Rob Howard

Use of Information Technology in Building

Proportion of staff with access to IT facilities

IT BAROMETER SURVEY 2001, DENMARK –   22 June 2001
THE USE OF INFORMATION TECHNOLOGY IN BUILDING

Rob Howard, professor of IT in building, ITbyg, BYG.DTU, Technical University of Denmark
Building 116, DTU, 2800 Lyngby, Denmark. Tel (45) 45 25 16 57 e-mail rh@byg.dtu.dk

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1. Dansk summering

Svarraten for IT-barometret for 2001 var højere end for 1998 og der var flere svar fra mindre ingeniørfirmaer. Store firmaer finder det nu sværere at indsamle data om IT. (4)

Udgifterne til IT er øget. Arkitekter bruger nu i gennemsnit 5% af omsætningen, tidligere 1-2%. Entrepernører bruger næsten 1% af deres noget større omsætning, en stigning fra 0 - 0,5% i 1998. (6)

Adgang til computere gælder for næsten alle ansatte med 98%, som har denne adgang. 92% af kontorpesonalet har deres egen personlige computer. 56% af dem, der arbejder på byggeplads, indrapporterede at have computere. (6)

Computerprogrammer som f.eks. tekstbehandling, regneark og email bruges af mere end 95% af virksomhederne og en øgning forventes indenfor: arbejdsbeskrivelser, databaser, økonomi og vedligehold. (8)

Klassifikation af bygningsdata udgjorde et specielt interesseområde. Indenfor nogle områder har virksomhederne udviklet deres egne systemer, men SfB bliver også brugt, specielt indenfor vedligehold. (8)

CAD-systemer udnyttes i stigende grad, især af arkitekter med 97%. I 1998 havde 80% af både arkitekter og ingeniører CAD, men kun 82% af ingeniørerne i denne undersøgelse havde CAD. (8)

Internetforbindelse viser den største stigning med 90% af kontorpersonalet, som nu har adgang fra egen pc mod 24% for tre år siden. 23% af virksomhederne har haft erfaringer med projektweb. (9)

e-business bliver allerede brugt i betragteligt omfang til handel. Det må forventes at vokse støt, men antallet af firmaer, som finder det ikke aktuelt, eller ikke vil bruge det, er stadig i overtal. (9)

Intranet er øget i anvendelse, hvad angår deling af data, fra 12% af virksomhederne i 1998 til 29% nu. Yderligere 25% ville finde dem brugbare og mange af dem planlægger intranet indenfor 5 år. (9)

Produktivitetsforøgelse som resultat af IT, er størst indenfor projektering og administration, ligesom i 1998, men der rapporteres også om stigende fordele i projekt- og byggepladsledelse. (10)

Fordelene ved IT ses indenfor kommunikation, hastighed og arbejdets kvalitet.Tilfredse kunder og muligheden for at kunne arbejde hjemmefra betragtes også som goder, men der forventes kun ringe stigning i hjemmearbejde. (10)

Planerne for investering i IT er lig dem rapporteret i 1998, hovedsageligt indenfor CAD- og dokumenthåndtering. Projektweb og internet forventes også at vokse, men ikke produktmodeller. (11)

Standarder har vist en stigning, både mht. opmærksomhed omkring dem og brug af dem, med SfB og ibb CAD-layersystemer udnyttet af mere end 40% af respondenterne. CIS-CAD er kendt i bredt omfang, men kendskabet til modelleringsstandarder som IFC og STEP er ikke særligt udbredt. (12)

Nyuddannedes niveau i IT anses generelt for tilfredssstillende, men arkitekters IT-niveau anses stadig af arbejdsgiverne som for lavt, og arkitektskolerne burde undersøge, hvad virksomhederne forventer af deres uddannede. (12)

1.   Summary of main results

The response to the 2001 IT barometer was better than in 1998, and there were more returns from smaller engineering companies. Large companies now find it harder to collect all the data on IT. (4)

Spending on IT has increased, with architects now spending an average of over 5% of turnover, up from 1-2%, and contractors almost 1% of their larger turnover, up from 0 - 0.5% in 1998. (6)

Access to computers is almost universal with 98% of all staff having them available. 92% of office staff have their own personal computer. About 17% have some form of hand-held device. (6)

Software systems, such as word processors, spread sheets and email, are used by over 95% of companies, and most growth is expected in: descriptions, databases, costing and maintenance. (8)

Classification of building data was of special interest and, for some applications, companies have developed their own systems, but the SfB system is also in use, particularly for maintenance. (8)

CAD system use has grown, particularly by architects, 97% of which now have systems. In 1998 80% of both architects and engineers had CAD, but only 82% of the engineers who responded to this survey had CAD. (8)

Internet access has shown the most growth with 90% of office staff having access from their own computers compared with 24% in 1998. 23% of companies have experience of Project Web. (9)

e-business is already being used for significant amounts of trading. It is expected to grow but the number of firms saying it is not applicable, or who do not plan to use it, will remain the majority. (9)

Intranets have grown, as a means of sharing data, from 12% of companies in 1998, to 29% now, with 25% more saying they would be useful and many of these planning to use them within five years. (9)

Productivity increase as a result of IT is greatest in design and administration, as it was in 1998, but there are also growing benefits reported from project and site management. (10)

The advantages of IT are seen as communication, speed and quality of work. Satisfying customers and the ability to work from home are also valued, but little growth is expected in home work. (10)

Plans for investment in IT are similar to those reported in 1998, mainly in CAD and document handling. Project Web and Internet are also expected to grow but not product modelling. (11)

Standards have grown in awareness and use, with SfB and ibb CAD layer systems used by over 40% of respondents. CIS-CAD is widely known but not modelling standards such as IFCs and STEP. (12)

Training of newly qualified staff in IT is generally regarded as sufficient, but the IT training of architects is still seen by employers as too low, and the Academies should find out what companies are expecting from their students. (12)

In general the use of IT in the Danish construction industry has moved ahead steadily. There have been large advances in communications and, particularly, the number of staff in companies with access to the Internet. With growing use of Intranets and Project Webs, the tools are available for exchanging information more efficiently on building projects, and the clients surveyed also have the capability to do this. As in the previous survey, but making progress, the take up of standards is slow, particularly in building modelling, and this is a problem being addressed by the classification project.

2.   Background to the survey

This survey is a repeat of the 1998 IT Barometer [1] and was also carried out in parallel with similar surveys in Sweden and Finland, hence its publication in English. Results were compared in the ITCon on-line journal [2]. It was based on questions used three years earlier and modified by Olle Samuelson at the Royal Technical High School in Stockholm. Many of the questions are the same, but it was felt that there is now less variety in the types of operating system and brands of software used, so more attention has been paid to communications, future plans and classification of data.

The survey was carried out between March and June 2001 by the IT byg group at DTU, led by Rob Howard with assistance from Ernst Petersen, Susanne Hartvig and Per Christoffersen. It was done partly to provide information for the Centerkontrakt Byggeklasifikation [3], for which DTU is carrying out research into needs for, and international experience of, classification, and the effects of IT in future. This is a major collaborative project is managed by the Teknologisk Institut and supported by Erhvervsfremmestyrelsen.

3.   Comparisons with other countries and previous surveys

The particular interest in repeating this survey is to obtain comparative information on the development in usage of IT in all parts of the construction industry, the take up of new developments and any changes in attitude to IT. The results for Denmark cannot be regarded as statistically significant for the whole country, but they were based on a similar sample of companies to the 1998 survey, and comparisons of the main groups analysed should be valid.

Since 1998, both Sweden and Finland have had major development projects which have informed their construction industries about innovation in IT. Comparison with their results will be published later and should show whether these projects, IT bygg och fastighet [4] in Sweden, and VERA [5] in Finland, have yet produced greater take up and benefits. A report on the future needs of the Danish building industry, Byggeriets Fremtid [6] has recently been published, and includes recommendations for developing the use of IT. A future repeat of this survey should be able to measure its effects.

4.   The groups surveyed

The same organisations representing major groups in building were approached as in 1998, and supplied addresses of samples of their members, large and small firms, in all regions of Denmark:

> 250 Architects, members of Praktiserende Arkitekters Råd, PAR
> 250 Building clients or managers – about 100 members of the Danish Facilities Management network, and 150 Kommunes, local authorities
> 250 Contractors – 100 members of Dansk Entreprenører, and 150 members of BYG
> 250 Engineers, members of Foreningen af Rådgivende Ingeniører, FRI

Questionnaires were sent out to principals or those responsible for IT, on paper since use of the Internet is not yet total. Of 1000 sent out, 136 were returned; not a high return but higher than that obtained in 1998 when 103 were returned. Some groups were poorly represented, such as the materials manufacturers, and these have not been analysed separately. The largest response was from architects and engineers, and the main difference from 1998 was that more engineers, from smaller firms, responded. This indicates the difficulty that large firms have in gathering the information from the various people responsible for different aspects of IT. Smaller firms now have greater use of IT than before, and can find the information more easily.
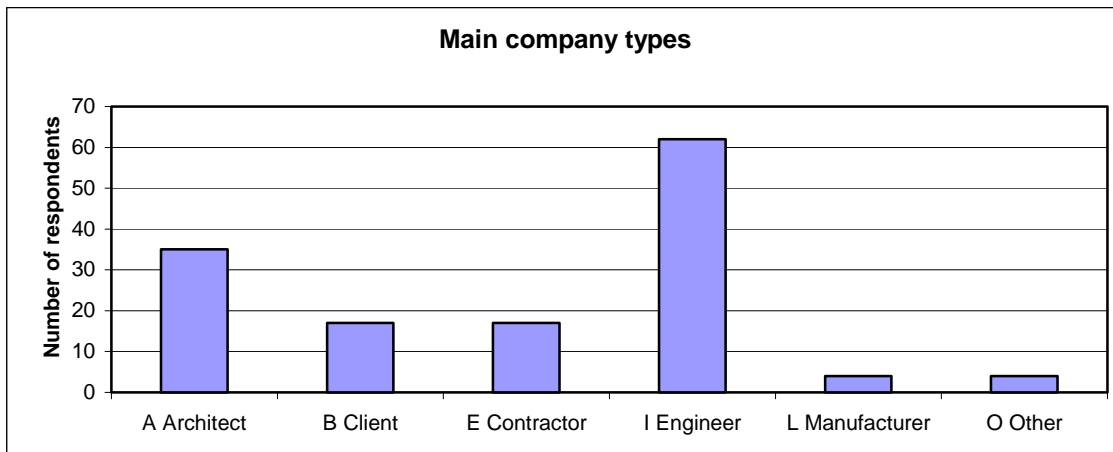
Main company types

Fig 1. Numbers of responding companies classified by type

5.   IT futures and classification

The classification research needs to find out what IT systems are likely to be in use in the next 5 – 10 years if the classification system to be recommended in 2002 is to help structure the data needed by IT systems in the future. It is also possible that these systems might impose their own structure for classification of building data. Questions were therefore added on some aspects of technology to obtain the industry views on what systems they were likely to be using in future. The periods used were 2 years and 5 years ahead, although few could look ahead as far as 5 years, let alone 10 years.

The classification systems used were also of interest, since Danish experience is largely of the SfB system and those established by individual firms. Awareness of standards and new developments in IT is also important since, in launching a new or revised classification system, its promotion to the whole industry is as important as its content. Finally the views of employers, on the IT skills of recent employees, are of great interest to a university that trains many of the engineers in Denmark.

6.   Levels of spending on IT

The numbers of staff in the companies in each of the groups analysed varies greatly, with building clients averaging nearly 1000 staff, most of whom are not involved with building, and the architects responding having an average of 28. Contractors were separated into office staff, average number 44, and site staff, average number 58. Respondents were asked to give their annual turnover and, if known, the percentage spent on IT, including hardware, software, communications and IT staff.

Percentage spend on IT varied from 5.37% for architects, an increase from the 1 – 2% reported in 1998, to 0.96% for contractors, an increase from the 0 – 0.5% reported in 1998. Consultants' turnover is based on fees while contractors' is based on the much higher value of the total construction cost. The most significant method of presenting this is to base it on IT expenditure per member of staff. Again the contractor is different in that there is a lower level of spend on site based staff, but Fig 2 shows the average spend for the total number of staff reported.
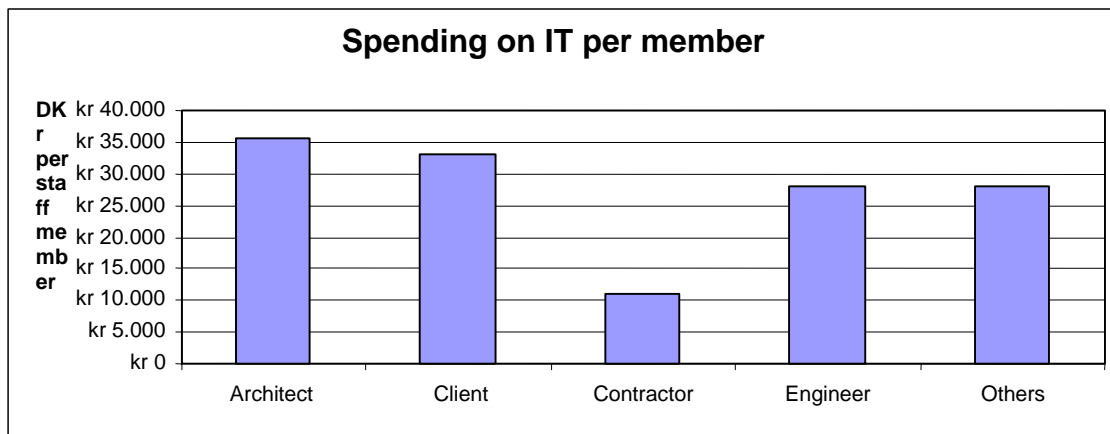
Spending on IT per member

Fig 2. Average expenditure on IT per member of staff for the main groups in the survey.

It is interesting to note that the spending on IT by engineers, with an average of 4.57%, has increased less than that of other groups since they were already spending 2 – 4% of turnover on IT in 1998. Allowance has to be made for the larger number of small engineering firms responding to the current survey. If they are grouped into the size categories used in 1998, the difference can be clearly seen.

Size of engineering companies responding	up to 20 staff	20 – 200 staff	more than 200 staff
2001	75%	20%	5%
1998	50%	35%	15%

7.   Access to computers and communications

The level of computer availability in companies is almost total with 98% of respondents reporting access to a Personal Computer or terminal. An average of 85% of staff in all companies have their own PC, with this going up to 92% for office staff. Other equipment studied includes mobile phones, with 44% of all staff supplied with these by their company and 50 % of site staff. This does not seem to be such a large change from 1998 when 40% ownership was reported but these were not all supplied by the company. About 17% of all staff had some form of hand held computer, and there is no doubt that mobile devices will have an increasing role to play on site when faster Internet data can be supplied to them.
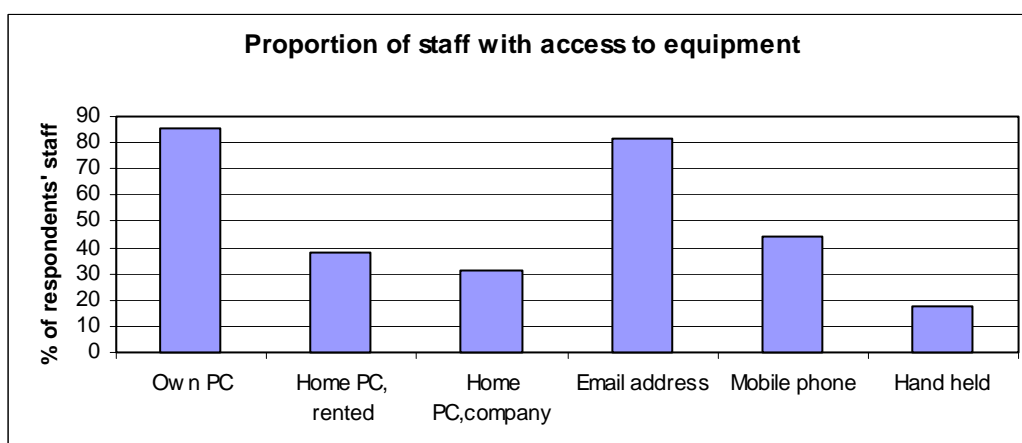
Proportion of staff with access to equipment

Fig 3. Proportion of staff with their own IT equipment

Another aspect of change that could affect the future use of IT, was the proportion of time spent working from home. Some of the smallest companies are home based and report already spending a high proportion of their time there. The average for all the respondents currently is 11.5%. Future expectations show some growth over five years, up to a level of 15%, but this is hard to predict.

8.   Applications software including CAD

Applications software is in wide use across all the companies, although some specialist applications, such as those for property management, are only relevant to building owners and managers. Over 90% of companies have administration software such as word processors, spreadsheets and Email. Growth is most likely in work descriptions, databases, cost calculation and property maintenance.
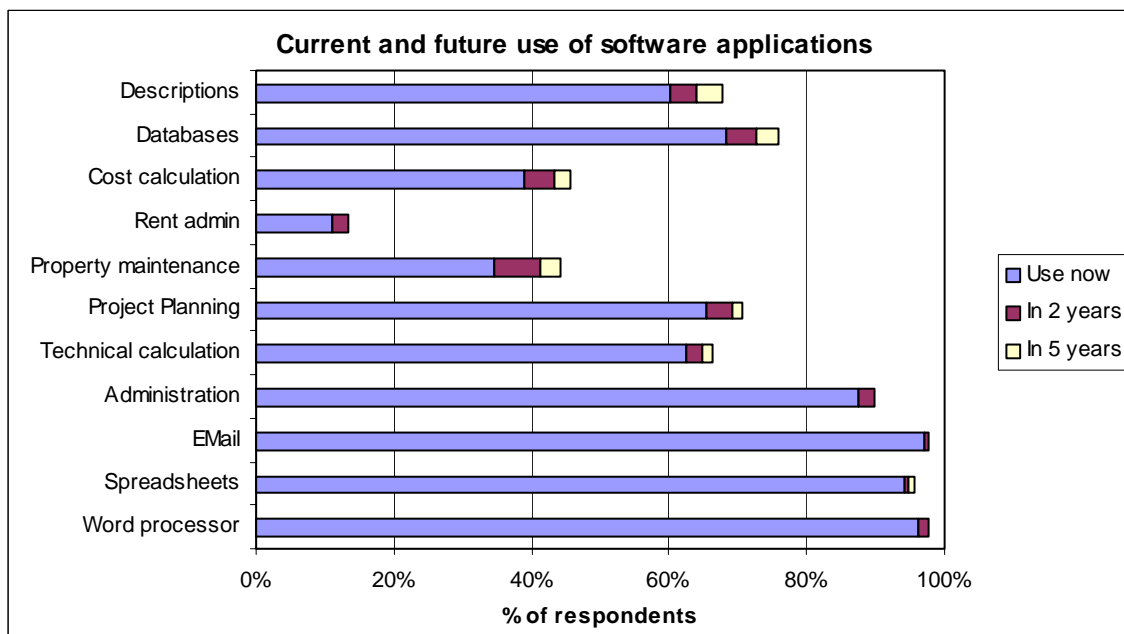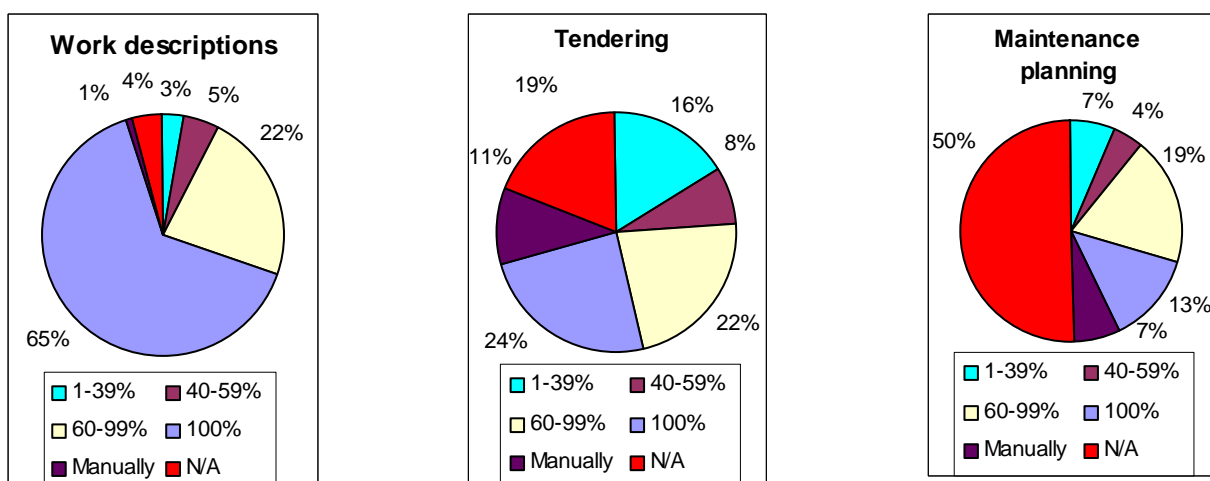

Fig 4. Current and future use of software applications

As well as having different types of software available, it is important to know for what proportion of work they are used. The pie charts in figure 5 show the percentage of firms to which selected applications are not relevant (NA), where the work is done manually, and on what % of projects.

Fig 5. Proportion of work by computer in: Work descriptions, Tendering and Maintenance planning.

For a number of these applications a supplementary question was asked about what classification system, if any, was used to organise the data. The majority of companies used their own systems, except in property maintenance, where the SfB system was most used. A number of other systems were mentioned.
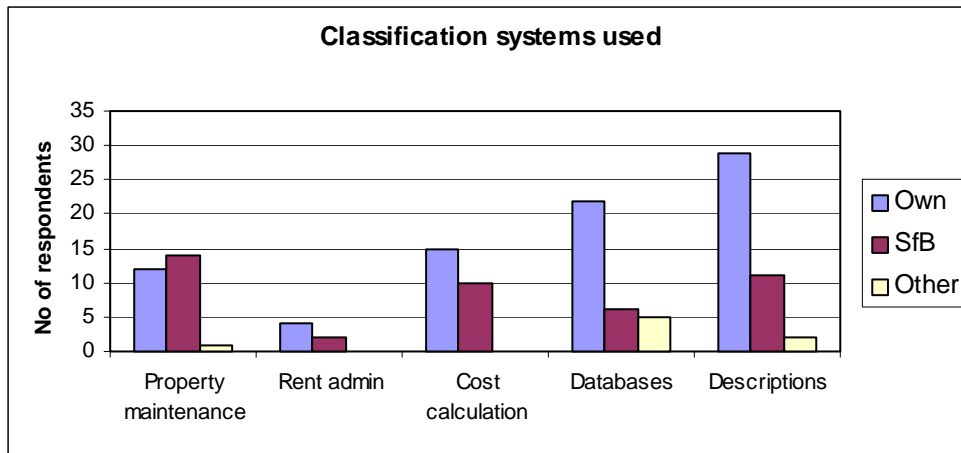

Fig 6. Classification systems used for particular types of application.

Computer Aided Design was a field that was studied in greater detail in 1998, when about 80% of architects and engineers had some use of this. Now 97% of architects report having CAD, while the figure for the smaller selection of engineering companies responding, is only 82%.
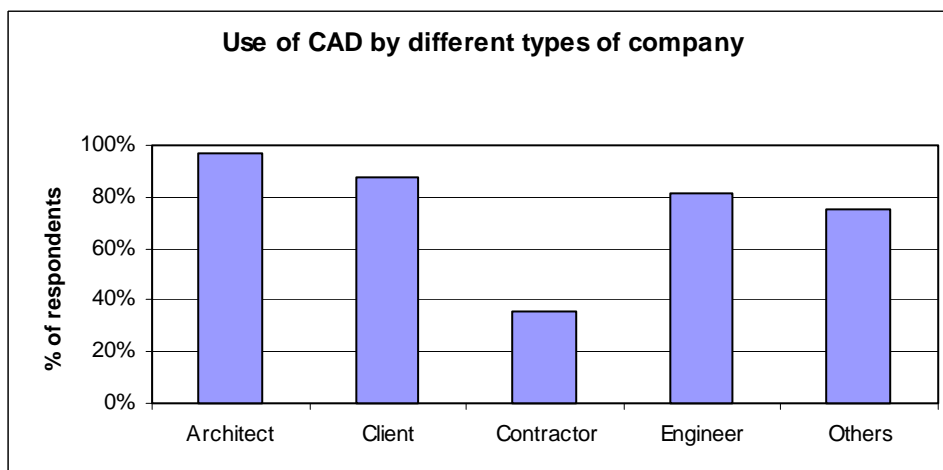

Fig 7. Use of CAD systems by different types of company

The types of CAD system used have changed little, AutoCAD dominating the market in 68% of all types of firm. Architectural Desk Top is merging with Point, and 23% of firms also have this. Microstation is next with 12%, about the same proportion as in 1998, but then it was found that these tended to be large installations so that the number of workstations was three quarters the number of AutoCAD workstations. This time the number of workstations has not been studied. ArchiCAD has grown since 1998 but is used only by architects. Others mentioned include MiniCAD, Visio and Geographical Information Systems, such as ArcView. 13% of firms have GIS.
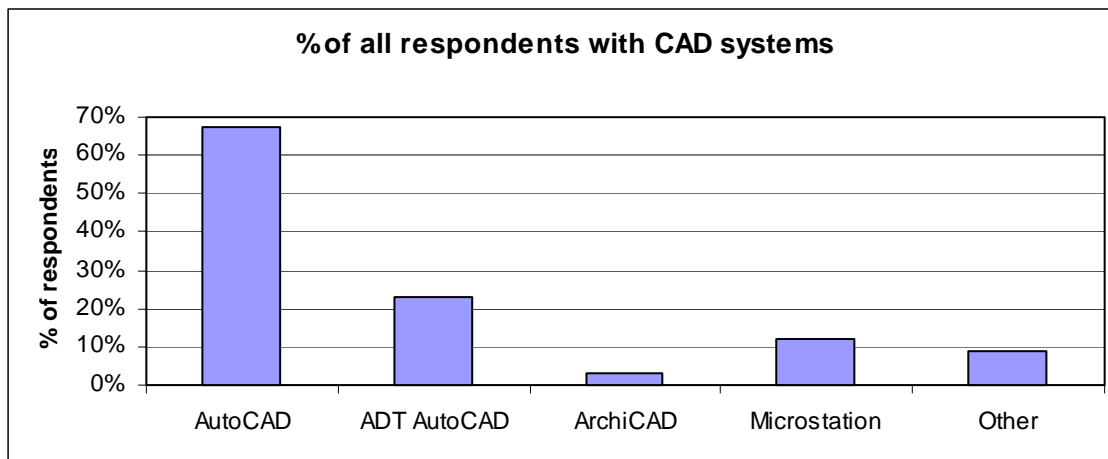
% of all respondents with CAD systems

Fig 8. Percentage of all respondents with different types of CAD system

9.   Internet and Project Webs

The biggest change has been in the use of the Internet with only 1% of responding companies saying they did not have any means of access. Nearly half of the rest had a permanent connection while 37% more used fast ISDN lines. About 80% of firms had Local Area Networks to share access. 90% of office staff had access to the Internet from their own computers whereas only 24% reported this in the 1998 survey.

The World Wide Web is seen as a valuable means of promoting all types of company. 67% already have home pages while 24% more thought they ought to have them. The contents of these home pages are shown in Figure 9.
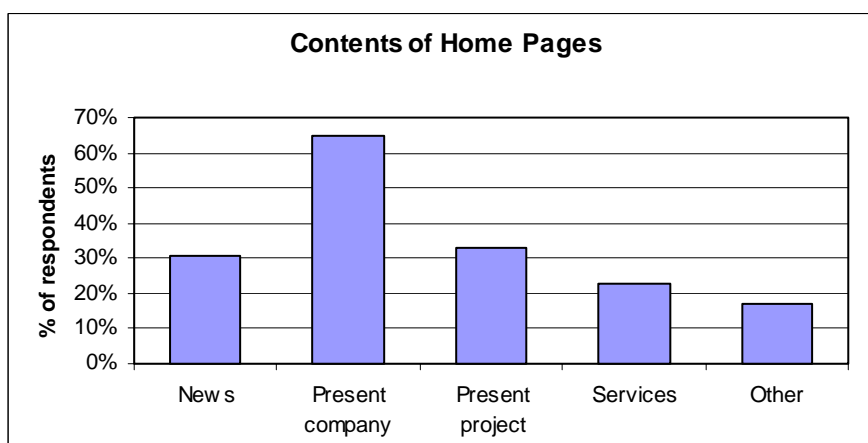
Contents of Home Pages

Fig 9. Contents of home pages on the World Wide Web

Project Webs are a new facility since 1998. They enable project teams to share and exchange information over the Internet. 23% of all firms have some experience of their use while 35% more think they would be useful, and many of these plan to start using them in 2 or 5 years time. About 19% of the firms using them apply them on nearly all their projects while 33% use them only occasionally. BYG.DTU has published a guide to selecting project webs – Rapport R-002 [6].
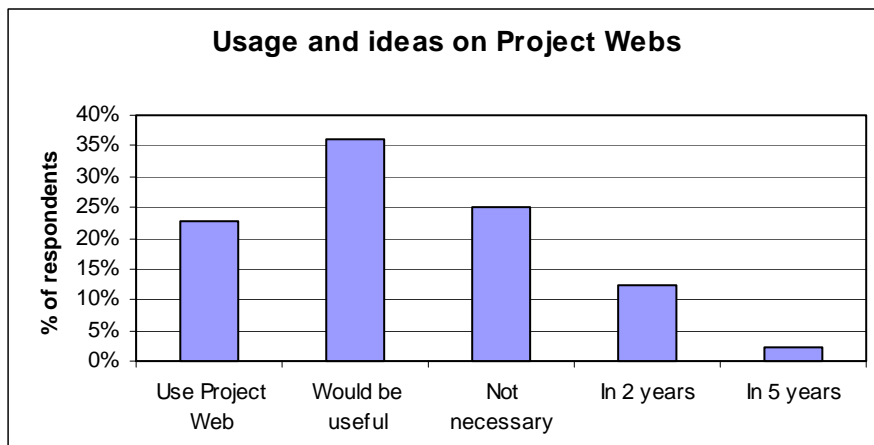
Usage and ideas on Project Webs

Fig 10. Use of Project Web and ideas about future usage

Another new area is e-business, trading over the Internet. This is relatively new and growing. It is interesting to know how fast it is likely to grow but, as with many communication technologies, it is likely to be driven by the needs of business partners, and it is difficult to predict these. Figure 11 indicates the amount of business that is currently transacted over the Internet and how responding firms expect this to grow in future. The majority of firms believe it is not applicable to them or do not use it, but their number will decrease over the next five years.
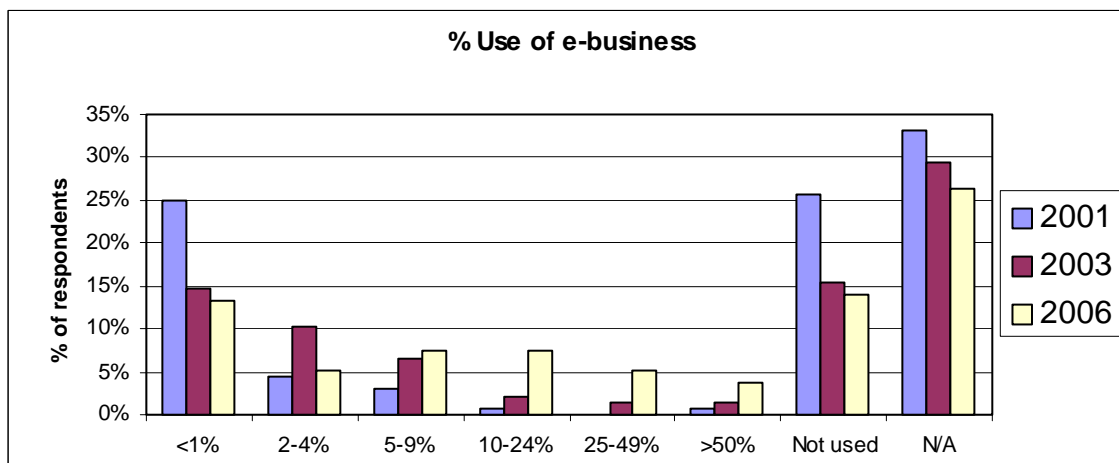
% Use of e-business

Fig 11. Current and future use of e-business, showing proportion of electronic trade.

Access to building product data online is one aspect of e-business which is very relevant to classification. It is already being used on a large scale with 20% of firms obtaining 10-24% of their information this way. A slightly smaller proportion order product information by this means.
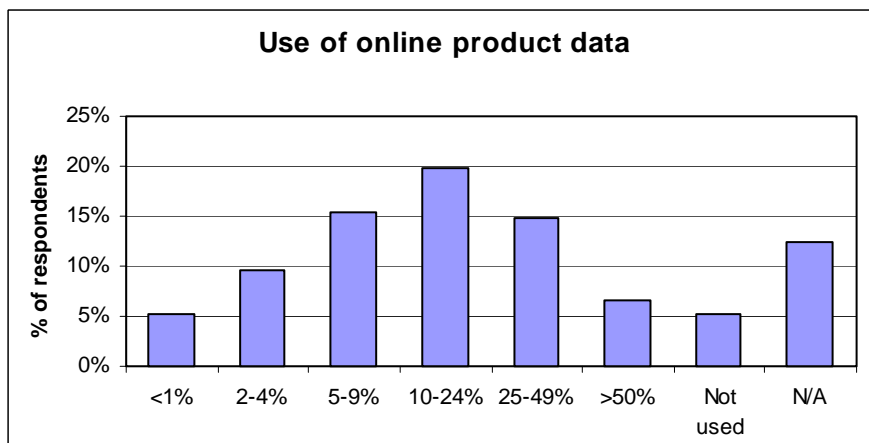
Use of online product data

Fig 12. Proportion of product data accessed on line

The final communications technology studied was Intranets, or use of Internet technology within companies. In 1998 this was known but only 12% of companies then used it. Now 29% of all types of company use it and a further 25% believe it would be useful. The largest group can see no use for this and they are probably the smaller companies. Classification on Intranets is largely devised by each company, but both alphanumeric systems and SfB are used.
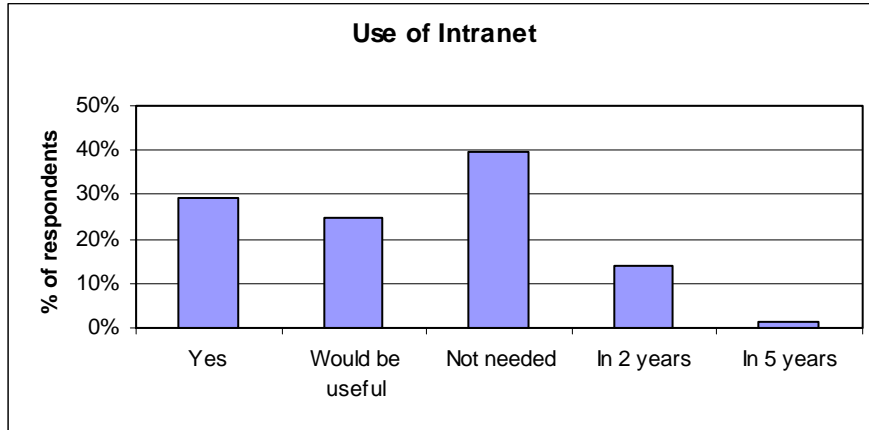

Fig 13. Use of Intranets and ideas about future usage

Since most of these forms of communication should involve all the members of a project team in a company, or all the participants in building projects, it is interesting to compare the current use, in each type of company, of LANs, Home pages, Project Webs and Intranets. Building clients are of particular importance since they can influence adoption of these means of communication by all the consultants and contractors they employ.
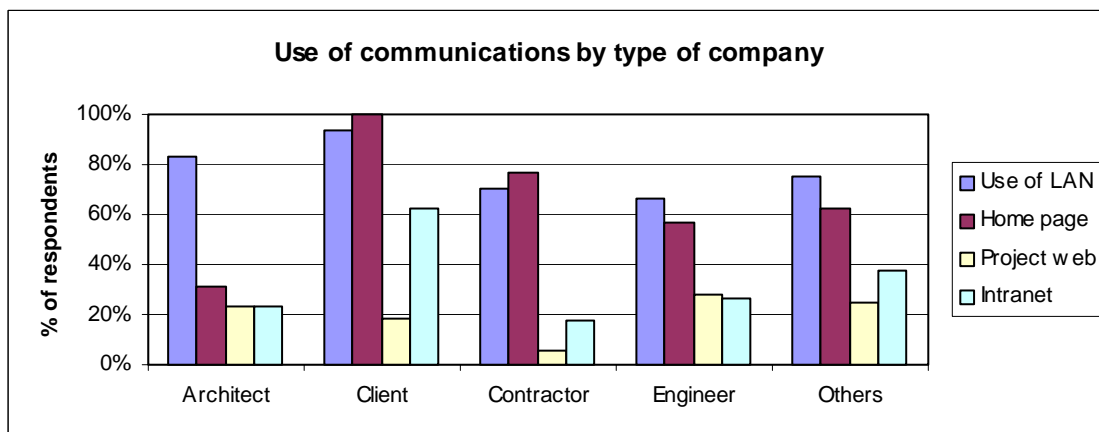

Fig 14. Current use of communication systems by different types of company.

10.   Reasons for investing in IT and benefits achieved

A number of reasons for investing in IT were suggested to the respondents and they were asked to rank their importance. Some of these were not applicable to some companies, but competitiveness and administrative efficiency appear particularly important.

Reasons for investment in IT

Number of respondents vs. Customer demand, Employee demand, Competition, Tech efficiency, Admin efficiency, To be in the lead, New business

Legend: Unimportant, Some importance, Fairly important, Important, Very important, Not applicable
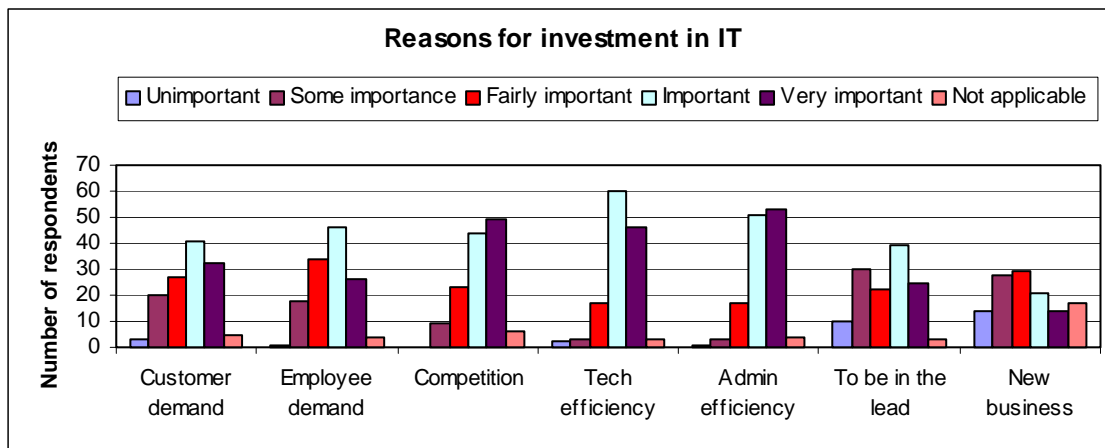
Fig 15. Reasons for investment in IT

Productivity is an important area for Denmark, where this has not increased in building over the last 30 years [5]. IT is expected to change this although some of the most obvious changes, to text and drawing production for example, have already been achieved. Respondents were asked to rank the effects of IT on productivity (defined as the turnover divided by people-days) on a number of tasks, from a 15% reduction to an increase of 15%. As in 1998, administration and design were the areas showing greatest productivity gain, but project and site management had also improved.

Effect on productivity

Percentage of respondents vs. General administration, Materials admin, Property admin, Project management, Design, Site management, Purchasing/selling
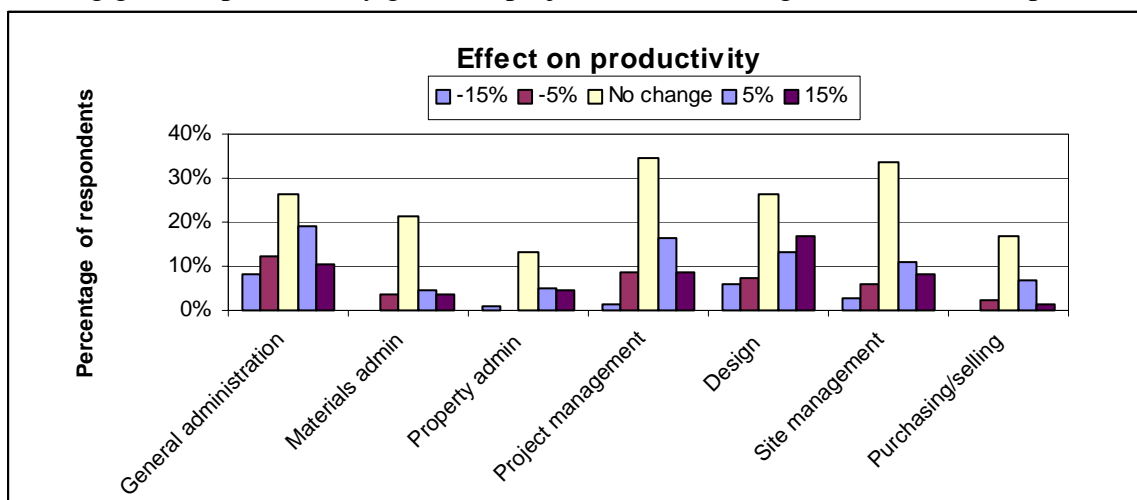
Legend: -15%, -5%, No change, 5%, 15%

Fig 16. Effects of IT on productivity in selected tasks.

The same questions, asked in 1998, about the advantages of IT, were asked again. The results are very similar with quality and speed of work, and faster access to data, being the main advantages
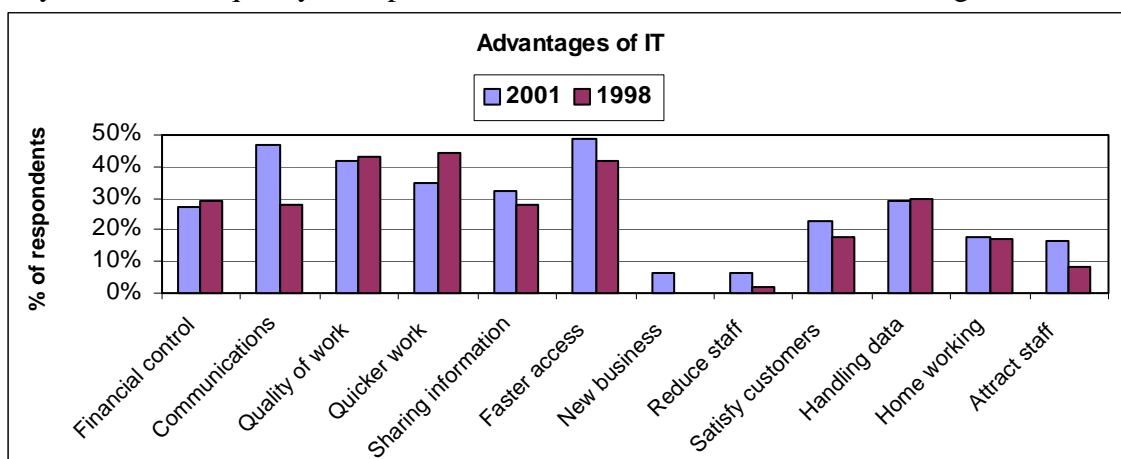
Advantages of IT

% of respondents vs. Financial control, Communications, Quality of work, Quicker work, Sharing information, Faster access, New business, Reduce staff, Satisfy customers, Handling data, Home working, Attract staff

Legend: 2001, 1998

Fig 17. Comparison between 1998 and 2001 for the advantages of using IT systems

11

11.   Future intentions and problems found

Plans for future investment in IT are useful to help predict the future and may also be of interest to those selling systems, although this is not a marketing survey. The questions varied slightly from the 1998 survey but the main growth areas were the same: CAD, document handling, accounting and the Internet. Project web is a growth area in this survey but product models are generally not planned. New business, project webs and e-trade were not surveyed in 1998.
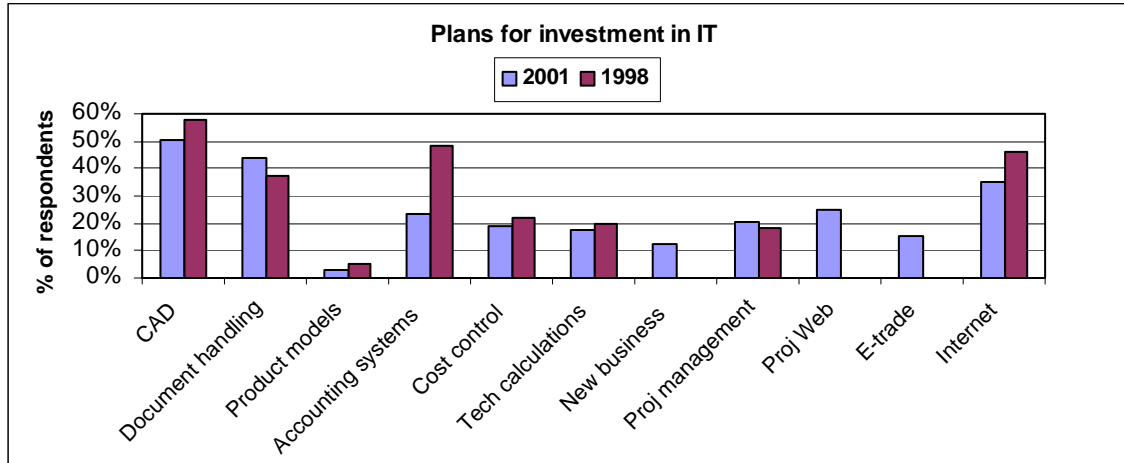

Fig 18. Comparison between 1998 and 2001 in plans for investment in IT

12.   Awareness of standards and views on education

The final questions, used only in the Danish survey and relevant to the classification research and the educational role of DTU, are on awareness of standards and views on IT knowledge of staff.

The standards, about which respondents were asked, are mainly de facto proposals, either international or Danish, which would help the exchange of information using the communications systems now widely available in the companies. SfB and ibb CAD layer guidelines are better known than they were in 1998, and much more widely used – over 40 companies out of 136. CIS-CAD, for facility management data, was also quite well known but little used. The remaining, rather specialist Electronic Data Interchange and Product Modelling standards, were generally unknown and hardly used. For some of these there is very little software yet available to the construction industry. The success of the ibb CAD layer guidelines is significant for the classification project in that it shows how adoption by the leading companies and good publicity can establish a system, even if there were no alternatives when it was introduced in about 1990. SfB is likely to be the basis for any new building element table and it is encouraging to know it is used by 44% of respondents.
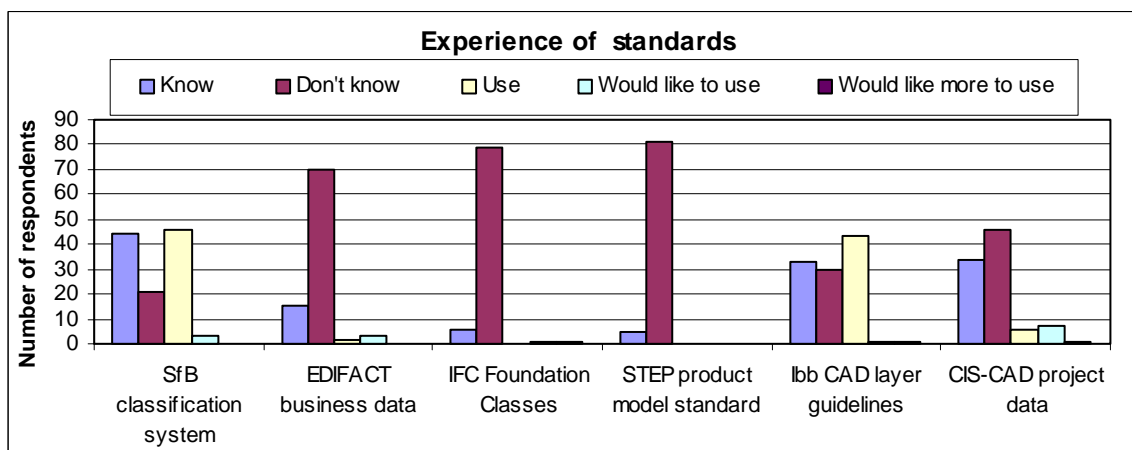

Fig 19. Experience of various national and international standards and proposals.

IT systems will not be fully exploited until staff in building industry companies are well educated in their application and management. Levels appear to have gone up but so, probably, have expectations. Most groups are regarded as adequately knowledgeable, except architects, about whom the largest number of respondents felt their knowledge was too low. This has improved since 1998 when the number believing this was much higher. Architects have since increased their spending on IT more than other groups. When these views are analysed by the type of company giving them, it is found that architect employers are the most critical of their employees' knowledge. Civil engineers are rated excellent by more respondents than other groups, but not as highly as 3 years ago. Perhaps higher levels of employment have since made good engineers harder to find. DTU obviously has a role to play in maintaining their standards, but the architectural academies have a greater need to find out what employers are expecting from their students.
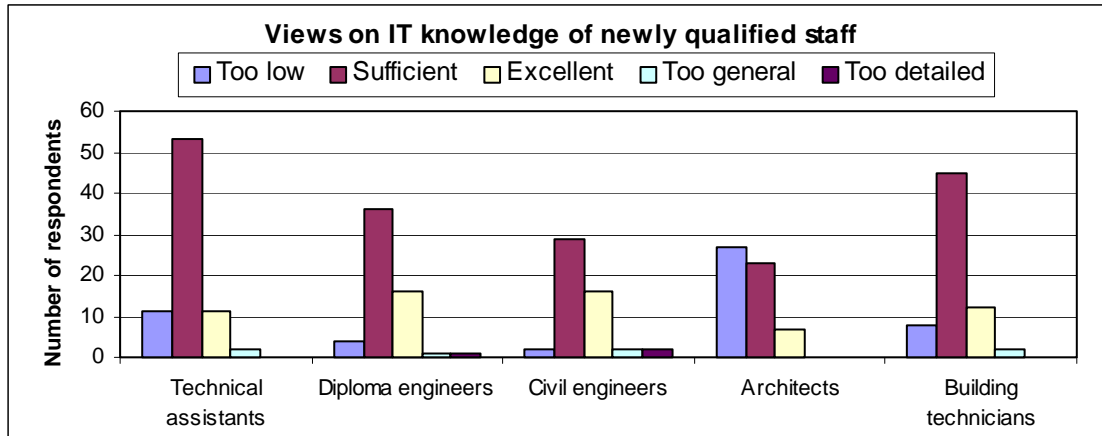

Fig 20. Views on the IT knowledge of newly qualified staff.

13.   Conclusions and further publication.

DTU is very grateful for the return of the questionnaires by the respondents, and to the associations for providing samples of their members. It is sending this report to all those who responded and asked for the results, as well as to the associations and other interested parties in Denmark. It will also be posted on the DTU website www.ifp.dtu.dk/~it/ The next stage is to compare the results with those from Sweden, for which the survey is already analysed, and for Finland when theirs is complete. There is also interest from many of the countries that participate in the CIB W78 conferences [8]. Comparable data is available for some of these, and all are welcome to use the survey questions in their own countries. The next meeting of this group will be in Aarhus, Denmark in June 2002 [9] and the final comparisons of the IT barometer surveys will be presented.

In general the use of IT in the Danish construction industry has moved ahead steadily. There have been large advances in communications and, particularly, the number of staff in companies with access to the Internet. With growing use of Intranets and Project Webs the tools are available for exchanging information more efficiently on building projects, and the clients surveyed also have the capability to do this. As in the previous survey, but making progress, the take up of standards is slow, particularly in building modelling. The centerkontrakt is aimed at developing better systems of classification, which will enable common understanding of project data by all participants.

The final report on the DTU research on IT futures will be published at the end of 2001 and will combine the views of experts on some particularly relevant technologies, with the reactions of some respondents to this survey on their likely take up of IT up to 10 years ahead. It is difficult to predict what lies ahead but the information provided by this survey, and by the other work on IT futures, should give the Danish building industry the best view possible of the systems becoming available and the probability of their being used.

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