Education: Information Technology and the Construction Industry

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ABSTRACT

The acceptance of Information Technology (IT) has been growing within the construction industry for some time. This however has been largely restricted to the design professionals, including architects and engineers - it has not (except in a few exceptions) had the same impact on the construction site. Part of this can be traced back to the training. Most architectural students are familiar with Computer Aided Drafting (CAD), whilst most engineering students are acquainted with the various related design packages. The same cannot always be said with respect to the building construction students.

In the past building students have been taught computer programming related to some aspect of mathematics, engineering or simple scheduling.

Today this is changing with the emphasis on the application of computers and is demonstrated by the growing use of spreadsheets adopted for specific reporting tasks through to the use of sophisticated scheduling packages, estimating packages and so forth. This extends to development of data bases for their own use and the use of service provided data.

Most students today have access through their computer terminals at the University to world wide data banks, either at other university libraries through such services as AARNET (The Australian Academic Network) or other similar services. The access to CD Rom information such as provided by Standards Australia has become one of the normal tools available to students. Facsimile and modem data exchange methods are part of every day living.

It can be expected that having graduated, the student will encourage their employer to provide similar services. Implementation of computer tendering as forecast for Singapore, will provide further encouragement for the employer to improve his commercial advantage. The growth of the mobile telephone and facsimile is already widely accepted and IT is the logical next step.

The need is for education to keep up with these developments.

Key Words

Information Technology, construction, education

The Good Old Days.

Cards

My earliest memories of computers is of a large room filled
by large blue machines lined up along one wall, black wheels
spinning and a number of large, mysterious boxes on the floor,
the whole thing accessible only through a carefully monitored
air lock. The common university student was not permitted to
enter. We were restricted to another room where there were
three large keyboard units, where the initiated sat and typed
lines of data that was punched out of the cards, which
dropped out with lovely cut outs through their surface. If
very lucky, you completed the punching of these cards at one
sitting. If you were like me, at the end of the session you
had more torn-up cards, with the wrong punching, than those
that you could use.

Following hours of back breaking - and finger tiring - card
punching, the lot were collected and delivered to the
controller who would arrange to run your program during the
night. The joy next morning to receive your sheets of
computer print outs, showing the program had run correctly.
was overwhelming. Yes 1 plus 1 did equal 2. Well not always,
I think I still have the record for the longest undiscovered
loop. The unknown person who controlled the even more
mysterious machinery, had dared to go for a cup of coffee. My
program spat out a box full of sheets of never ending loops.

Technology has moved on from need to punch cards.

Programming

The initial method of teaching computing was to instruct
students how to program. Every computer section within
bookshops (when you could find them) was filled with titles
such as 'One Hundred Programs to Save You Dollars', which made
large sums of money for the authors (maybe) and larger sums
for the book sellers. Beyond the first attempt (which
invariably did not work - the second edition had the
corrections and the new errors) the programs were seldom
implemented. I could not begin to add up the hours I spent
trying to get my large 16 kb machine to come up with the
perfect program for finding those missing documents.

Many people will remember Fortran IV, (what happened to
Fortran 1 to III?) Cobalt then Basic, and a lot of others that
I do not wish to remember. The care needed to get the
language correct , (I have enough trouble with English, let
alone computer-talk) has long been the butt of jokes. These
programs have their own life - they grow up - my daughter,
undertaking chemical engineering, was taught , (or should
that be learnt?) Fortran 7 in 1990. I do not remember
spread sheets, or even word processors in 1970. The word IBM
meant something - usually large, mysterious and spelt M O N
E Y. Big Blue! And you still ate apples.

In the 1980's things began to change. The computer room was still large - but now had multiple small units, each with a screen, working quietly, to all appearances entirely self possessed. The people sat at these units ignoring their neighbour and going about their own business.

They were using the desk top computer. In most cases self contained, or connected to a strange box under the desk that sent out a quiet hum, employing strange pieces of plastic which were almost indecently shoved (never gently pushed or even inserted) into the face or into a box, connected to the computer. The screens were black and white - or grey or green . To most of us an Apple was still an edible fruit . Then there was that thing called an Apple IIe upon which our children played games and even enjoyed learning mathematics or heaven help us - spelling. Toys - or so we gullibly thought.

The Current Position

Today we have IMB reportedly in decline but its clones on virtually every desk, or if you prefer, the Apple Macintosh something - who can keep up 268, 368, 468, Macs, Classics, Notebooks, Quadra,CX, etc.

Yet there are major differences. First, the hardware is very sophisticated compered with those of even a few years ago. Coloured screens, large memories, (try to buy a 20 megabyte hard disc) a single Compact Disc storage capable of storing the whole of Encyclopedia Britannica (does this spell the end of the annual upgrade volume) and links to other computers via 'servers' and the telephone system. No roving reporter would be seen dead without their laptop computer, complete with fax sending facilities. Hotels now advertise the second telephone plug for your fax.

The second is in the area of software. The basic tools today are the spreadsheet, the data base, the word processor, the desk printing program, the slide shows, the video facilities, not forgetting the computer aided drafting and so forth. What was once a mystery is today a way of life to many people. Added to these general tools are the quite sophisticated 'off the shelf' programs.

The User.

One of the major problems facing educational institutions is time. With the growth of information, very little drops out, but huge amounts flow in. That is, the basics still have to be taught. In the case of construction, the rudimentary principles still have to be taught - from what is a nail, to how to place concrete on a 400 meter high building. Yet the tools used for teaching have changed almost totally.

Very few lecture rooms even have chalk boards. The use of the white board and markers may be a very basic change, but is representative of the changes - a higher technology - much cleaner and to most people, easier to use. The latest units incorporate the ability to print out the data on the board, which once photocopied can be distributed to all the students as a permanent record. This allows the student to give full attention to the lecturer, rather than trying to write notes and listen at the same time. A skill very few students possess.

This is followed by the overhead projector. A simple
implement that has been around for some time, but has
gradually become more reliable and efficient. Then followed
the slide projector and the video machine. At RMIT only two
years ago, all video showings had to come from a central
point. The majority of our tapes were on U-matic - that 19
mm wide strip which could only be reviewed in the library.
Today we use VHS or Super VHS. Our own department has three
cameras - two of which just about require a full technicians
licence. To go with this we have the editing suite which
permit the most technically advanced mixing and editing. A
further advance to this technology has been the computer.

Up until now, the computer in academia has been a desk top
unit - either in a computer laboratory or on a lecturers desk.
Now we can take our laptop/notebooks computer (with more
abilities than the largest unit of only a few years ago) and
connect it into a machine on top of the overhead projector,
and project the computer screen onto the large projector
screen on the wall. In even more sophisticated set ups, the
computer can be fed into the fixed projector (Bardu units etc)
and give extremely good resolution.

Thus anything that can be done on the computer can now be
instantly reproduced in front of the students - even mistakes.
This is very useful for demonstrating structural design right
through to architectural CAD drafting principles.

Teaching Reality.

Whilst virtual reality may be the 'buzz' word of the year,
teaching is actual reality. That is, the institution has to
equip the student with the ability to graduate from the
institution and obtain employment. In the current tough
economic climate, obtaining work in the construction industry
is not easy. Yet many of our students are being offered work,
not only in Melbourne, but throughout Australia and Asia. To
quote Prof. Sumner Miller, 'Why is this so?'

The answer lies in our syllabus. As stated earlier, we no
longer teach our students computer language. We instruct them
how to use specific programs widely used in Industry. Thus
at the completion of their course, the graduate can go into
an office, sit at a computer and immediately start to produce
income for his employer.

This principle is applied right across the subject spectrum.
Subjects usage ranges from Statistical data packages through
to sophisticated scheduling programs (Faststat, Minitab,
Estimator II, ACE, Buildsoft, Primavera, MacProject II, STRAN
- a structural analysis program., accounting packages etc).
In most cases these are used by the students in tutorial work,
and right through to major submissions.

Other uses include the employment of the basic program tool
such as a spreadsheet - Excel or Lotus 1-2-3 . Feasibility
studies and general economic related subjects are employing
this system to an ever growing degree. Added to this is the
straight forward use of word processors for assignment
submissions. A sidelight to this is that the students now
have a copy of their submission should their original
submission go astray for what ever reason.

Most of us have been faced with the 'need to know' but not having the 'how to find out,' at some time in our career. The visit to the library, if on campus is the usual starting point in finding where the information can be located. The time spent looking through the catalogue - once a whole series of cards - with someone always at the drawer you need is legendary. Then came the era of microfiche. Those small blue pieces of plastic, which to the human eye were entirely unreadable, but placed in a reader, immediately opened up a large number of catalogued references. Finally arrived computer catalogues. The information was still basically the author, title and general classification of contents. However the computers were within the library and you still needed to queue up to gain access.

A recent development in Australia has gone back to the microfiche. A company is producing microfiche where the data itself is not subject to updating. Additional information comes out on new sheets, but the old remain relevant. The computer data base is better where regular updating of the data is required.

Today I can sit at my desk and gain access to the library at the push of the right buttons. Further, I and most students through the computer laboratories at RMIT, can gain access to libraries within other institutions in Melbourne, in Australia or across the world. There is something rather wonderful to be sitting in Melbourne Australia, just about as far south as you can go, and gain access to a library in a Scottish University.

The technology to enable this to happen is a combination of the telephone line, satellite communication and internal networking systems. Thus an academic can connect to other people within his department via his computer keyboard to discuss a particular problem, or by use of such systems as MINYOS can talk to his colleagues around the world.

Currently a lot of the information available is only slightly advanced on that of the old library catalogue card. Yet even this is now changing. It is possible to dial up CARL in Maine USA and to inspect over 10,000 magazine indexes, going back some four years. From here, having found the magazine article you wish to read, by keying in your credit card number, a copy of the data will be faxed to you within 24 hours. For earlier magazines, special arrangements can be made.

Schools are generally leading the way in multi-media production. Acorn, the UK company has been behind the development of a number of CD - known as the CD-ROM Applications Development Scheme. Such projects as 'CHEMISTRY', '20th Century art,' which is based on the collection at the Tate Gallery and a disc known as 'Industrialisation in Britain 1750 to 1900', are typical examples. Typically these are available in Archimedes, PC and Apples.

Not only academics, but students will have access to vast
quantities of information at the touch of a keyboard. The
growing libraries of Compact Disc storage - from encyclopedia
to magazines and newspapers, will reduce the time and effort
required to locate and access information. The need for self
control, so as not suffer from information overload, will
need to be appreciated by the early users.

FUTURE

Computer Aided Learning

One of the pressing problem currently facing academics is not
the lectures, there is plenty of information readily available
as discussed above, but is the marking of assignments. In
my department we are currently enrolling over 70 students into
our first year. With lectures, within reason, it does not
matter how many are in the lecture room. With the use of
small tutorial groups, a reasonable level of two way
communication can ensue. However if you have a laboratory of
20 computer consols or more, then more than one tutor would
be required per group. This has several disadvantages.

First disadvantage is that it is imposing old education
methods on a modern system.   Second it does not permit the
same attention to all students. The quietest student will not
get the attention of the noisier - no matter how well
intentioned the lecturer/tutor.

Second it is much harder to mark that number of exam papers
with the same concentration as you can give to 20 papers.
This is both hard on the person marking the papers who will
try to be fair, perhaps even overcompensating at 1.00 in the
morning. This in turn is not fair on the student who has
worked hard for the exam/assignment and deserves full
consideration by t he person assessing his work.

The third point is the quality of the learning. Exams and
assignments do not necessarily reflect the true understanding
of the subject by the student. How many people can remember
the details of a subject once the exam is over? It is common
practice amongst students to move onto the next subject. The
linking of one subject to another is seldom appreciated from
the point of view of the average student. The best normally
expected is that the underlying principles may be retained by
the student.

Finally there is the pressure being applied onto Australian
Universities and from conversation with other academics,
pretty much in all institutions across the world, to minimise
costs.   At the same time society has come to the an
unrealistic expectation that all students who complete
secondary school should have the automatic right to enter the
institution of their choice.

The solution to one of these problems in the past would have
invariably intensified the pressure on the other areas. The
more students enrolled, the more staff are required, the more
pressure for new buildings, added maintenance and resultant

costs escalation. As these pressures have increased, there has arrived on the scene a solution which can in most instances resolve many, if not all, of these problems. This is the use of Computer Aided Learning (CAL) or CAE (education).

This is the use of computers enabling students to learn at their own pace, with minimal supervision, but with maximum assistance when required. The program is generally a shell into which can be install both instruction and associated assessment. An example would be the theory of bending moments. This can first be the formula, with diagrams showing the principles. Then a series of photographs demonstrating the principle used in practice, and if required, even video sections can be incorporated. The complexity is dependent upon the program and the computer memory - the more sophisticated the program employed as the shell, the more computer memory is required.

At any point during this process, the student can be requested to solve specific problems. If he answers correctly, the program will take the student on to the next stage. If the answer is incorrect, the program will either give the student another opportunity, or will take the student back to the instructive section covering the area of knowledge where the student has failed to comprehend the lesson. Thus the student has control of the pace of his learning and the computer is acting as the examiner and marker.

To be of any use, many hours have to be spent preparing the information to be included in the program. Once established, the data if it is to continue to be relevant, has to be regularly updated to meet changing knowledge and emphasis. The advantage is that once prepared, a program such as this has almost unlimited use. If, as is beginning to occur, each student has their own computer , then copies of the program can be prepared with relative ease, so that each student can work, where and at the time, that suits them.

These advantages to the student should also lead to less pressure on the student - dead lines are more flexible, to the point of almost being set by the student rather than the lecturer. The student is in effect, competing against himself. This reduces the pressure of some students being able to comprehend the work immediately, and others requiring more time, and possibly several repartitions of the same data. A chore to the lecturer to have to say everything several times, and worse, boring to the brighter students with the chance that they will become bored and the class nuisance.

To the lecturer this method of teaching offers many advantages. It allows the lecturer to cover areas in the lecture that will broaden the understanding rather than needing to spend a lot of time on minor, but possibly very important points. It will free up the lecturer to spend more time updating his knowledge of the given topic, and will also provide instant feed back as to how students are progressing, as the programs have built-in reporting features, normally only accessible to the lecturer. This will permit the lecturer to readily discern the student who needs his

assistance, rather than the student who makes the most noise.
Added to this, will be a reduction in the facilities required
for students - large computer laboratories may soon be a thing
of the past. With the addition of reporting via modems, the
student does not have to physically visit the institution to
submit his assignment.

Thus all parties are happier. Students will feel they have
better control of their learning process, lecturers will have
both more time for improving their own knowledge and better
knowledge of how the student is progressing, whilst the
administration will be obtaining a better return for their
dollar.

Other advantages include teaching students (or at least
tutoring) in language other than the lecturer's own. The
program once established, can be readily converted into any
other suitable language - English into Chines, Malay etc.
Thus in our own case the disadvantage and resultant pressures
on the student whose first language is not English, can
largely reduced.

Research.

The other activity of academics is that of research. This is
an area which is receiving considerable attention in Australia
in particular and in universities world wide. It is the
quality of research which now often provides the financial
resources that permit employment of the employment of the
personnel who will pass on the best information to the
students.

The single biggest problem to Australian (and many other
countries) researchers, besides money, is that of the physical
isolation. Many researchers in Australia do not get the
opportunity to visit overseas institutions so as to keep up
with all the research being undertaken or if we do, only to
a limited extent compared with either our European or American
counterparts. Magazines and most reporting is of the outcome,
thus it is too late to contribute It would be very
embarrassing if you were half way through your own research
only to see the answers published by another researcher.
Embarrassing as well as a waste of valuable resources.

An extension of the inter library facility mentioned above is
now being applied to research. Assoc. Prof. Peter Edward's
at RMIT has established a network of researchers, using the
electronic mail facility. For full details, I refer you to
his paper published by ARCOM (The Association of Researchers
in Construction Management, in the United Kingdom at the
Annual Conference on the Isle of Man in 1992.

The principle of his network is that researchers working in
their own institutions have the opportunity to instantly
discover which other researchers may be covering the same or
complimentary areas. It will permit draft report and papers
to be available to encourage people to read and provide rapid
feed back. Whilst this will provide an avenue for
unscrupulous researchers to plagiarise the data, the very
nature of the network should discourage this occurrence.

There are other organisations now looking at establishing
similar networks. The University of Manchester is reviewing
a similar network for Alternative Dispute Resolution research.
There is no reason that the CIB cannot begin to establish
similar networks for the various working commissions. Thus
people from around the world could participate at minimal
cost. Imagine the impact that might have on airline and
conference related institutions.

SUMMARY

The future graduate will have a vast amount of knowledge about
construction. Whilst this is no different to that of all
previous graduates, they will have one advantage. They will
have the knowledge of how to speedily and effectively keep
their own expertise current. Through the use of information
technology via their own computer keyboards, they will be able
to search the world for answers to what ever questions they
need to solve. In addition they will be able to pick up new
programs and feel comfortable with them.

We are on the brink of the new generation of graduates - the
'info-tech'.

References:

 'Tomorrow's Dream system is here today'. article in the
COMPUTERS -High Technology section of 'The AUSTRALIAN' -
Tuesday Feb. 23 1993 .

'Costs hold back a rising revolution' - article in the
COMPUTERS -High Technology section of 'The AUSTRALIAN' -
Tuesday Feb. 23 1993 .

'The role and effectiveness of construction networks in future
construction management research'. Assoc Prof. Peter Edward's
& F. Pretorius - ARCOM (The Association of Researchers in
Construction Management), in the United Kingdom at the Annual
Conference on the Isle of Man in September 18-20 , 1992.