TECHNOLOGY MANAGEMENT IN ARCHITECTURAL PRACTICE

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1. INTRODUCTION

Today, we are truly in an *information society*. Moving vast amounts of information quickly across great distances is one of our most pressing needs. From small one-person entrepreneurial efforts, to the largest of corporations, more and more professional people are discovering that the only way to be successful in the new millennium is to realise that technology is advancing at a break-neck pace — and they must somehow keep up.

Work groups can now conduct interactive conferences with each other, paying no heed to physical location. You have at your fingertips the ability to talk in 'real-time' with someone in Japan, send a 2,000-word short story to a group of people who will critique it for the sheer pleasure of doing so, see if a Macintosh sitting in a lab in Canada is turned on, and find out if someone happens to be sitting in front of their computer (logged on) in Australia. The possibilities are endless — all from your desktop computer.

The largest problem people face when first using a computer network is grasping all that's available. Even seasoned users find themselves surprised when they discover a new service or feature that they'd never known even existed. Once acquainted with the terminology and sufficiently comfortable with making occasional mistakes, the learning process drastically speeds up.

This is what we are going to do throughout this paper — introducing IT management concepts, making you feel comfortable with the issues and learning ways to manage all of it.

2. TECHNOLOGY IN THE BUILDING INDUSTRY

Traditionally, the building and IT industries seem to be at the extreme opposites. While building is an ancient practice, IT is relatively very new. In addition, the building industry is basically a 'bricks-and-mortar' industry, with tangible end-results. On the other hand, the IT field is an intangible one primarily 'servicing' and adding value to the various other core-industries.

This last factor has resulted in technology being often defined as the *'enabling tool'* for the traditional facets of the economy. Thus we have now IT within almost all facets of our daily lives from the home, the workplace, the motorcar, banking to entertainment and leisure activities.

Having crept into society so deep and within such a short time span, technology is today diminishing the lines between the 'luxury' and the necessary. For example, no longer is it considered a luxury to use an ATM machine but a necessity. And in the building industry, no longer is it a luxury to deploy CAD but a necessity — often even stipulated in the terms of reference and appointment.

In the old days, users and employers often went to great lengths to justify IT use, usually using one or more of the following methods:

a. productivity ratio — improved productivity over manual methods (most common method);
b. turnaround-time ratio — time required to do a task manually divided by the time required to do it with computers; and / or
c. cost ratio — the cost to accomplish a task manually divided by the cost to accomplish it using IT tools.

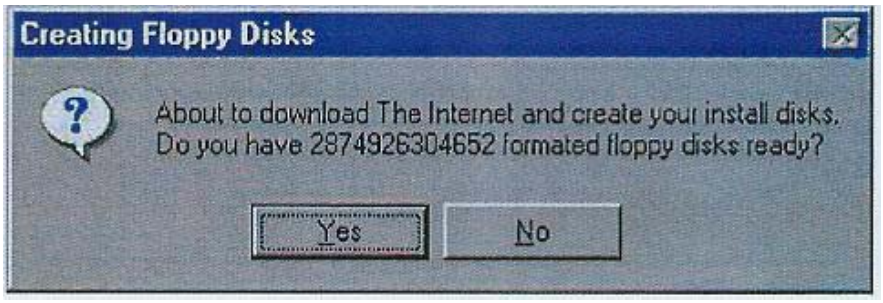
We have now reached the stage where users and managers are seldom asked to justify IT purchases and use in such arcane ways. This is just as well because generally, the cost-benefit analysis of IT systems can be more misleading than useful — and positively dangerous in that it diverts attention from the real and substantial but unquantifiable benefits such as improved accuracy and quality of product — that such systems can confer.

In Malaysia, the building industry began using technology noticeably in the mid-1980s. Almost two decades later, the industry now deploys the latest hardware and software techniques and is being managed by competently trained personnel.

Japan leads the Asian online growth revolution

3. INTERNET TECHNOLOGIES

The Internet is a large 'network of networks' all inter-connected together into one great 'living thing', communicating at amazing speeds using the TCP/IP protocol. All activity takes place in 'real-time'. No one controls it and no one owns it. It is not a tangible product or service and does not exist in any particular form — you don't buy it off the shelf, nor do you 'load' it into your computer!



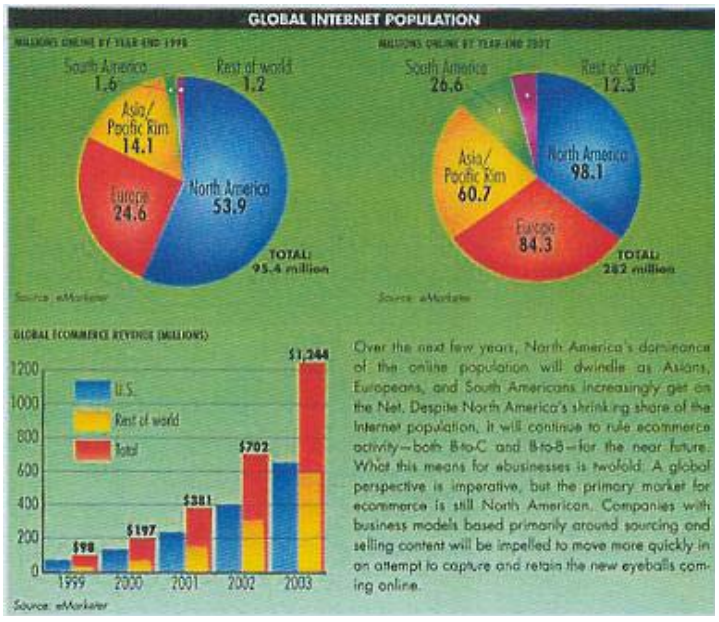
No-one owns the internet!

The Internet has taken the world by storm and now reaches out to every corner of the world. It's use is growing exponentially and today very few areas of human endeavours are excluded from it's impact.

We can now link up and communicate in real-time with others anywhere in the world by merely using a computer and some peripherals and software. What's even more enabling is the fact that the Internet transcends geographical and other barriers such as time zones, languages, cultures, etc.

The Internet is a major paradigm shift for the uninitiated and the world is truly a global village now. Components of the Internet of relevance to an Architect today include:

- *World Wide Web (WWW) sites* with the millions of websites
- *email services* allowing fast, reliable — albeit somewhat insecure — data transmittal
- *portal sites* with news, information, lifestyle and a myriad of other services
-*ftp sites* for downloading software, etc.



The number of online users are increasing exponentially

5. ISSUES DIRECTLY AFFECTING TECHNOLOGY MANAGEMENT

Several areas of technology impact the day-to-day work of an Architect.

5.1 STANDARDISATION

Computers are a mixed bag — while on the one hand they demand absolute accuracy and preciseness, their use also gives extreme freedom to us. For example, whereas the old typewriters gave us one typeface (or a few at most on later models), suddenly users have the freedom to use a hundred different font types on a computer word processor! While this wide selection can be put to good use in a creative project, an organisation needs to standardise its documentation to maintain a consistent, 'corporate' look and feel.

In CAD work for example, it is absolutely important to standardise typestyles, font sizes, whether text is all uppercase or mixed case, color, etc. CAD layering systems are a major concern in any installation with more than a couple of workstations. A standardised layering strategy not only aids in inter-office work but is also useful when exchanging data with outside parties or across platforms.

Good practice dictates that there be an office manual outlining these standardisation policies. Such policies should be strictly adhered to; otherwise there would be chaos. However, these guidelines and policies should also be flexible enough — if and when required — to be changed or adapted with the changing times and needs of the organisation.

5.2 SECURITY

In any business environment, security — both physical assets and business information remains an important issue, especially in today's highly competitive world.

5.2.1 Physical Security

Physical security is slightly easier to handle. At the very least, the issue has been around for ages and society has largely learnt to deal with it in a systematic manner. Apart from physically securing your premises, organisations dealing in P&C type of information have strict policies and non-disclosure agreements with their staff and suppliers.

In an architectural office, the main security issue revolves around confidentiality of project information, especially certain sensitive projects. This is more of a management and policy matter.

With the use of technology the physical security of the computers and their related software become an issue. What if your computers are stolen or maliciously damaged by vandals, disgruntled employees, etc?

It is therefore extremely important to have a backup policy in place. All data on your computers must be regularly backed up and stored securely. A physical copy of the data must be kept off-site, ie away from your office. This would safeguard against any major disasters such as fires, floods, earthquakes (yes, its safer to take precautions rather than regret it later). While hardware can be easily replaced, its the data that is irreplaceable, thus such offsite backup would ensure that you are up and running in a minimum of time following any disaster.

A data backup policy, having been devised, must be religiously followed — it must be second nature to your employees to do regular backups. All the same, do not just rely on your junior employees — it is the ultimate responsibility of management to ensure that sufficient backups exist.

5.2.2 Information security

It used to be that to control information outflow from an architectural office, it would suffice to have a policy of controlling *'who took what drawings out from the premises'*. Employees, especially on the verge of leaving, would often amass sample drawings and other project information to be taken to your competitor.

With the advent of IT, it becomes even simpler for unscrupulous employees to siphon away large quantities of information without being detected. All it requires is a CD-ROM or simpler still, to send massive amounts of information out of your office via an internet connection.

Easiest is to copy data into floppy diskettes — these fit unsuspectingly into a pocket. Luckily, the amount of information that can be copied using floppies is rather limited due to their small capacity. Enter the larger capacity media such as Iomega's Zip drive or even higher capacity magneto-optical (MO) disks and now the recordable CD (CD-R). In just one go, employees can whisk away 650 MB (CD-R) or up to 4,700 MB (DVD-R) of your precious information. For comparison purposes, the total CAD database for the KLIA project during the tender stage (for all architectural, engineering, etc drawings) was just under 1,000 MB. So you can see, whole project databases including detail drawings, schedules, BQs, specifications, etc can be stolen in a matter of a few minutes!

If you think that's bad, worse news is here. With the Internet, newer security concerns arise. If all your employees have access to the Internet and email services at work, they can quite literally email themselves (ie. to their private account at home or elsewhere) all your company information. In fact, this is the simplest form of security breach uncovered in the majority of computer fraud cases — ie. untrustworthy personnel or worse still, strangers, to access and transmit sensitive information out of your computer system.

So what do you do to keep your precious data secured? Obviously a multi-pronged security strategy is required. Firstly, have a strict security classification system throughout the office — information ought to be available strictly on a 'need basis'. Data access points need to be controlled and monitored by senior personnel. The use of floppy diskette and other removable media drives need to be monitored. Internet access needs to be controlled — there is very little need for junior staff to access the Internet at work.

Alternatively, other — invariably more expensive — strategies need to be employed. Your intranet should not be directly connected to the Internet, if at all. Sophisticated firewall technologies exist to control the movement of information both inwards and outwards. Such screening measures also safeguard your internal systems against malicious attacks from the outside, eg. virus, spam, etc (see below).

Lack of computer security is a major cause of white collar crime

5.2.3 Viruses & other malicious attacks

Technology attracts it's share of crazy people. In the early days, there were *'bugs'* (software glitches causing expected or unexpected problems). Soon enough, there were computer *'viruses' (so* called because they seem to behave like biological viruses).

Viruses, in their various forms, basically are pieces of computer code written to cause chaos, disruption of service, or at it's worst, deletion of data altogether. Some of the best brains in the IT industry are often behind such works, albeit being deranged or outright crazy. The damage viruses can cause is well known and smart computer users never leave it to chance — yes, it can, and will, happen to you — unless of course you are protected! Constantly remain vigilant and maintain good work practices. Computer viruses only get transmitted via a physical medium — unlike their biological cousins which can be airborne and transmit through the environment. Therefore, the more you use computers and interact with outside parties, the more you open yourself up to a virus infiltration or outright attack.

Good work practices and an ever-vigilant attitude, especially when receiving files from unknown or untrustworthy recipients, is a starting point to keeping viruses at bay. A reliable anti-virus package is a must in any decent computer setup, however it is imperative that the virus recognition patterns are kept up-to-date so as to be able to quickly detect, clean, or at the very least isolate, existing and emerging viruses.

If you have a website or conduct some other forms of web-business, you may be open to other means of malicious attacks. At the simplest, your site may be hacked into and data on your website be tempered with. This is fairly common but in most cases it's 'pranky' in nature and seldom causes major disasters.

On the other hand, your site can be subjected to more serious attacks aimed at either disrupting your services or damaging/corrupting your information. If yours is a busy website and is accessed by thousands of users a day, a mere disruption of services (DoS) is sufficient to annoy users to go away or at the least, cause an embarrassment to your organisation. If you deal in confidential information, such attacks may cause your clients to loose confidence in your service — often a big blow to any business. These problems can be minimised by having in place sophisticated security systems and rerouting traffic to mirror sites at different locations. The better cousins of the hackers and virus authors are always available to advice on such security issues.

5.3 BACKUPS & ARCHIVING

Back in the good old days. Architects used to keep their project files in the back storeroom — until it became clogged up and it would be moved to the principal's old bungalow somewhere across town. By law. Architects must keep all documents related to a project for a number of years — this includes not only plans and other drawings but also specifications, bills of quantities, project correspondences, etc. All this amounts to a rather hefty quantity of documents, especially over the years a firm has been in practice.

Using technology, most project documents can now be kept in an electronic form. Documents in computer format can easily be stored in their original formats while non-computer format documents can be scanned and kept in a digitised format.

The issue now is not so much the quantity but the actual management of such large quantities of information. Organisations need a clearly defined and strictly followed set of guidelines in archiving documents. After all, the ultimate aim of archiving is to be able to locate the right document from among the hundreds of thousands of documents. Otherwise it would be the classic case of finding a lost needle in a haystack!

5.4 LICENSING & COPYRIGHT

Software licensing issues are increasingly becoming important and complex. Most IT users are either ignorant of the provisions of the Copyright Act 1987 or are of the view that software copyright is ridiculously protectionist in nature. Firstly, it is only fair that the owners of software copyright be protected as much as an Architect would like his designs to be protected. Obviously the software creators have invested large amounts of time, effort and money in developing world-class software programmes. Today's software packages are extremely complex and large. On top of that, millions of dollars more are spent marketing, promoting and supporting these products.

To an end user, especially a small architectural practice, spending money on something as intangible as software seem like a waste. Some businesses are under the mistaken belief that you can buy one original package and duplicate it on a dozen computers — this is tantamount to a developer paying an Architect the fees for one bungalow but using the drawings to build a hundred units!

In terms of management, an architectural practice — be it big or small — will need to spend time and effort to record and control the use of computer software. Someone within the practice should be in-charge of this effort and his responsibilities would include among others:

- recording the serial numbers of all software packages within the office
- correlating these serial numbers to actual hardware/computers
- managing the upgrading of these software products (see under Upgrading)
- ensure that all software products are registered with the vendors/principals
- formulating, implementing and policing strict software licensing policies throughout the organisation

The above responsibilities may seem like overkill, however the law is pretty strict and clear when it comes to users infringing the copyright laws. Under the Copyright Act 1987, not only will the end users be liable for prosecution, managers and principals/owners of an organisation will also be held liable for the infringements by their employees.

Such responsibilities coupled with the heavy penalties imposed if found guilty mandate a thorough and vigilant policy for firms using computer software. You must not only have the policies in place — you should also be continuously *be seen to be enforcing* the same.

5.5 ONGOING UPGRADING

Technology seems to become obsolete the day after you unpack the boxes. In reality, most hardware and software remain 'current' between 6-12 months, at maximum.

5.5.1 Hardware upgrading

It used to be that hardware would be 'current' between 18-24 months, ie. you could be using it for that long before a substantially improved model would be released. In those days, it was said that a user ought to maximise his use of the system in, say, an 18 months period. In other words, you ought to drive the system to repay itself within 18 months and then use the system for another 6 months to make you a profit.

This, however, is no longer applicable today. Now, hardware remains 'current' between 6-12 months at most. In a year's time, hardware advances are so fast that the performance of newer models would be roughly doubled. Even though your computers would still be working perfectly, for several reasons - notably, productivity and increased labour costs — it would make sense to upgrade your hardware.

5.5.2 Software upgrading

Software seems to have a slightly longer 'shelf life' — typically between 12-24 months. Upgrades for major software are usually scheduled every 18-24 months while minor updates happen in between.

While vendors delight in announcing new upgrades, the same causes major headaches for end-users. Among others, the following issues need attention each time hardware/software is upgraded:

- cost of new hardware/software upgrades
- software upgrade often warrants a corresponding upgrade of hardware and vice-versa
- backing up all data before upgrading to new hardware/software and restoring afterwards
- conversion of data due to software version/file format changes
- managing and updating the inventory of hardware/software serial numbers
- tackling inconsistencies, bugs and 'clashes' between hardware and software

5.6 TRAINING

Training remains largely a neglected area due to a lack of sufficient funds being made available. Invariably, the attitude of organisations is *'we want to hire you to work, not to train you so that you can leave us'*. To a large extent, this attitude is justified, especially during the boom times when staff mobility is extremely high.

However, it is the responsibility of management to ensure that the staff are provided with not only the right tools but also the proper knowledge to use these tools. As it happens, with each new upgrade of software — and to a lesser extent, hardware — staff require bridging or 'top-up' training programmes. Such investment in training will ensure that the staff can quickly be up to speed in using the new systems.

Apart from the actual expense in training, there is often the added 'loss of productivity' during the hours when the staff undergo the training. To minimise such productivity loss, the staff can be sent for training either in batches or better still, send only some of the staff for external training — and they would then return to train the other staff in-house, on-the-job.

To safeguard investment in such training costs, management has the right to bind the trained staff for a reasonable time frame. If these staff members decide to leave immediately upon completing their training, they may then have to reimburse the organisation for the cost of the training or part thereof. However, many local employers consider this a petty matter and avoid implementing such stringent policies.

It's always better to train your staffs — lack of training shows in their poor productivity

5.7 CHARGING FOR IT SERVICES

This is not so much an issue now as it was in the early days of IT implementation in architectural offices. As ridiculous as it sounds today, some Architects did try to charge separately for using CAD on a project!

As a general rule, we should be charging for *information* (which keeps getting more valuable) and not for media (getting cheaper) or time (with IT it will take shorter time to do the same task!).

With CAD drawings for example, the base architectural drawing can be used by the Engineers for overlaying their services thus, saving the Engineer a lot of time having to redraw the building all over again. What is even better is that provided the Engineer is using the latest version from the Architect, inaccuracies and discrepancies are a thing of the past.

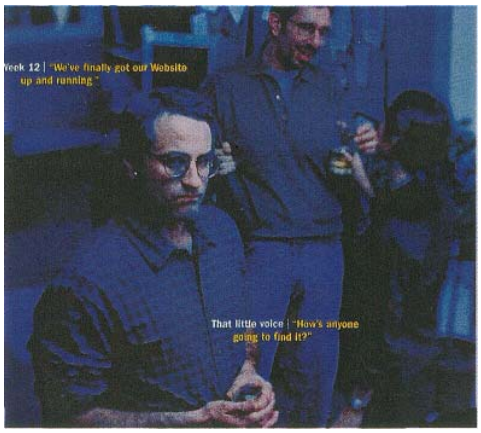
The CAD database is a very important, powerful and re-useable piece of information. As CAD usage spreads further, other sub-consultants, contractors and suppliers find it useful to refer back to the CAD database. For example, the kitchen specialist consultant on a hotel project would find the architectural and engineering CAD drawings immensely useful to help him plan the kitchen spatially. He can thus be assured that his kitchen equipment will fit into the spaces correctly.

But, for an Architect or Engineer, where does this free sharing of information stop and when do they start charging for it? There are no hard and fast rules. However, one strategy gaining wide acceptance is that information is shared freely within the consultants' team but is charged for to the sub-consultants/contractors/specialist contractors.

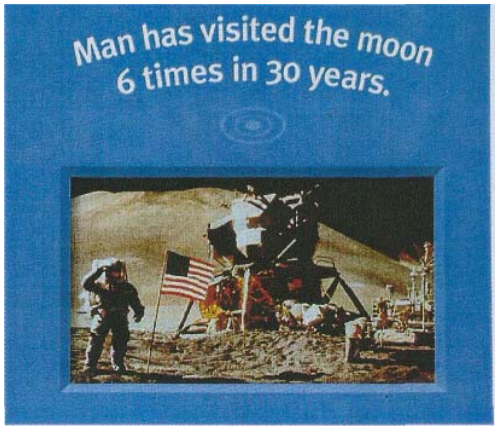
In terms of the quantum, again there are no fixed rates but it is logical and practical to charge for a reasonable fraction of the actual cost that would be incurred should the recipient party have to draw that information themselves. Therefore, there is a win-win situation — the contractor wouldn't mind paying and the Architect can recoup some cost of having to copy the files (labour) and the cost of the media (relatively negligible).

Other specialist services utiling technology tools are sometimes charged for separately although more and more clients are beginning to expect these as part of an Architect's basic services. Examples include CAD perspective drawings, computer-based rendered walkthroughs and sophisticated animations output to videotapes or CDs.

Having said all that, it remains management's prime responsibility to have guidelines for such charge-outs and these ought to be made clear to all parties, internal as well as external.



Websites — promote & update them regularly!



6. AREAS OF CONCERN

Technology in an architectural practice has its own set of problems and management has to deal with these in the best way possible. The following sections outline some of these concerns.

6.1 ONGOING COSTS

Technology investment, while declining in unit terms over the past decade, keeps increasing as practices keep computerising more tasks within the workplace. Sure enough, the cost of computers has declined tremendously. On the other hand, while a decade ago, an architectural firm may have had 4 computers with CAD, today the same office could have 40 computers performing tasks ranging from CAD to administration, specifications, accounting, project management, etc.

In dollar terms however, IT investment is roughly consistent, but now you are getting more for the same amount.

6.2 HARDWARE vs SOFTWARE

In the very early days, CAD systems were sold as 'turnkey systems', bundled together with software and hardware and often, even a service/maintenance contract. Later as PC were introduced, CAD became more generic and users began to build their own systems — although often relying on the one vendor to source and supply hardware and software solutions.

An interesting aspect of this development is that while a decade ago, powerful CAD workstations cost much more than the software itself, this trend has reversed itself completely. Today, it's the hardware that is cheap while software is much more expensive. Over and above that, software now comes with maintenance contracts and even so, major upgrades still cause a substantial dent in an architectural practice's finances.

6.3 BLOATED SOFTWARE

This is a major area of concern to most users today. Many software programs that started off with a good set of commands and features, have over the years, expanded to ridiculously bloated levels. Among others, they have unnecessary and often gimmicky features, less than optimum coding and large data file sizes.

This has been brought about mainly by two reasons: first, the cost of permanent memory media (hard disks, etc) has been going done steadily; and second, software companies have this (grossly mistaken) notion that users out there are demanding more and more features (sometimes arcane and ridiculous ones!).

Most users use at most between 30-50% of the command set available on any software program. The remaining commands are primarily stuff off the 'ghost wish lists' and in a few cases, commands that come in handy maybe once a year.

6.4 UNREASONABLE SOFTWARE LICENSING

While the construction industry has a very long history and a mature, well-developed body of procedures established in statute and common law, the IT industry is young and brash, and its law is undeveloped and imbalanced in favour of vendors. It has so far managed to place the burden of loss on purchasers, its operations are unregulated by licensing or ethical tenets, and there are no standards of minimum skill required.

As software become popular and the companies producing them become rich (and arrogant), most resort to unreasonable licensing policies. This is evident in many forms: expensive initial costs, expensive and restrictive upgrading and maintenance policies and many other unfair practices.

The reason for this imbalance is primarily the vendors being big and cartel-like with associations such as the Business Software Alliance (BSA) protecting their rights, not to mention the close support of government agencies. On the other hand, users are very much fragmented and unrepresented at any level.

It is therefore important that users also band together to protect their rights and have their voices heard by vendors and other agencies in matters such as 'wish-lists', pricing policies, copyright issues, etc. Obviously, what it needs is the *time* and *commitment* of IT management to these issues.

6.5 POOR VENDOR SUPPORT

The computer industry has not exactly gone out of its way to ensure that clients have successful installations, preferring more to sell new 'boxes' than supporting their existing clients. Marketing staff are frequently ignorant of the needs of the building industry and not even too hot on their own products. Not that this is limited to architecture.

A survey of Australian businesses using computers revealed enormous discontent (Davies, 1984 — The Australian Small Business Computer Market, Australian Computer Bulletin). Only 5 percent were very satisfied with their systems, some 70 percent were dissatisfied in some way and 10 percent had actually abandoned their systems completely.

The main causes of complaints were faulty software, poor support and misleading salespeople. A later survey in 1991, undertaken within the building industry, reported slight improvements in user satisfaction (Sidhu, 1991 — The Use ofCADD in the AEC Industry in Australia, Design Computing Research / Australian Building News). It would be revealing to have more up-to-date and localised data to asses if things have changed in the past decade.

7 SUMMARY

Computers have affected many traditional professions. Blacksmiths, typesetters, locomotive stokers and lathe operators are examples from different eras of activities now obsolete or markedly diminished, m the building industry, the skills that an Architect or draughtsman was supposed to possess until about ten years ago are rarely an issue today. On the other hand, someone without CAD and general IT skills is at a definite disadvantage in today's business world. For architectural practices to be competitive — not only locally but also in the cutthroat global marketplace — in-depth IT knowledge and management skills are essential. This is where the Chief Information Officer — a senior level manager with the large overall picture, yet understanding the nitty-gritty of computers — comes into play.

The important factors to make technology a successful implementation are interest, commitment and professional management. All three factors must be stressed from the top all the way down to the junior most staff in any company. The combination of unskilled directors (power without expertise) and low-level system managers (expertise without power) is usually fatal.

Technology management must never be an after-thought. It is an integral part of the modem day business model.

ABOUT THE SPEAKER

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Since 1992, he has been with a prominent multi-disciplinary practice based in Kuala Lumpur overseeing the group's computing strategies and has been instrumental in the setting up and management of the IT/CAD facilities for all their projects, among others the Kuala Lumpur International Airport, the Mid-Valley/MegaMall Shopping Centre, the Sungai Buloh Hospital, as well as the group's forays into the international scene.

He is an active member of Pertubuhan Akitek Malaysia, having served on its Education and Publications Committees and IT Panel. He is currently serving a fourth term as an elected Council Member and chairs the IT Committee and co-chairs the Publications Committee. Among others, he is responsible for the redesign and relaunch ofPAM's website and currently is studying various new and exciting services for members' benefit. He also is a Member of the Malaysian National Computer Confederation (MNCC).