Implementation of IT and CAD - what can Architect schools do?

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Summary

In Sweden representatives from the Construction industry have put forward a research and development program called: "IT-Bygg 2002 - Implementation". It aims at making IT the vehicle for decreasing the building costs and at the same time getting better quality and efficiency out of the industry.

A seminar was held with some of the most experienced researchers, developers and practitioners of CAD in construction in Sweden. The activities were recorded and annotated, analysed and put together afterwards; then presented to the participants to agree on.

Co-operation is the key to get to the goals - IT and CAD are just the means to improve it. Co-operation in a phase of implementation is enough problematic without the technical difficulties in using computer programs created by the computer industry primarily for commercial reasons. The suggestion is that co-operation between software companies within Sweden will make a greater market to share than the sum of all individual efforts.

In the short term, 2 - 5 years, implementation of CAD and IT will demand a large amount of educational efforts from all actors in the construction process. In the process of today the architect is looked upon as a natural co-ordinator of the design phase. In the integrated process the architect's methods and knowledge are central and must be spread to other categories of actors - what a challenge !

At least in Sweden the number of researchers and educators in CAAD is easily counted. How do we make the most of it ?

Background

The Construction industry in Sweden has for a long time been used by governments as an economical tool for getting more money into the market in bad times. Also the right to a high private housing standard has been a political goal. According to the argumentation in the daily press and TV the construction industry in trouble therefore always seems to start acting by looking for governmental subsidies.

On the initiative of some enthusiastic researchers, developers and practitioners within this industry, a national research and development

program, IT-Bygg, was started in 1990 - then with 2/3 governmental money and 1/3 from the Swedish Construction industry development fund. The goal of the program was to create joint environments for research and development for the construction industry at the three Technical Universities of Sweden with schools of architecture and engineering in Göteborg, Lund and Stockholm. This was also achieved at the end of the program in 1996 but a continuation is needed to make use of these efforts.

A group of representatives from the different partners of the construction industry has put forward a document "IT-Bygg - 2002 - Implementation". Five areas of interest are indicated, each to be acted upon within the fields of research, development and implementation. The areas are:

1.   Communication and provision of knowledge
2.   Human - machine interface
3.   Product, process and computer models
4.   Classification and standards
5.   Implementation and changed forms for action

The document[1] is primarily aimed to be used when promoting the companies of the industry to participate and contribute economically to the program - 40% government and 60% industry. It is therefore quite brief. To analyse the impact of the program on design and modelling the author of this paper was asked to host a seminar with some of the most experienced researchers, developers and practitioners of CAD in construction in Sweden.

Some 30 persons were contacted personally by phone and almost everyone took part in the seminar. By way of introduction each participant personally declared his special concern, then a group discussion took placed which finally was summarised and made the base for a final discussion. The activities were recorded and annotated, analysed and put together afterwards; then presented to the participants to agree on. Some of the problems are put forward and discussed in this paper.

Co-operation - the key to renewal of the construction industry

Analyses have pointed out that the construction industry is characterised by its fragmentation into a lot of actors usually representing different knowledges and even separate companies; working in ad hoc project groups in a sequence of separate phases.

It was stated at the seminar that the total knowledge needed for a construction task long ago passed the limit of what is possible to keep in the head of one person. Yet architects and the bosses of building sites are doing their best to do just that. The advantage for the information keeper

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[1] "IT-Bygg - 2002 - Implementation", draft

is that he has to be present personally when the information is needed. The serious disadvantage is what happens if he cannot.

If we cannot rely on the "one person model" we have to co-operate. Sharing information is essential to co-operation. Information Technology can be a fantastic tool for those who have to share information. But is it yet ?

One of the real difficulties is how to convince holders and creators of information to let go of their privileged access to it. This is to a great extent a matter to be dealt with by social scientists. As most of the industry with cautiousness looks at behaviourists, making a link to interdisciplinary work might be a way for the Architect schools to support the development of attitudes. At least within Lund University there are good contacts between the CAAD lab and for example the department of Applied Psychology.

Commercial competition versus co-operative development

For some reasons the frustrations of early users of CAD and IT has not been a popular issues to be studied neither by researchers nor the market. One severe reason for user frustration is the use of computer "formats" and grade of user friendliness as tools in the commercial competition. It would be interesting to get an evaluation of what has been actually gained by these rather crude measures. A natural hypothesis was stated by some of the participants of the seminar - that the total market to be shared by the competitors would have been much larger with for instance more generous attitude towards formats. However, this is almost impossible to prove so it can only be used as an "academic" argument.

From an academic point of view it is easy to find the weaknesses of the CAD market, but what can actually be done to improve co-operation between rivals? Being neutral or support those you think might win? Being short of funding and therefore seriously tempted by anyone who offers you soft- or hardware free of charge - it is not easy to be neutral.
From another point of view, the MIT Media lab, Nicholas Negroponte[1] sketches a promising future for the development of the digital media's. More efforts are being put into user friendliness. Even persons who want to stay computer amateurs facing computers feel will at home interfacing the machines. Format troubles are going to be solved whether the computer industry wants it or not. There is already promising progress being made with for example Java and TCP/IP on the Internet.

In the seminar there was a concern about how to be oriented in the international environment. Writing almost any academic paper demands

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[1] Negroponte, N. P. "Being Digital", First Vintage Books edition, New York 1996, ISBN 0-679-76837-8

that issues are related to what is being done at other universities. It is therefore a natural task for the universities to take responsibility for keeping updated information on the state of the art in the world. Building networks such as AVOCAAD is a good example of what an Architect school can do to create a forum where especially those belonging to small firms or organisations have a chance to keep in touch with what happens.

The seminar suggests an inventory of softwares already in use in the country, analysing it and describing it to be published as IT environment tools. It was also suggested that efforts should be put into a "de facto standard" to be used until a better one, internationally agreed upon, is available.

The "slavery" of drawings

An architect, who is in charge of the implementation of IT in one of the biggest consultant firms of architecture and constructions in Sweden, stated at the seminar that "architects must be relieved from the slavery of drawings". And he got support for that opinion !

The reasons are in short that using CAD for production of drawings is not taking advantage of CAD. The production of drawings would still rule the process keeping intelligent humans occupied by doing work which to a great extent easily could be automated. The time could be used to put more efforts into the design work.

"The problem with a set of architectural drawings, for example, as a symbolic picture or model of a building is that they present an inadequate means for the rigorous testing of the form against the requirements of the programme or context; they are a model of what the proposed building will look like, how it will be disposed three dimensionally in space, but not how it will behave....."[1]

The quotation from Philip Steadman is another argument against overestimating the role of drawings, but it also states a warning! If we use the CAAD modelling tools the same way as we would use drawings we are not very much better off ! When educating architects at the CAAD lab in Lund, we have found that there has to be a change of mentality. Students are taught to present there projects in the form of drawings for everyone to make his own opinion. They have to be taught more about communication and how to create messages and tell stories.

Information Technology in the design process.

The concept of Computer Aided Design might to the advanced IT user feel a bit ancient but to the majority of the construction industry it still

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[1] Stedman, P. The evoluation of Designs, Cambridge University press 1979, ISBN 0 521 22303 4.

means something - mostly 2D computer drawing, but never mind... At the seminar there was a lot of discussion about different aspects of Information handling etc. It has to be stressed, though, that object-(product-) modelling is the narrow key part of IT in the design process which is the basis for the following phases. The need for a certain amount of communication tools for exchange of information etc. within the design work could be incorporated into the concept of CAD. It also seems a waste of manpower to state a new concept when CAD has finally been established.

Co-operation in the design phase must mean that more actors are being involved in the design work - evaluating consequences, suggesting new solutions, negotiating to create compromises etc. There is a misunderstanding among architects as well as engineers that architects are the only actors who are expected to be creative. There is a difference in methods of problem solving. Engineers want to have a fixed framework and rules within which to solve the problem. Architects often start when everything is uncertain and nothing is decided trying to stretch the limits to be able to use the solution in his imagination. Architects often summarise their method in the concept of "sketching".

If the design process is going to make use of co-operation and more integrated work more actors will have to learn how to sketch. As architects in general disagree whether to use computers for sketching or not, it might have to be both ways.

Implementation of IT is a huge challenge to the educators of architects and engineers.

There was a time when CAD was just another drawing board which did not at all affect architects aged traditions of work methods. Now, having more experience, we imagine that the new technic offers possibilities which will change many of our ingrained options.

So far education of CAD for practitioners has been something between two days and a week. It has been offered by the dealer of the software and as such naturally focused on the most urgent commands. In a study made by some doctorate students at the CAAD lab in Lund some years ago, it was obvious that this was disastrous in at least two ways. The operators of the CAD system at the office were anxiously limited in what to do with the system. To a large extent they were occupied by making plan drawings as they had been taught to do when the system was installed. This also meant that the operator was very keen on making just that but had begun to loose their identity as a qualified architect or engineer, which is an embarrassing wastefulness.

To make the full use of IT in the construction process will mean using a lot of different software for different tasks. There will be plenty of opportunities to teach "key pressing and mouse clicking" for a long

period of time. But taking experience so far seriously we have to perceive that this still has to be the smaller part.

The real challenge is to make a lot of sceptical professionals convinced and willing to develop skills in reigning a powerful medium into a personal assistant. It will have the same need for support by theoretical clarifications and methodology as other subjects already taught in architect and engineering schools.

Educating the reflective practitioner - architect as well as any other professional.

Donald Schön[1] has described how the traditional way of teaching design also can be used for education of any other practitioner. Every architect reading his examples will smile with recognition of how this actually worked - at least once or twice. Briefly it means that students are being coached through the design task by an experienced teacher who brings problems to the surface for reflection and discussion. Within the Architect schools there ought to be a knowledge of this educational method which could be used for a broader group of students.

At CIFE at Stanford University[2], among other places, education has been given to practitioners from different disciplines. Offering an educational platform for consultants from different professions to try each others tasks and methods could definitely be of interest for the construction industry.

In Sweden we are discussing a co-operation between the CAAD labs of Göteborg, Lund and Stockholm to develop a joint course package for a collaborative educational project to meet the predicted needs. It would certainly be interesting to discuss making an even broader base for it on Scandinavian or even European levels.

International joint ventures for Architect schools.

At the seminar it was stated that Swedish industry has an advantage before many other countries - we talk with each others over the phase and professional boundaries. In Sweden the number of researchers and educators in CAAD and CAD in the construction industry are easily counted. So we will have to start talking with our colleagues outside the country.

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[1] Schön, D.A., (1987). Educating the reflective practitioner. San Francisco, ISBN 1.55542-220-9
[2] http://www-leland.stanford.edu/group/CIFE/index.html

Beside some exchange of students within European programs so far there is not very much contact between Swedish and other architect schools generally. However, the educational conditions for CAAD has been strikingly similar.

This paper is a kind of test to see if conditions in other countries are similar enough for us to share experiences and use each others good examples.

What can Architect schools do?

Finally a summary of the proposed answers. Architect schools could support implementation by:

-    Making a link to departments of social sciences for interdisciplinary work

-    Building networks, such as AVOCAAD, to create a forum where especially those belonging to small firms or organisations have a chance to keep in touch with what happens

-    Taking responsibility for keeping information updated on the state of the art of CAD.

-    Getting away from the slavery of drawings, students have to be taught more about communication and how to create messages and tell stories

-    Teaching other actors of the design process how to sketch.

-    Teaching object- (product-) modelling to students of architecture as well as engineering

-    Making a lot of sceptical professionals convinced and willing to develop skills in reigning a powerful media into a personal assistant

-    Creating support for CAAD education developing theoretical clarifications and methodology

-    Making use of the traditional learning method - That students are being coached through the design task by an experienced teacher who brings problems to the surface for reflection, discussion and action.