a follow-up to the IT-Barometer 1998 and 2000 surveys. This paper presents the most significant results from the Swedish survey with comparisons with the earlier ones. The survey was sent out to a statistically chosen selection from the whole country, divided into architects, technical consultants, contractors, property owners and the materials industry. The survey provided knowledge of access to computers and communication tools, use of IT in some work operations and in the three focus areas: CAD, project webs and electronic trade, and finally plans and strategies for the use of IT in future. 100 % of all employees work at workplaces with computers. Over 70 % of them, including site workers, have their own computer, their own e-mail address and access to the Internet at their workplace. The use of CAD in general has increased but was almost fully integrated already in 2000. The use of model-based CAD software has increased among architects as well as technical consultants, and CAD is now also being used for other purposes than geometrical data. The use of project webs and electronic trade in the construction industry, which had started already at the time of the survey in 2000, is now widespread, even if the use is still not at a high level. The plans for IT investments are concentrated on well-tried techniques in the companies' support business, and at the top of the list at the moment are mobile solutions.*

KEYWORDS: *Survey, IT, construction industry, CAD, product models, project webs, electronic trade, communication, Sweden.*

1. INTRODUCTION

1.1 Background

The IT-Barometer project originally started in 1997 as an initiative of the Swedish R&D-program 'IT Bygg och Fastighet 2002', (IT Construction & Real Estate 2002). The aim of the project was to create a measuring tool for the use of IT in the construction and facility management sector, and to perform measurements at intervals of some years. Three criteria were set up for the survey tool. It should:

1. Be repeatable and comparable over time.
2. Be comparable between countries.
3. Cover all categories of companies in the construction industry, which was defined as architects, technical consultants, contractors, facility managers and the materials industry.

The survey has then been performed twice in each of the countries Sweden, Denmark and Finland. The results for each country and comparisons between the countries have been presented in several papers, (Samuelson, 1998a; Howard & Samuelson, 1998; Howard et al. 1998; Samuelson, 2002). In Canada too, a survey was performed in 1999 with some changes as to the questions (Rivard, 2000).

During the years since the last survey, a lot of changes have occurred in the construction industry. Access to the Internet and different web services has increased; the way of communicating project information has changed; development of software regarding building information models has increased as well as the knowledge and awareness of them; and long-term work in standardisation of electronic trade has finally resulted in a visible increase in use.

In the light of this development, an initiative was taken to follow up the earlier studies to be able to make a longitudinal study of the subject 'IT use in construction'. The IT-Barometer was therefore repeated in the spring of 2007 in Sweden and Finland. This paper presents some results from the Swedish survey in 2007 with comparisons with the older surveys.

When repeating the study in 2000 as well as in 2007, the guiding principle was to make as few changes as possible to make sure that comparisons could be made, but at the same time to adjust questions which had not been working well and also to add questions or alternatives to make the questionnaire up to date with the development in the sector.

1.2 Purpose

The purpose of this paper is to describe the development of the use of IT in the construction and facility management sector during a nine-year period, by presenting the most significant results from the Swedish IT-Barometer 2007 survey, with comparisons with the situation in 1998 and 2000.

The results describe some common areas in respect of access to computers and equipment as well as strategies and plans for investments in IT. The results also focus on three particular areas, which are stated as necessary in the use of IT to increase productivity and efficiency in the sector.

2. MEASURING THE USE OF IT

To be able to measure the use of IT in a reliable way and, especially to make comparisons between measuring occasions and different surveys, the method has to be well described. Differences in methods regarding population, register for selection, selection method and weighting of answers must be clear, and therefore the comparisons are made on the same basis.

2.1 Method

The main method for the IT-Barometer was developed in 1997 (Samuelson, 1998b) and includes definition of target population and strata, selection of register for the population, principles for selection and weighting of answers to represent the right part of the industry. This method has been the same on all three occasions, apart from a slightly more ambitious approach in 1998 where the purpose was to make statements of the combination of company category and size instead, which resulted in a bigger selection. In the two later surveys, 2000 and 2007, statements were made for strata divided into categories *or* sizes. Nevertheless, the selection was made in the same way.

The method is well described in (Samuelson, 2002) and this is a short summary. The target population is the construction and facility management sector, which has been defined on the basis of the register from Statistics Sweden and includes all workplaces in the five categories: Architects, technical consultants, contractors, property owners and the materials industry. A workplace is defined as each address where a company carries out activities. This approach makes the answers more balanced, since bigger companies with different activities may have difficulties in giving answers for the whole company. The workplaces are also divided into four groups of sizes with respect to number of employees: 1-9, 10-49, 50-199 and 200-. The selection was made as a stratified free random selection, where stratified stands for the division into the categories and sizes above. A free random selection was then made for each stratum.

Since the IT-Barometer is supposed to describe the situation in this industry as a whole, it is important to consider the size of the companies. The answers have been weighted with respect to number of employees in each workplace, to make sure that every answer represents its part of the industry. This method has been used each time and is well described in (Samuelson, 2002).

The total population in the register was 62,488 workplaces in November 2006. The selection was made at a confidence interval of 95 % with a margin of error of ± 5 %. This resulted in a selection of 1,385 workplaces.

2.2 Collecting data

For the first time, the IT-Barometer 2007 was set up as a web questionnaire. On the two earlier occasions, this method was rejected for obvious reasons. Questions about access to computers and the Internet are meaningless

if the basic condition to answer is that there is access. In the late 1990's there were still a lot of companies, at least smaller ones, which did not use computers and their answers were as important as those which did.

However, there are advantages with web questionnaires; they are easy to use for the respondents and it is an efficient way of collecting and analysing data. The probability that a company in Sweden in this sector in 2007 should not have access to the Internet was this time estimated as small. The invitation to participate in the study was sent to all respondents in a letter by post, in which the study was described. Each respondent was given a unique web address for his/her answers and there was also the possibility of sending an SMS answer by mobile phone, if access to computers or the Internet was missing. There were therefore two reasons for sending the invitation by post instead of by e-mail. Firstly, the register only includes physical addresses and no personal e-mail addresses. Secondly, the postal letter made it possible to get some answers from those who, contrary to expectation, lacked access to the Internet.

The letter was followed up by a reminder two weeks later, and finally there were telephone calls to approximately 20 workplaces, chosen from the biggest workplaces that had not answered. This resulted in 180 answers, which corresponds to a response rate of 13 %. This is the lowest response rate of the three surveys, see table 1. The reason for this can be discussed. It has always been difficult to get people to answer surveys, but the feeling is now that it is getting harder and harder, since the number of surveys is constantly increasing. The access to the Internet and survey tools for the web has made it easy for many companies to create surveys and marketing investigations. IT managers especially are being burdened with all kinds of studies, and they probably do not have the time to even read the letter. The best response rate was in the 2000 survey. A reason for this could be that Statistics Sweden was involved in the whole process, which gave the study credibility and a serious impression which made the respondents more willing to answer.

The response rate makes it impossible to interpret the results as statistical truths, but the answers still cover a big part of the industry and contribute to giving a picture of the status today and the development during the last nine years.

TABLE 1: Response rate for the Swedish surveys.

	2007	**2000**	**1998**
Selection size	1385	1316	2723*
Number of answers	180	641	636
Response rate	**13 %**	**49 %**	**23 %**

* A bigger selection was made to get results for combinations of strata

2.3 Comparability between surveys

As mentioned above, the questionnaire has been slightly modified each time it has been used. Some questions have been removed and others have been added with the purpose of making it up to date. Also small changes have been made in formulations and alternative answers, which did not appear to work well. For some questions, the differences have made it hard to make direct comparisons in figures. Still, it has been possible to estimate whether the measured property has increased, decreased or is more or less unchanged.

3. DEVELOPMENT OF THE USE OF IT

The results from the survey are presented below in text and figures and start with common use and access to computers and equipment and then focus on the three areas: computer aided design, project webs and electronic trade. At the end results from questions about strategies and future plans for the companies are presented.

3.1 Access to computers and communication tools

The two earlier studies stated that approximately 90 % of all employees in the sector worked at workplaces that had computers. Those who did not came from small companies, mainly contractors and property managers. In this study, the workplace computerisation is 100 %. It must be emphasised that this study was made as a web survey, which assumes access to a computer and to the Internet. However, there was also the possibility of answering by means of SMS if this access was lacking at the workplace. There were a few such answers, which

indicate that this method worked. The computerisation is still 99.99 % and the figure has been rounded up to 100 % for access to a computer and to the Internet at the workplaces.

The employees' access to different equipment has been studied in slightly different ways on all three occasions. The result from 2007 is presented in Fig. 1. In 2000, 54 % of the employees in this sector had access to their own computer. This figure includes office as well as site workers. About 90 % of the office workers had access to their own computer. The question in 1998 was not asked in the same way, but the answers indicated approximately the same level as in 2000. In total, access to computers has increased noticeably, especially among site workers. One conclusion is that computerisation among office workers was fully integrated already in the late 1990s and that it has been spread among site workers also in the last few years.

It can also be seen in Fig. 1 that access to computers corresponds with access to e-mail addresses; persons with their own computer also have an e-mail address of their own. This was the case also in 2000, but the level was lower. Regarding access to mobile phones there has been an increase from 50 % to almost 80 % in the sector as a whole. There is no difference at all between categories of occupation, and the mobile phone has been a natural tool for all employees.

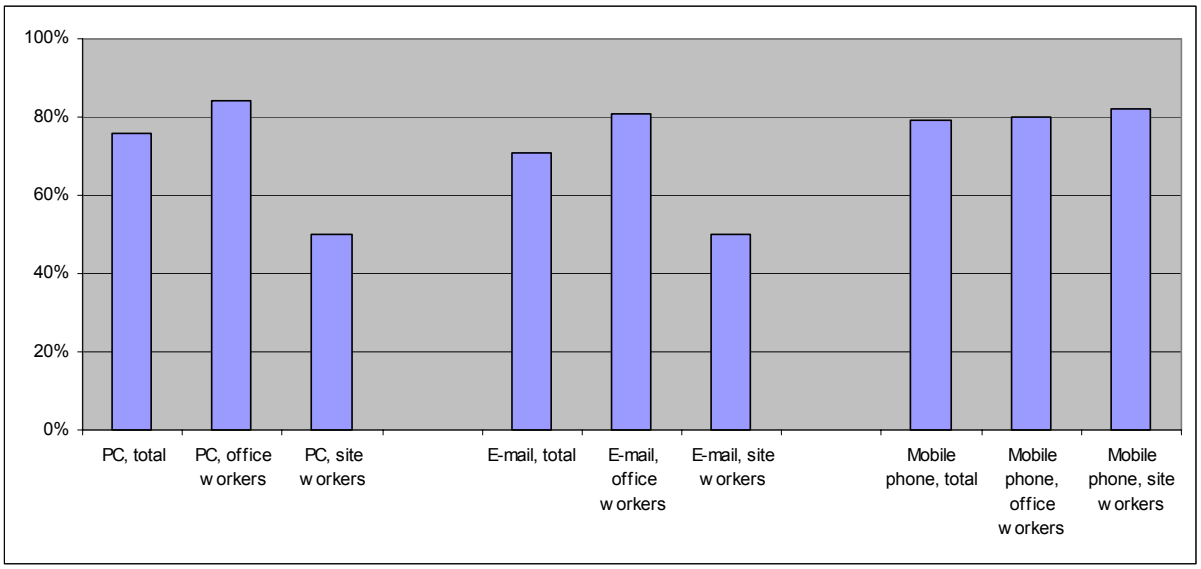


FIG. 1: Proportion of employees at workplaces with access to own computer, e-mail, and mobile phone, 2007.

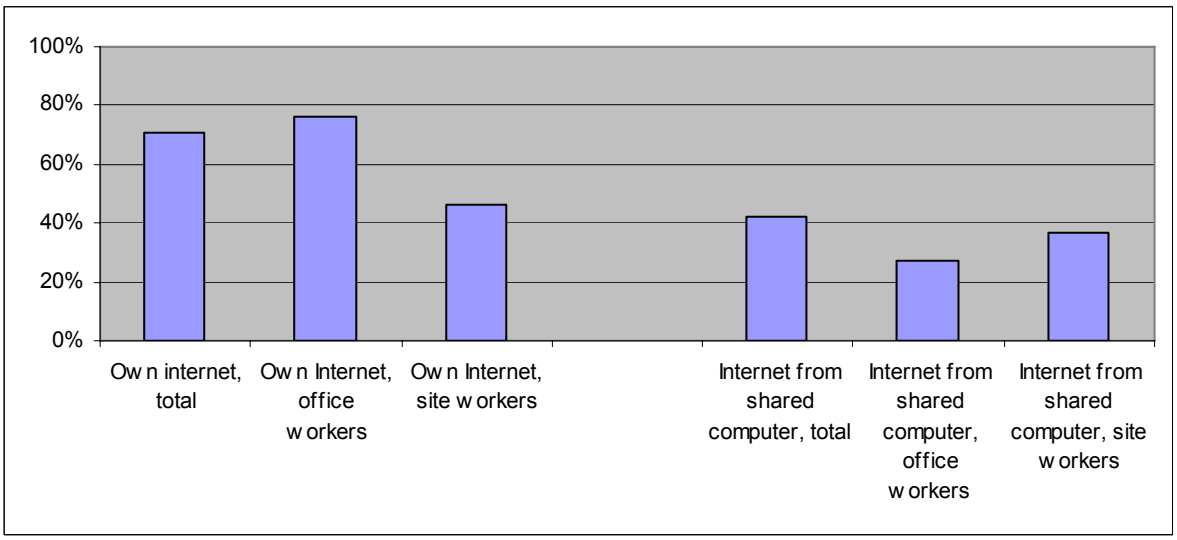


FIG. 2: Proportion of employees at workplaces with access to the Internet, 2007.

Also access to the Internet corresponds with access to computers. Within the margin of error, the figures in Fig. 1 are practically the same as in Fig. 2, apart from office workers. Some of them have their own computer but no access to the Internet. The development during the last decade is shown in Fig. 3. There has been a continuous growth in access to the Internet from own computers as well as from jointly shared computers.

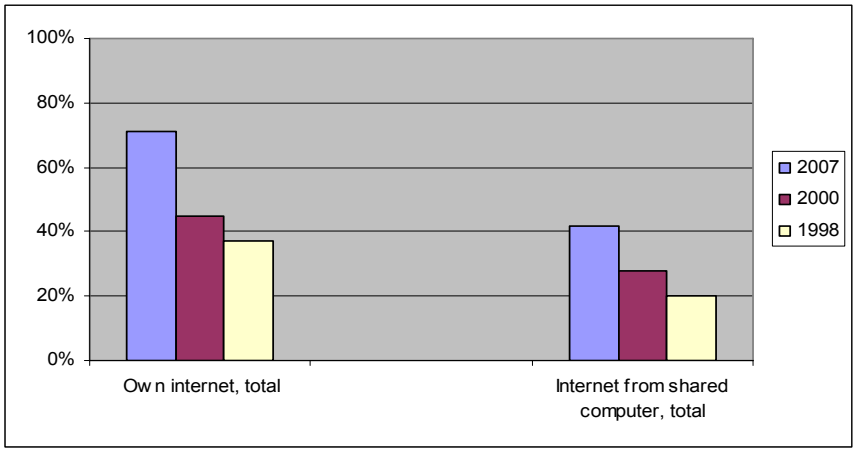


FIG. 3: Proportion of employees at workplaces with access to the Internet, 1998 – 2007.

The speeds of connection to the Internet in 2007 are shown in Fig. 4. The most common level is between 2 and 8 Mb per second, which probably has to do with limitations in technology. At the moment, the highest speed that can be delivered from a traditional copper cable is 8 Mb. To get a higher capacity, connection by fibre optics is required.

Figs. 1-4 show that the infrastructure in the industry is well developed. There are lots of computers at the individual level and they are connected with each other with acceptable speed. This creates necessary basic conditions to be able to work together in new and more efficient ways.

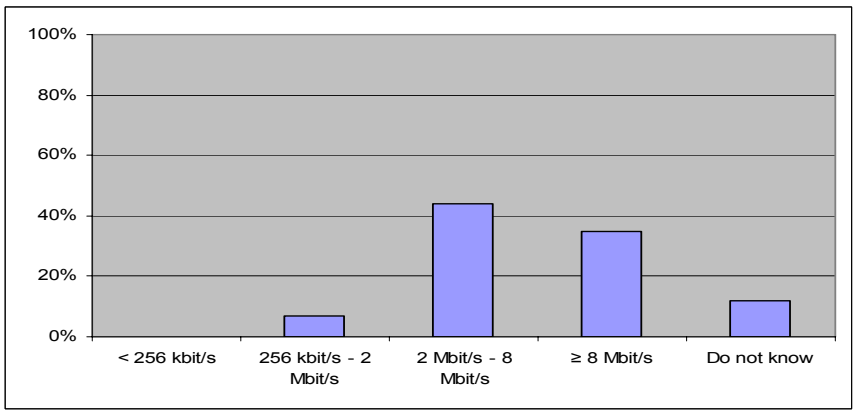


FIG. 4: Proportion of employees at workplaces with different speeds of connection to the Internet, 2007.

3.2 Use of computers for some work operations

In the two last surveys, the same questions have been asked about some common work operations that are done with computers. The result of some of these operations is shown in Figs. 5-7. The black colour in the bars represents those who use computers for 100 % of the operation. The lighter colours represent lower and lower use. To make comparisons with the 2000 survey easier, the 60 % level is marked with a red line for 2007 and a red dotted line for 2000. In some cases, the level for 2000 is a bit higher, but the differences are small and lie within the margin of error.

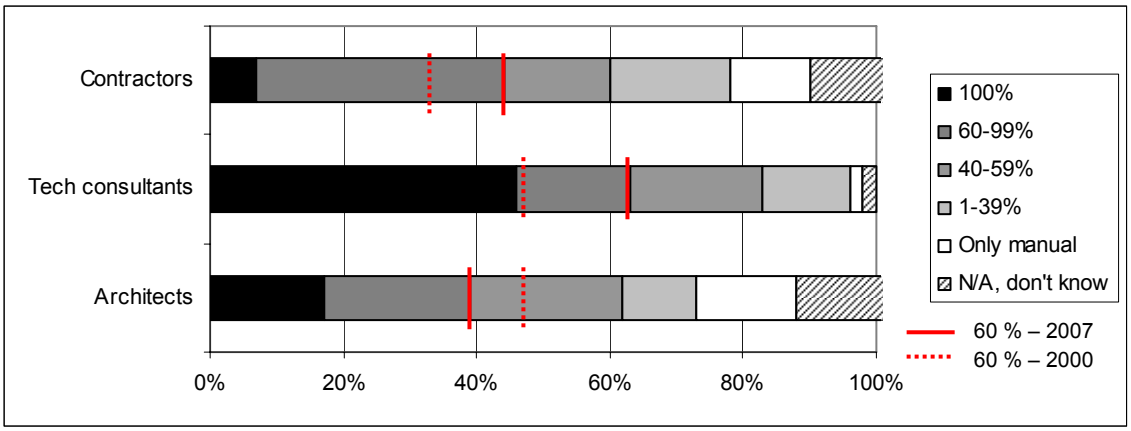


FIG. 5: Proportion of scheduling and resource planning works performed by computer.

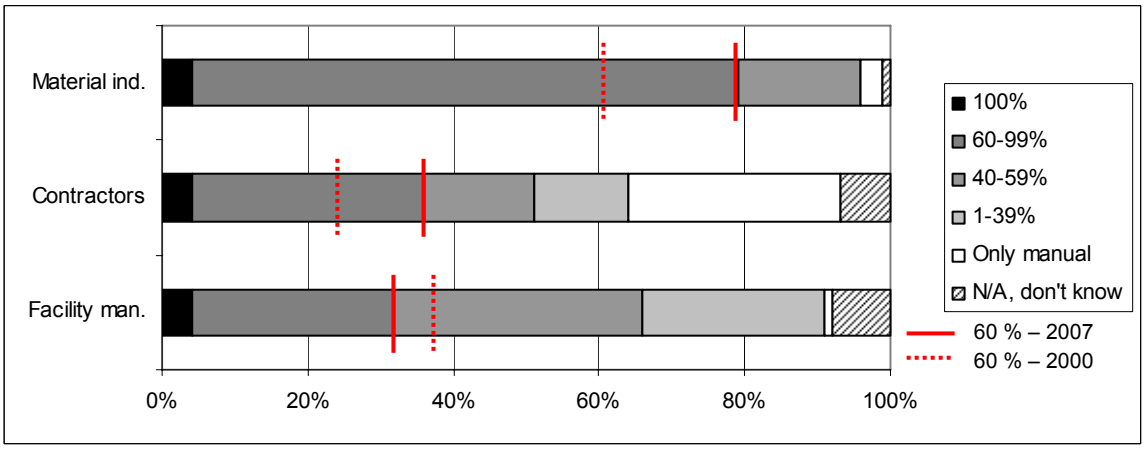


FIG. 6: Proportion of materials control and purchase work performed by computer.

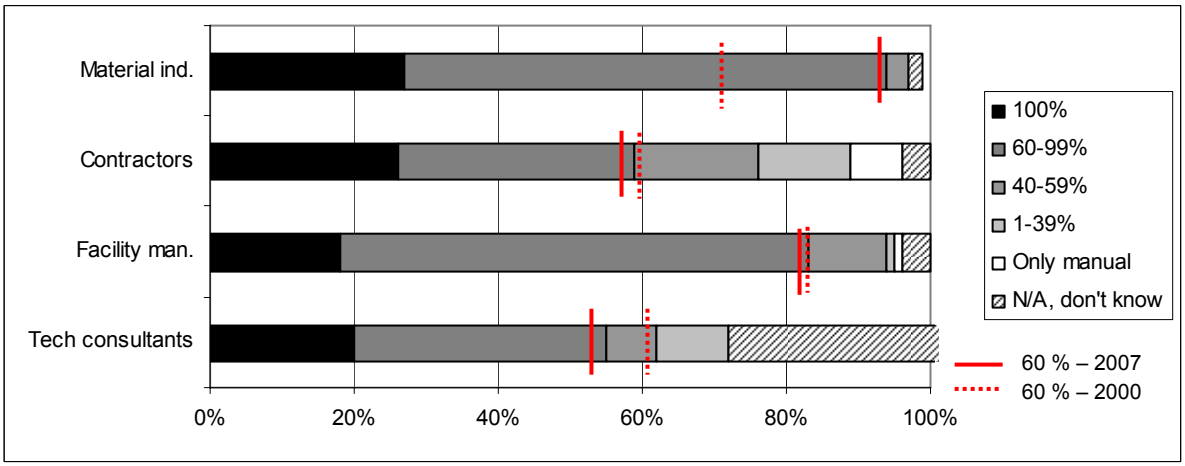


FIG. 7: Proportion of costing and budgeting work performed by computer.

For scheduling and resource planning, which is shown in Fig. 5, there is a clear increase as regards the consultants. Also the contractors seem to have increased their use, but the change is not as clear and the use is still at a surprisingly low level, when looking for example at the 100 % -level. Scheduling and resource planning is an important work operation for the contractors' business; yet they are still not using the tools available to make it more efficient.

The same tendency can be seen in Fig. 6 about materials control and purchase. The contractors seem to have increased their use, but not very much, and the level is still low. The materials industry, on the other hand, has increased its use more and it is also at a much higher level. The stated work operations are admittedly close to their core business, but that should be the case also with the contractors. There is a common low 100 %-level for these operations, which might indicate that the operations are complex and that there are few existing tools that manage the whole of the operations.

For costing and budgeting, Fig. 7, the only measurable change is with the materials industry, where the 60 %-level seems to cover almost all companies. For the other categories, there have been no changes, but the level is constantly higher than that for the other work operations.

The ways of sending and exchanging documents have been measured in the same way and the results for graphical documents and some common documents are shown in Figs. 8 and 9, respectively. In this area the change is clear. The increase is more than 30 percentage points for almost each category. The only exception is again the contractors, who do not have the same level or increase as the others regarding graphical documents. One explanation is that they still need their paper copies at the site. It is also worth noting that their change is from a very low level, and that their 60 %-level has risen almost three times. The change in exchanging documents is not surprising, and is probably a result of access to the Internet and e-mail.

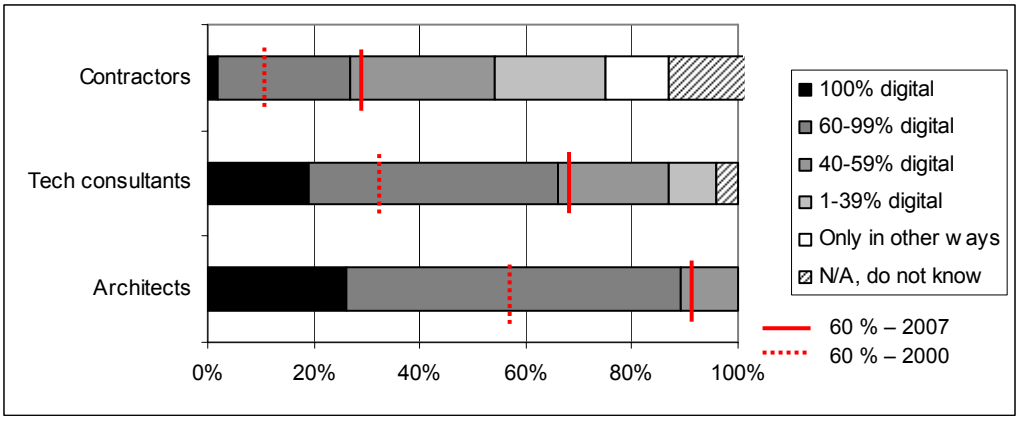


FIG. 8: Proportion of graphical documents sent digitally.

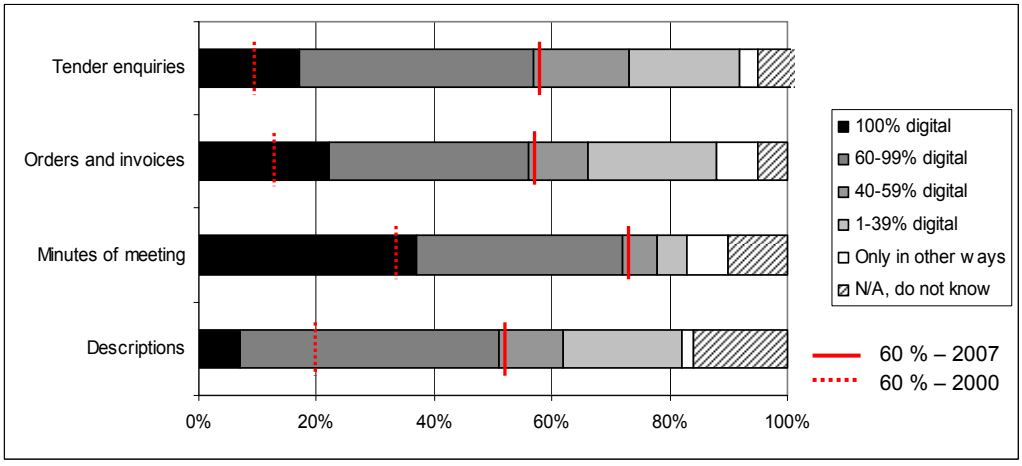


FIG. 9: Proportion of common documents sent digitally.

3.3 CAD and Building Information Models (BIM)

Computer Aided Design, CAD, has been the main tool for design work since the middle of the 1990's. Workplaces with access to CAD are shown in Fig. 10. The figures are almost the same as in the two earlier surveys.

This indicates that CAD as a design tool was fully integrated by designers already in 1998. It should be noticed that not all the technical consultants are designers, and therefore they do not use CAD.

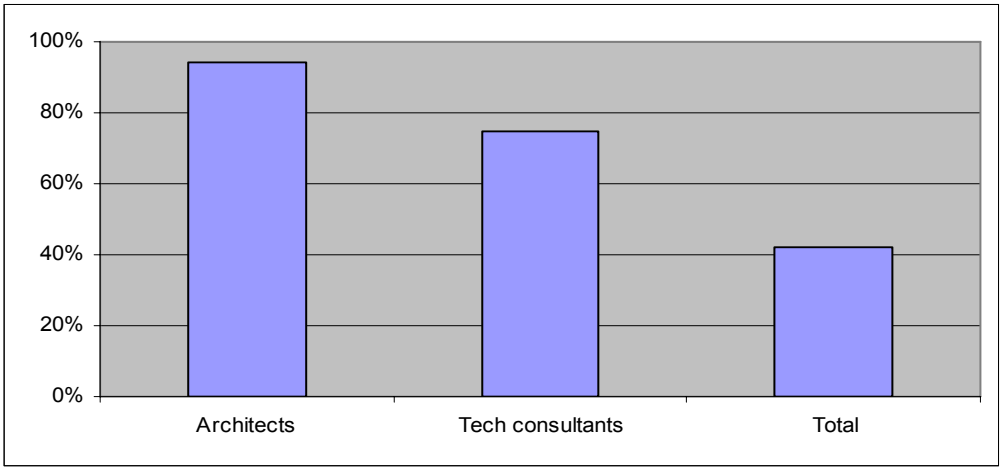
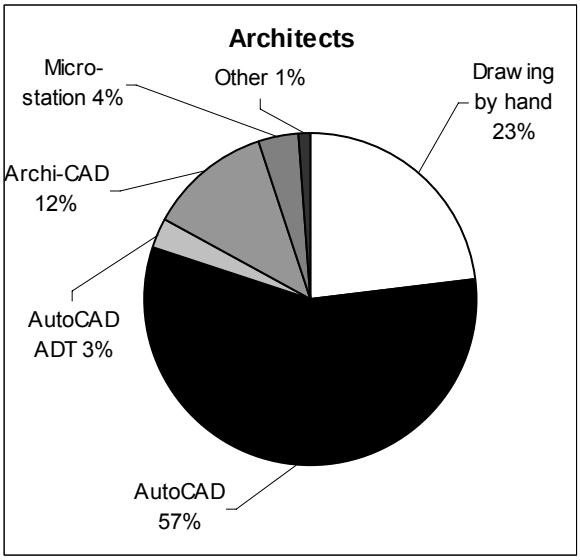


FIG. 10: Proportion of employees at workplaces with access to CAD, 2007.

The way of using CAD in design work has been discussed since the beginning of CAD. Visions of using computer models in some way with more information than just geometrical started to occur in the 1980s. One way of measuring this development is to ask which types of programs and tools designers are using. This was done in the same way in 2000 and 2007, and the result is shown in Figs. 11 and 12. An overall change that can be noticed is that use of plain AutoCAD has moved to use of AutoCAD ADT to a greater extent. This could be the result of the suppliers' way of licensing the product. However, the question was in fact *the use* of different tools, and figures show that the use of tools that can handle 3D and objects has doubled by architects and increased from 0 % to over 30 % by technical consultants.

Another change that can be measured is that drawing by hand has decreased by architects to approximately the same level as by technical consultants. In the latter, drawing by hand seems to have increased. However, this is probably not the case; the difference is more likely within the margin of error. In the earlier studies, the difference between architects and technical consultants was explained by the fact that architects were still making sketches and early drawings by hand. This seems therefore to have changed and architects too are now using CAD early in the process. The level of hand drawing seems to have stabilised around 10 % and this figure probably relates to sketches and "thinking with the pen" that is unlikely to be replaced by computers for a long time.



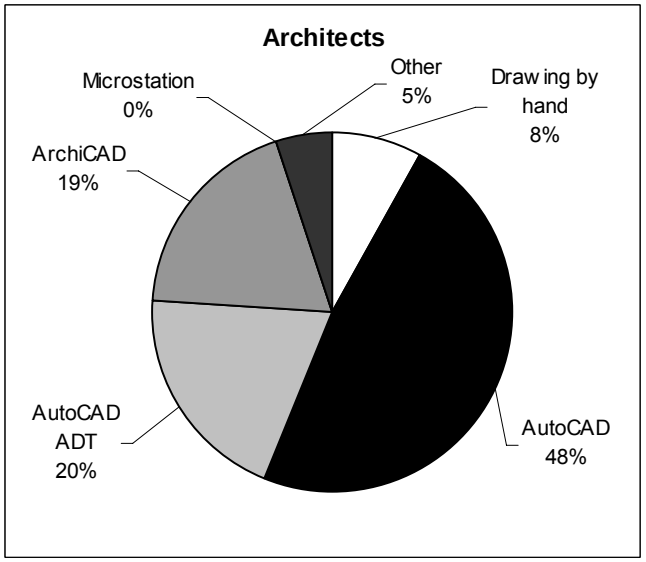


FIG. 11: Proportion of techniques of the total design time in 2000 (left) and 2007 (right).

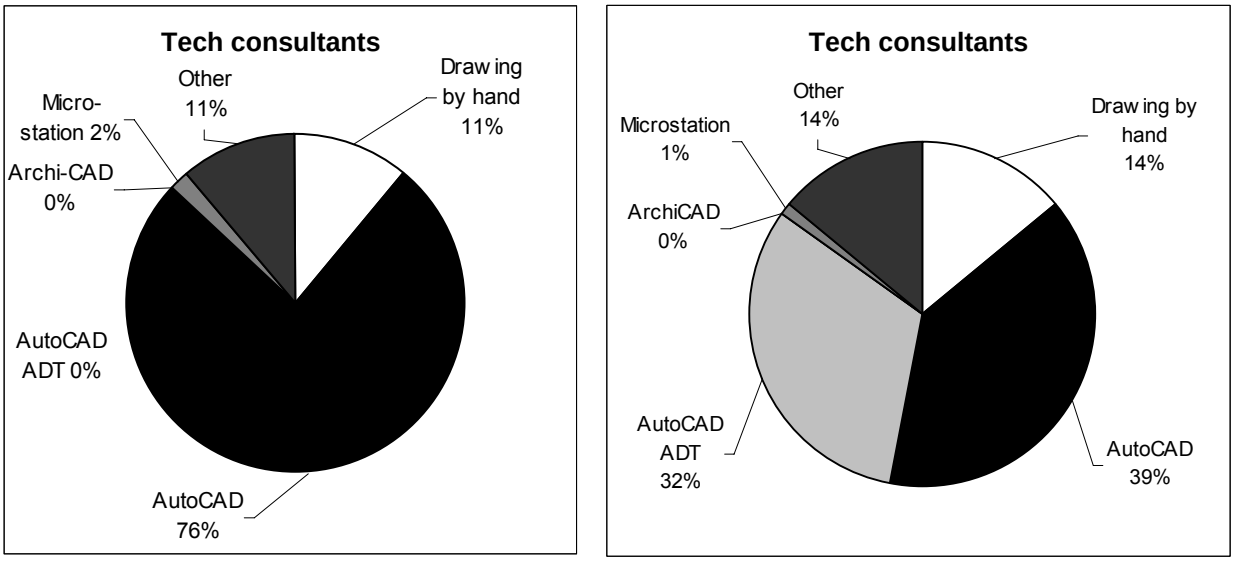


FIG. 12: Proportion of techniques of the total design time in 2000 (left) and 2007 (right).

As shown in Figs. 11 and 12, the use of tools which handle 3D and objects has increased, which indicates that CAD is being used in new ways. To find out to what extent this is done, the respondents were asked to state in which of four different levels they use CAD, see Fig. 13. Every level includes also the levels before, so the alternative "also object-based in databases etc." states that some use at this level occurs, but also at lower levels. Fig. 13 shows that few designers use CAD only for 2D drawings and that 60 % of the architects and 70 % of the technical consultants use CAD for geometrical data in two and three dimensions. The highest level, "also object-based in databases where several parties in the project have the right to retrieve and supply data", is used by over 15 % of the designers, both architects and technical consultants. This is verified by the fact that contractors and facility managers also use this level to almost the same extent, see Fig. 14.

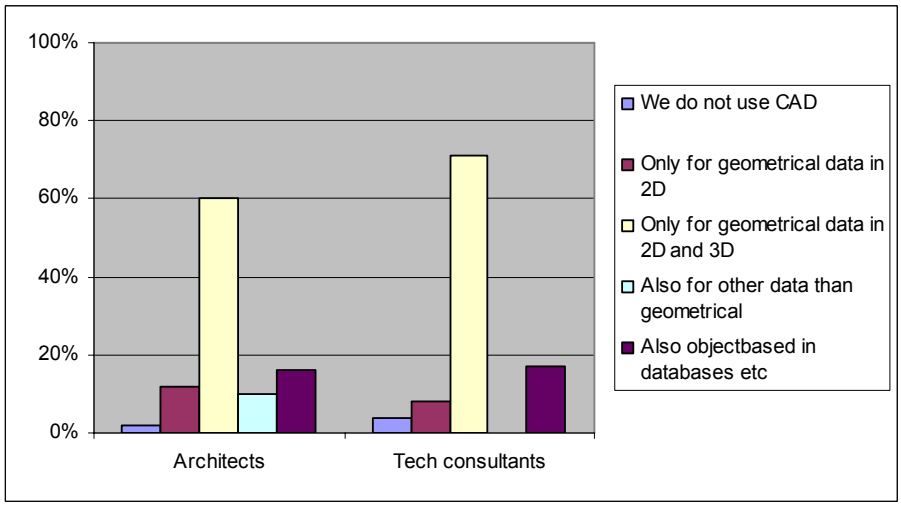


FIG. 13: Proportion of use of CAD for different types of data, designers.

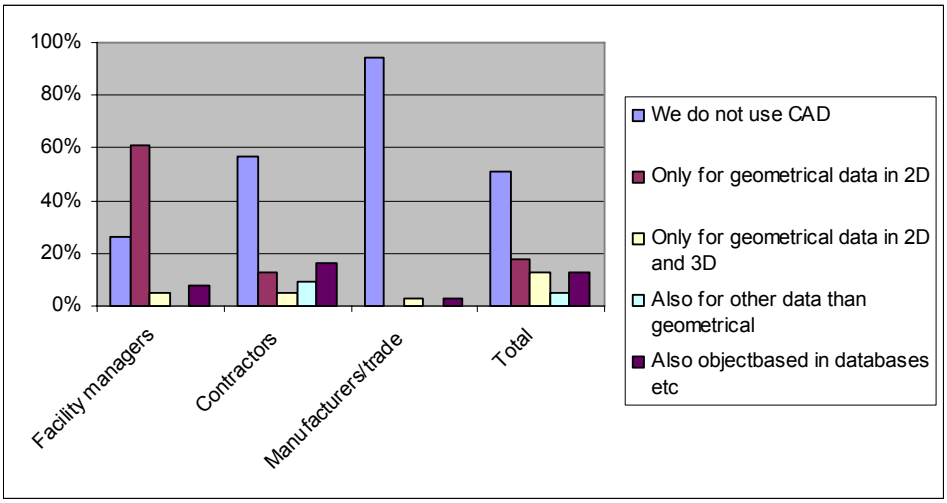


FIG. 14: Proportion of use of CAD for different types of data, other categories.

Those who answered one of the two highest levels were also asked to state which types of data, except geometrical, they use in their CAD databases. Surprisingly, it is not data relating to "time" or "economy", which has often been used as an example of the benefits of using models. Instead, "product properties" are the most common data for architects and "other" for technical consultants, see Fig. 15. The survey gives no answer to what is included in "other". This has to be investigated further. Questions about types of data in CAD were not asked in 2000, because the level of use was so low. Therefore, no comparisons can be made.

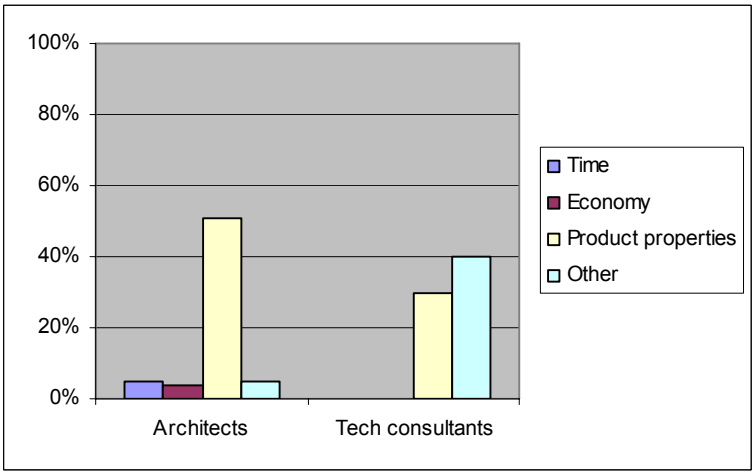


FIG. 15: Proportion of non-geometrical types of data that is used in CAD, among those who use it.

The use of CAD for other purposes than geometrical is more common among architects than among technical consultants. 40 % of the architects, *of those who use CAD for purposes other than geometrical*, state that they use it in almost all projects. Since the base of respondents for this question is small, the figures in Fig. 16 should be considered with care.

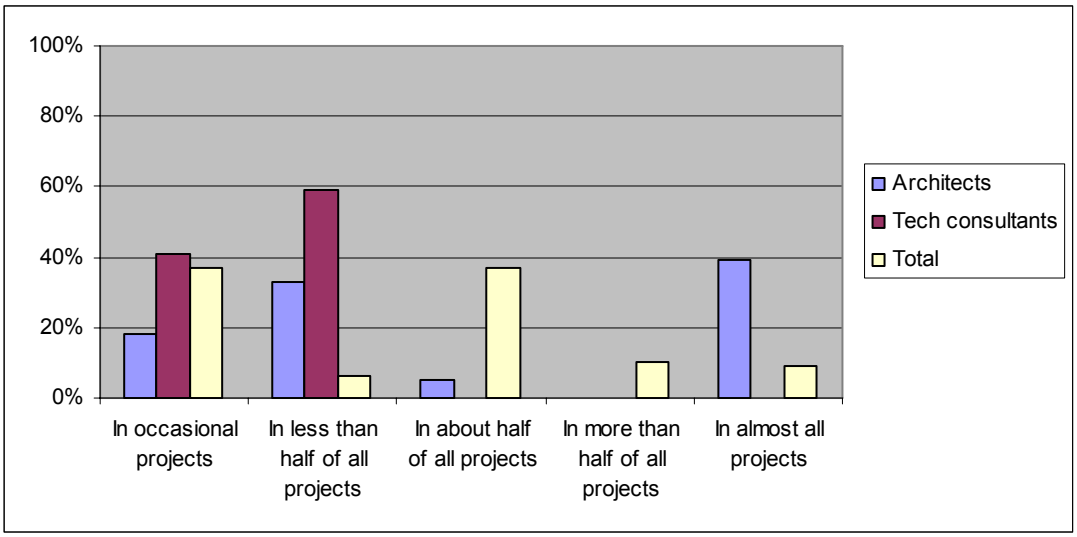


FIG. 16 Proportion of how often CAD is used for other purposes than geometrical data, among those who use it.

To investigate how well-spread knowledge of model based design is in the construction industry, the survey had a question about some concepts in this area, see fig. 17. For the industry as a whole, no concept is particularly well-known, but the concept of product models gets the highest figure. Among designers on the other hand, all concepts seem to be quite well-known and product models also get the highest figure. The concept of BIM (Building Information Models), which was introduced by Microsoft a couple of years ago, has also become relatively well-known and has over 60 % in the diagram. Surprisingly, the standard format IFC is also at the same level. The discussions in the industry over the last decade about model based design, product models and standards have obviously given results, at least in knowledge of the concepts.

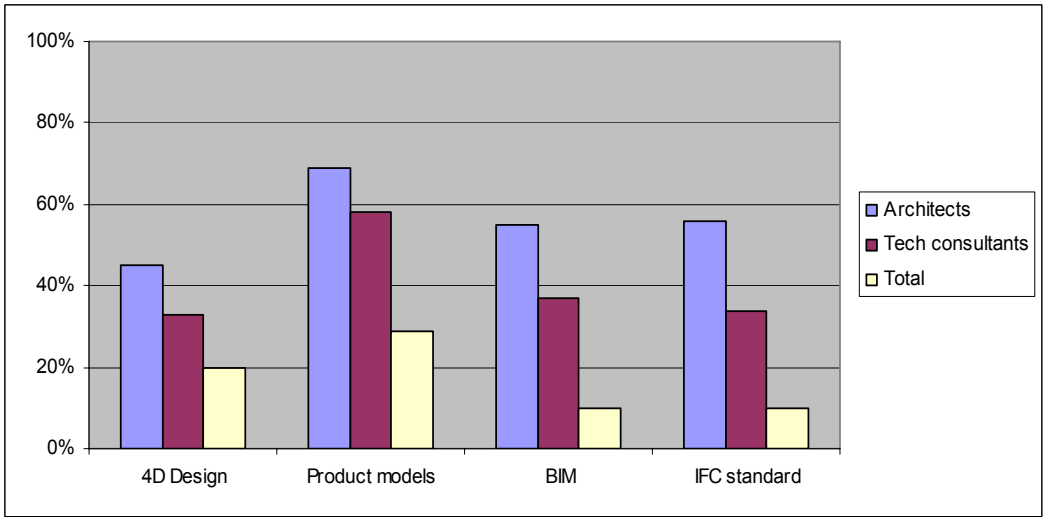


FIG. 17 Proportion of respondents who are familiar with different concepts.

3.4 Project webs

The use of the Internet as a communication tool and storage of common project data in a structured way on a web site was not measured in 1998. The technique existed but was not widespread in the construction industry. Already in 2000, the use of project webs had become more common and about 40 % of the consultants, (architects and technical consultants) had used them in some projects, see fig. 18. Still, they only used them in few projects, Fig. 19. In 2007, the use has increased considerably in the sector. 70 % of the consultants and almost 50

% of the contractors have been using project webs. The difference in use frequency is not as clear, and half of those who use them, only do so occasionally.

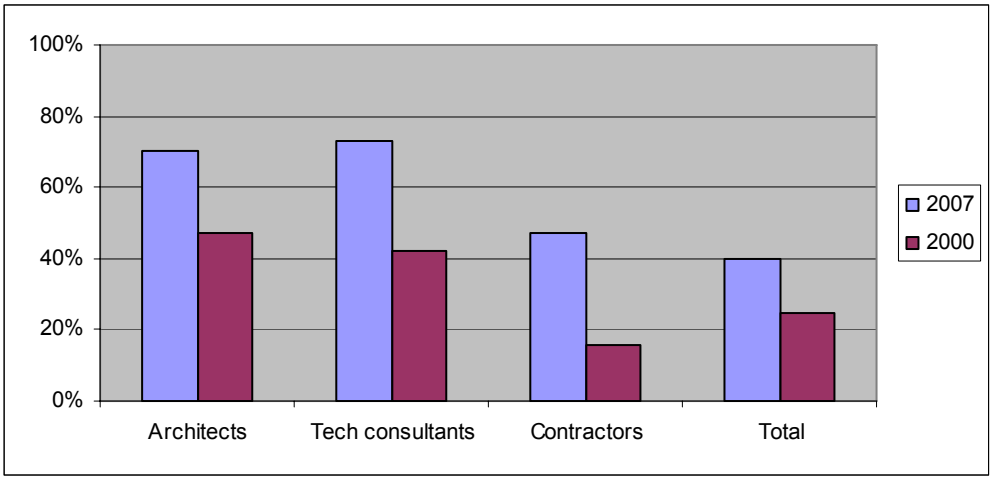


FIG. 18: Proportion of employees at workplaces where project webs have been used in some projects.

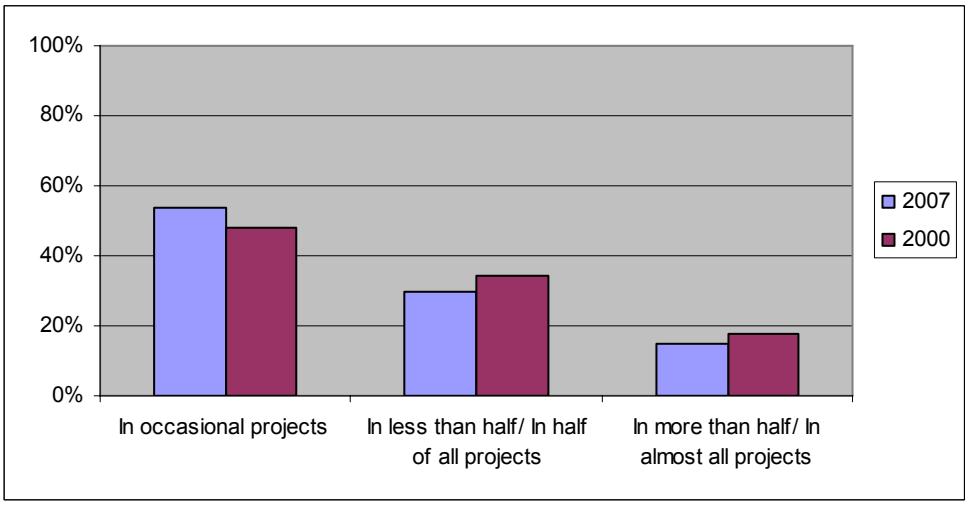


FIG. 19: Proportion of how often project webs have been used, among those who use it.

3.5 Electronic trade

Electronic trade is an area where a lot of standardisation work has been done during the last decades. The use has still not been widespread, but is increasing. Electronic trade is a wide concept, but the vision has been to create an unbroken link from information about the product via order and order confirmation to delivery information, invoicing and finally payment. This should be done in an electronic format where computer systems at the buyer's and the seller's exchange information. This is often called "full EDI". This way of doing business requires investments in systems and also long-term agreements between the parties involved. Because of this, only some of the bigger companies have implemented this way of working. In the two later surveys, almost the same question about using electronic trade was asked and the result is shown in fig. 20. In 2000, the question regarded annual turnover and in 2007 annual purchase. There is a big difference in use, and the difference is most clear regarding the fact that almost everybody uses electronic trade in some way or other in 2007. Only 5 % of the respondents state that they do not use it at all, compared to 64 % in 2000. There has also been a significant increase, from 3 % to 32 %, in the number of respondents who use it for 25 % or more. There are probably several explanations. Firstly, technical development of the web has enabled several safe solutions for web shops, market places and different types of web EDI, where the seller receives all information into their business systems,

whereas the buyer has to fill in forms on the web site. Secondly, the use of full EDI between contractors and materials suppliers has increased as a result of technical development, standardisation work, and probably a maturity among the companies in the sector as well as in society as a whole. The use of electronic trade divided into four levels is shown in fig. 21. The use of company web shops is the most common level for electronic trade by all categories of companies. But the use of full EDI is also at a relatively high level; 30 % of the contractors and 20 % of the materials suppliers are using it.

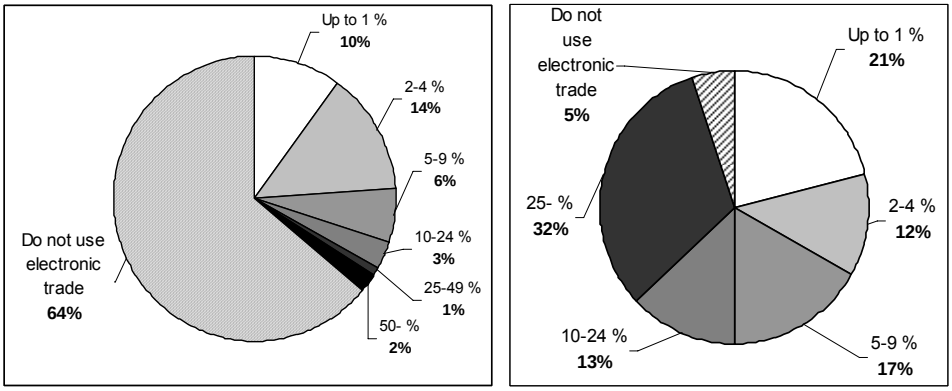


FIG. 20: Proportion of value of annual turnover in 2000 (left) and annual purchase in 2007 (right) coming from electronic trade.

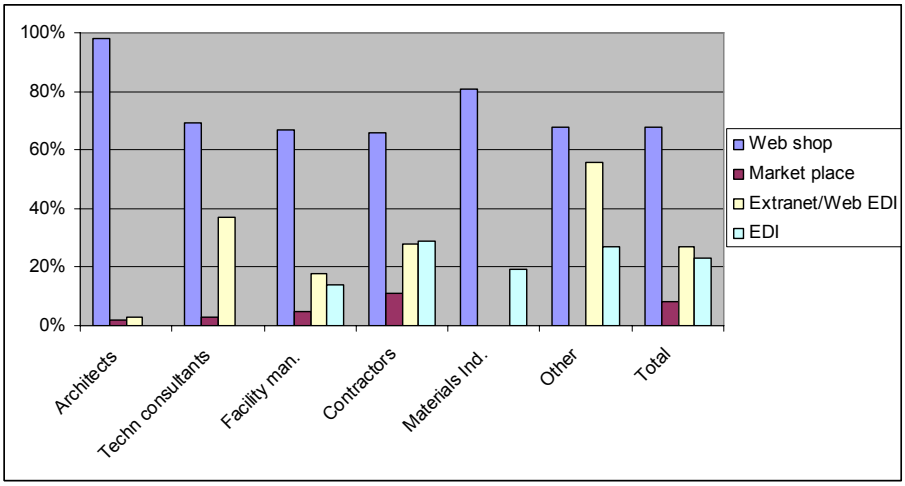


FIG. 21: Proportion of employees at workplaces where different types of electronic trade are being used (2007).

The most common types of products purchased by electronic trade are production material for the industry and IT equipment, fig. 22. When dividing this question into company categories, it can be seen that the first one is predominant among the contractors and the materials industry, while the latter is predominant among the consultants. For the contractors and the materials industry this is part of their core business, and there are lots of benefits to make in the purchase process. This is also the reason for the relatively high level on full EDI (fig. 21) for these categories, which is based on long term agreements between the parties and demands quite large investments to get started. The consultants have no part in the material process, but they can make benefits by using companies' web shops for support products such as IT equipment.

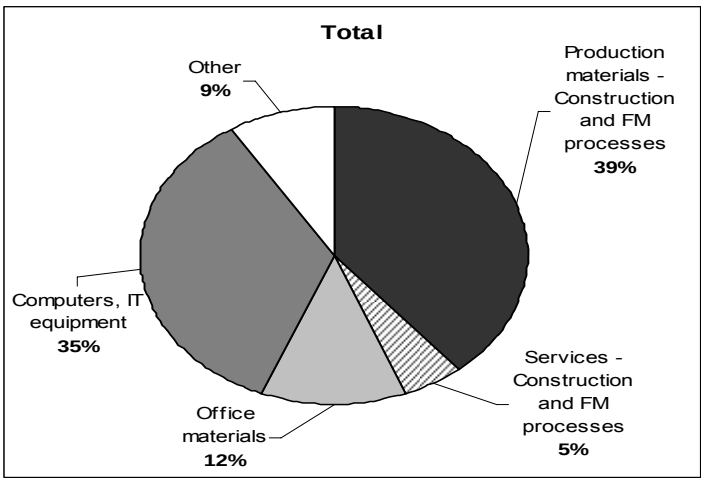


FIG. 22: Proportion of categories of products purchased by electronic trade (2007).

3.6 Effects, strategies and plans

The respondents were asked how important different motives for decisions about new IT investments are. The result is shown in fig. 23. In this type of question the bars in the graphs should be read relatively to each other, instead of in absolute figures, since it is easy to think that everything is important. This is also shown by the fact that the level for 2007 is consequently higher, which does not automatically mean that these items are more important now than in 2000. However, the relation between the motives is almost the same as in 2000 and the first two, administrative and technical work, were also the most important in 1998, but in reverse order. In all three surveys, "wish to develop new products/new business models" is found at the bottom, while efficiency of traditional work methods is most important.

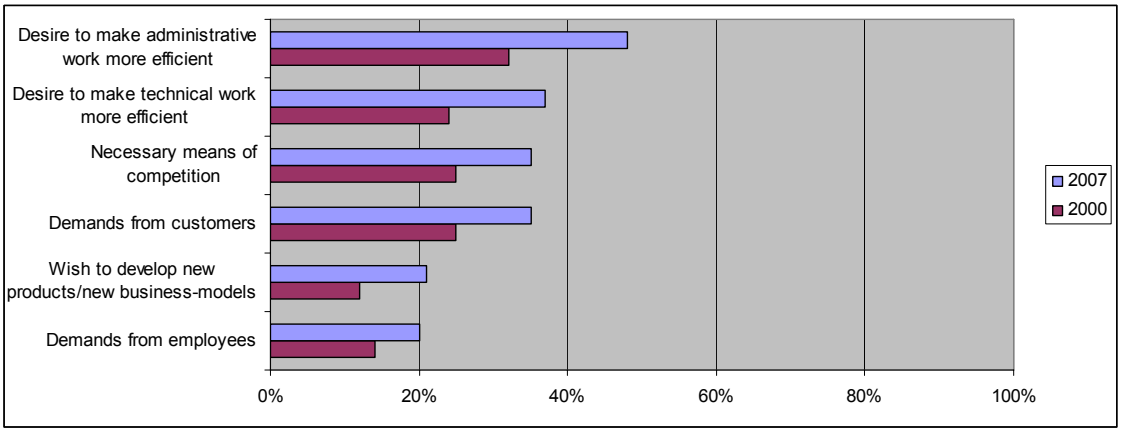


FIG. 23: The importance of different motives for decisions about new IT investments.

The survey shows that IT still has the greatest effect on productivity in general administration. This is shown in fig. 24. One change since 2000 is a clear increase in productivity in purchasing/selling, which is also in line with the result for electronic trade as shown in fig. 20 for example. The other bars show no measurable change and can be regarded as equal. In fact, the question was about change in productivity over the *last two years*, which would indicate that productivity has continued to increase. However, there is a risk that the respondents have answered the question as productivity change caused by IT since the start of using IT. A continuous increase by 15 % or more seems unrealistic.

Fig. 24 shows the result for the whole industry. However, the different categories of the companies often experience a larger productivity increase in their particular business. For example, 50 % of architects state that design has increased productivity by more than 15 %, and 21 % of the contractors state the same for site management.

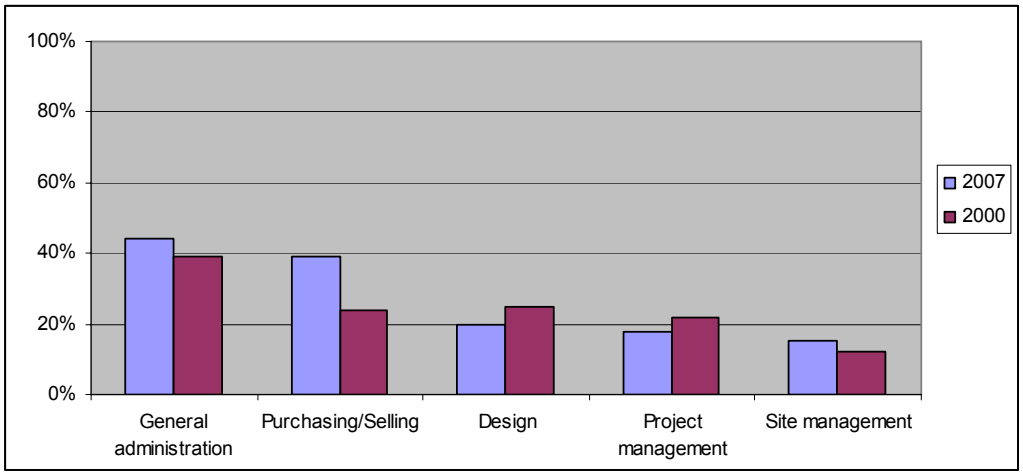


FIG. 24: Proportion of estimated productivity changes by more than 15 % caused by IT in different areas in the past two years.

The respondents were asked to state which advantages and disadvantages/obstacles they have experienced with increased use of IT. At most, three alternatives in each area had to be chosen. Table 2 shows in which order the advantages were prioritised in 2007, 2000 and 1998, respectively, and table 3 the obstacles/disadvantages. The largest changes in the same direction during the years have been marked with arrows.

The largest advantages of increased use of IT are stated to be "simpler/faster access to common information" and "better financial control" at top position, followed by "possibility of sharing information". The first two are the same as in 2000, while the third one has slowly climbed in order of priority. Access to, and sharing information is important, which in fact speaks for the use of both BIM and project webs. In shared fourth place we find "possibility of teleworking/telecommuting", which had priority nine in the earlier two surveys. The importance of communicating and having access to information anytime and anywhere is obvious. Wireless LAN, broadband at home and mobile phones with e-mail connections have made this possible. In contradiction better communication seems to have fallen, and looking at table 3, "overabundance of information" is one of the two largest disadvantages. At the same time, there are demands for being able to work and communicate everywhere, and the flow of information is a big problem. The advantage "possibility of developing new products/new business models" is still at the end of the list, which emphasises how difficult these changes are.

The two largest obstacles/disadvantages of increasing the use of IT are stated to be "continuous demand for upgrading hardware and software", and "overabundance of information". Upgrading costs have always been at the top. A big change is that investments in IT-solutions no longer are among the two most important obstacles but seem to have gained more acceptance. However, the companies do not like the licensing procedure, which demands yearly costs for maintenance, upgrades and subscription agreements. "Overabundance of information" is mentioned above and is now becoming a real problem. It is difficult for individuals and companies to sort out and handle what is important in the huge flow of information.

A rather strange change is that a negative attitude to doing things in new ways has risen to third place. This kind of conservatism should not be increasing when technology becomes more mature and spread. There is perhaps a connection with "risk that IT leads to inefficiency", which also has risen slowly during the years. Development in this technology is moving fast and people in the organisations may have difficulties in keeping up with the changes.

Table 2: Experienced advantages of increased use of IT, in order of priority.

	2007	**2000**	**1998**	**Trend**
Simpler/faster access to common information	1	2	1	
Better financial control	2	1	5	
Possibility of sharing information	3	4	6	↗

Work done more quickly	4	6	3	
Possibility of teleworking/telecommuting	4	9	9	↗
Better quality work	6	7	2	
Better communications	7	3	4	↘
Easier to handle large amounts of data	8	5	7	
Greater flexibility for satisfying customers	9	8	8	
Makes the company more attractive when recruiting staff	10	10	10	
Possibility of reducing staff	11	12	11	
Possibility of developing new products/new business models	12	11	N/A	

Table 3: Experienced obstacles/disadvantages of increased use of IT, in order of priority.

	2007	**2000**	**1998**	**Trend**
Continuous demand for upgrading hardware and software	1	1	2	
Overabundance of information	2	4	7	↗
General attitude that old ways of doing things have worked well throughout the years and changes are unnecessary	3	5	5	↗
Greater know-how required from staff	4	3	3	
Investment costs too high	5	2	1	↘
Risk that IT leads to inefficiency	6	9	12	↗
Non-compatible software	7	6	N/A	
Insufficient interest/commitment from the management	7	12	9	
Decision-makers have no time for IT efforts because of heavy workload	9	7	6	
Difficulty in measuring profit/assessing investments	10	10	4	↘
Preference for manual working because of lack of standards/coordination problems	11	11	8	
Reduced security	12	8	13	

The respondents were also asked to state in which areas they are planning to increase their use of IT in the next two years. Table 4 shows in which order the plans were prioritised. The result shows that ”document handling” and “accounting systems” still are among the top three as they have been each time. These are obviously areas that always are highly topical to the companies. A new area at the top is ”portable equipment/mobile systems”. This emphasises the discussion above about the importance of communicating and having access to information anytime and anywhere.

There is no such clear area that has fallen in priority during the years. Some areas in the middle of the list seem to go up and down at different times, also depending on the different categories of companies. To overview these differences, the result has been divided up into the categories in tables 5-8. In these diagrams, the percentage of answers for each item has been included. CAD is the most important item for the designers, while portable equipment/mobile systems are in focus for the contractors, and electronic trade is the most important item for the materials industry. In short, each category focuses on their core business and needs.

At the bottom of the list of plans in table 4, we find again “product models”, “virtual reality” and “new business models and activities”. As in the earlier surveys, this one shows that focus is on support systems and not on more advanced techniques that can change the business. It will probably always be like this when asking a lot of companies; only a few of them will take the lead and commit themselves to more complex techniques for the future.

Since this survey has been focusing on three particular areas, they have been marked with a light grey colour in tables 5-8. For the construction industry as a whole, only “electronic trade” is prioritised and has risen during the years. For the materials industry, “electronic trade” has been in first place since 2000 and 82 % of the respondents in this category indicate that this is one of the three most important areas. “Product models/BIM”, which obtained a low level of interest when looking at the industry as a whole, is now highly prioritised by architects;

almost 30 % of them consider it as one of the three most important areas. Technical consultants too prioritise "BIM" significantly higher than before, but not as much as architects. Project webs do not have such a clear direction of change, but are by nature of greatest interest to project participants, where again architects are those who are making most effort in this area. For technical consultants and contractors, project webs do not seem to get high priority for investments, even if they use them as we can see in fig. 18.

Table 4: Areas for planned IT investments, in order of priority.

Areas – Construction industry as a whole	2007	2000	1998	Trend
Portable equipment/mobile systems	1	4	8	
Document handling	2	1	1	
Accounting systems	3	3	3	
Electronic trade	4	6	7	↗
Systems for costing/cost control	5	2	5	
CAD	6	7	4	
Information search via the Internet	7	8	2	↘
Project management	8	5	6	
Project webs	9	10	N/A	
New business models and activities	10	13	N/A	
Systems for real estate information	11	12	N/A	
Systems for technical calculations	12	11	9	
Product models/BIM	13	14	11	
Virtual Reality	13	15	10	

Table 5: Areas for planned IT investments, in order of priority.

Architects	(%)	2007	2000
CAD	79	1	2
Document handling	42	2	6
Project webs	29	3	1
Product models/BIM	27	4	11
Information search via the Internet	21	5	5
Project management	20	6	8
Systems for costing/cost control	18	7	4
Portable/mobile systems	18	8	3
Accounting systems	9	9	10
Virtual Reality	8	10	7
New business and activities	3	11	14
Electronic trade	3	11	12
Systems for tech calculations	2	13	15
Systems for real estate info.	0	14	16

Table 6: Areas for planned IT investments, in order of priority.

Tech consultants	(%)	2007	2000
Document handling	62	1	1
CAD	54	2	1
Portable/mobile systems	38	3	3
Project management	29	4	4
Accounting systems	22	5	9
Systems for tech calculations	17	6	6
Product models/BIM	10	7	14
Electronic trade	6	8	11
Project webs	5	9	7
Information search via the Internet	5	9	5
Virtual Reality	5	9	15
Systems for real estate info.	4	12	16
Systems for costing/cost control	2	13	12
New business and activities	1	14	8

Table 7: Areas for planned IT investments, in order of priority.

Contractors	(%)	2007	2000
Portable/mobile systems	52	1	6
Accounting systems	43	2	3
Document handling	42	3	2
Systems for costing/cost control	37	4	1
Information search via the Internet	25	5	9

Table 8: Areas for planned IT investments, in order of priority.

Materials industry	(%)	2007	2000
Electronic trade	82	1	1
Portable/mobile systems	74	2	4
New business and activities	52	3	9
Accounting systems	32	4	3
Systems for tech calculations	23	5	12

Electronic trade	22	6	7
Project management	20	7	4
CAD	18	8	8
Project webs	15	9	11
Systems for real estate info.	2	10	13
Systems for tech calculations	1	11	10
Product models/BIM	0	11	12
New business and activities	0	11	14
Virtual Reality	0	11	15

Document handling	15	6	2
Information search via the Internet	3	7	7
CAD	1	8	6
Systems for costing/cost control	1	9	8
Product models/BIM	0	10	14
Systems for real estate info.	0	10	15
Project management	0	10	11
Project webs	0	10	10
Virtual Reality	0	10	16

4. DISCUSSION AND CONCLUSIONS

This third version of the IT-Barometer creates, together with the earlier surveys, a longitudinal study where tendencies and trends over time can be seen. The survey tool has shown to work well in measuring levels and changes in IT use. It has been possible to make adjustments in the questionnaire to adapt to the development, but at the same time retain the basic questions that make the survey comparable. To be able to continue with the concept IT barometer it is important to secure a high answering rate. This will be done by evaluating the three surveys and finding the key factors in the survey 2000, which gave that the best in answering rate. Since the concurrence in getting answers from respondents is increasing, much effort has to be put in to getting as many answers as possible.

There are clear trends of increase in access to computers, networks and other equipment. This is today easy to get and relatively cheap, as a result of the technical development in society as a whole. The use of sector specific applications is also increasing but not at all as clear, and there are differences between the company categories in the sector. The largest increase is in the way of communicating information, where the Internet has become the natural way of sharing information in different ways. But, again this is more a result of the common development than of innovation initiatives in the sector.

In the focus areas, there has been a clear increase in the use of IT in the last few years. More and more designers use 3D and objects to describe the product; in particular architects, who are leading the development at the moment. Also other parties than designers, such as building owners and contractors, are now beginning to use information created in CAD models. Project webs are a natural way of sharing information, even if they are not used in all projects. The use of electronic trade has increased up to a level where almost all companies use it in some way or other. Still, the use of web shops is the most common way of trading electronically. Contractors, however, are using “full” EDI to a considerable extent.

The focus areas have developed in different ways, and to different levels. The standardisation work in electronic trade, that has been going on for almost 20 years, has finally resulted in wide use in the industry. The standardisation of product models and BIM is much more complex, but the technology is now starting to get used, even if the standardisation work is far from finished. The result in the survey indicates that the users now are ready for this technique and that there soon will be a critical mass of users that will speed up the development even more. Regarding project webs, there is nothing that indicates that the use will increase dramatically. The IT infrastructure has been well development for many years, without any big differences in use. Project webs are used for bigger projects with several participants, where the need for good structures and routines in document handling is worth the effort of setting up and administrate the webs.

Through all three surveys, contractors have been those who use IT least of all. This is partly for natural reasons, since their core business is performed on construction sites, and applications that support actual work on site are hard to find. Nevertheless, in planning and follow-up of time, cost and materials supply, there is much to gain in using IT and they are still behind in these areas, apart from their use of EDI.

The possibility of making use of IT to support new ways of working and to make the process more efficient is increasing. The companies are nevertheless doing this in small steps, and in their future plans they still focus on common well-known techniques, such as mobile solutions and document handling, instead of product models, virtual reality and new ways of doing business.

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