

INTELLIGENT ISLAND, INTELLIGENT PRACTICE?

The effects of national IT policies on the Architectural Profession in Singapore

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Abstract. Historically, the discipline of Architecture experiences time lags in its incorporation of novel philosophical ideas, technology, social ideas and so on, thanks to the inertia brought about by the building process of any built space. So, how has this concrete entrenched discipline taken on the business of Information Technology in this Information Age?

In a 99% wired up 'Intelligent Island' with the national IT master plans created every 5-10 years, how has architectural practices adapted to these changes? What are the factors surrounding IT in architectural firms and how does this affect their adoption of IT. What role should architecture play in a 'Knowledge Economy'?

Keywords: Information Technology, Architectural Practice, Technological Climate, Office Environments, Design thinking

1. Purpose of Study

The purpose of the paper is to document and evaluate the effects that a national drive towards information technology has on the practice of architecture within a country. The country been studied is here Singapore, a small city-state south of the Malaysian Peninsula. It is 646 square kilometers in area with a population of about 4.1 million.

This in an ongoing research, and questions that drives the investigation includes: How does technology created in research laboratories in USA get propagated into professional and location specific situations? Which sector

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drives the propagation and how? What effect does all these have on the local architectural profession in terms of organizational structuring, building procurement, and design thinking?

Data presented in the paper had been collected in a fieldwork session conducted between January and February of 2003. Much of it was done through interviews with management level personnel in various organizations affecting the architectural industry. These include architectural practices, the Singapore Institute of Architects, architectural software solutions companies, and the educational sector. Other sources of current information are collected from government websites.

Beginning with brief outlines of the history of architecture and IT in Singapore, the paper establishes the historical and political context under which current developments and trends in IT operate. Policies, regulations and technological developments will be discussed and case studies will reveal the current working practices of architectural practices, and how these practices are affected by IT policies, IT resources and the technology itself.

2. Context

2.1. BRIEF HISTORY OF ARCHITECTURE IN SINGAPORE

Singapore was a former British colony that was founded in 1824 when the British acquired control of the whole island. Due to its excellent geographical location at the tip of the Malayan Peninsula, it became an important port for shipping between Europe and East Asia.

The main architectural style at the time was the Palladian style, an import from Britain. Most, if not all, of main public architectural projects were handled by British architects. Towards the 60s, expatriate architects also built mass housing based on the Modernist styles. (Hancock and Gibson, 1954)

Following the “Heroic” 60s where young local architects of the newly independent nation dotted Le Corbusier inspired buildings into the architecture landscape (Lim, 1990), the 70s saw the mushrooming of the international styled office architecture when the government declared its objective to make Singapore a global city. In the rush to build and internationalize, a skyline synonymous to that of a global city created the Ultra Modernist city-state and the western ‘death of Modernism’ simply did not happen.

Towards the 80s and 90s, the country amassed great confidence in its rapid economical development and efficient way of life. Architecturally, collaborations between overseas and local firms made possible a significant

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number of large scaled projects, including the Esplanade, Supreme Court, Expo MRT, and Indoor Stadium among others. The nature of such two fold collaborations made use of the efficient local procurement systems as well as the international design expertise of the overseas firms. (The Straits Times, 2002)

With the recommendation towards Design and Build contracts by the 1999 Construction 21 report, currently being implemented by the Building and Construction Authority (BCA), architects increasingly hinge their services on construction-based paradigms of designs. Although local practices have a hand in the design of a number of notable architecture, good design slowly became linked to efficient project management, project delivery and cost management.

2.2. INFORMATION TECHNOLOGY DEVELOPMENT

The island's development as a nation-corporation, together with a supportive network of regulatory bodies, private corporations and population assures a concerted and vigorous pursuit of any ends deemed by the government as constructive to the nation's development. Information Technology is such an objective, and Cronin and Devanport (1993) has observed that Singapore is "a recognized leader in leveraging and sustaining its competitive edge through far-sighted investments in information and communication technologies".

The drive towards mass telecommunications is not a new policy. Back in 1984, the then First Deputy Prime Minister Mr. Goh Chok Tong announced that Singapore will "build a city of expressways and free flowing traffic. Of time-saving Mass Rapid Transit... of electronics, telecommunications and computers." (Lim, 1991)

A series of IT initiatives spearheaded Singapore's quest to become the 'Intelligent Island'. The 1980-1985 National Computerization Plan computerized major functions in every ministry and facilitated the development and growth of the local IT industry by developing IT manpower and forming the National Computer Board. The National IT Plan (1986-1991) introduced networking technologies, and seeded the first government to business electronic communications. IT 2000, the IT Master Plan for the 'Intelligent Island', was launched in 1992. It provided the Singapore One network, which connected the whole island into one broadband network. With this, Singapore became one of the top few countries in the world with the highest PC and Internet penetrations. Online filing, applications, and registrations in many areas were increased.

The latest blueprint harnessing information communication technologies for national competitiveness and quality of life is the new INFOCOMM 21. The blueprint articulates the vision, goal and strategies that would facilitate the

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development Singapore's infocomm industry over the next five years, and make Singapore into the 'Global Infocomm Capital' based in a knowledge economy.

2.3. CURRENT DEVELOPMENTS AFFECTING ARCHITECTURAL PRACTICES IN SINGAPORE

Out of all these IT policies, sector specific initiatives were generated. This section outlines the developments most relevant to architectural practice.

2.3.1. CORENET – Construction and Real Estate NETWORK

This is an IT initiative spearheaded by the Ministry of National Development and driven by the Building and Construction Authority in collaboration with various other public and private organizations. The stated objective of CORENET is to "re-engineer the business processes of the construction industry to achieve a quantum leap in turnaround time, productivity and quality".

The major CORENET feature that is affecting architectural practices the most is the E-submission process. To deal with E-submission, firms have to acquire the right equipment and know the procedures. The architectural industry in Singapore now has to computerize because of the compulsory E-submission process. The BCA offers an incentive program that reimburses up to 50% of the cost of setting up the office infrastructure.

The E-Submission system is a government to business network infrastructure that facilitates the online digital submission and processing of project related documents. Previously manual submissions have to be made to various different regulatory bodies like the URA, BCA, FSSB, etc. Now this one-stop repository in the form of CORENET minimizes multiple replications of the hardcopies of drawings, costs of dispatch, and multiple trips to the authorities.

2.3.2 Singapore Standards CP83

The implementation of the nation wide CAD standard, the Singapore Standard CP83 allowed for more efficient exchange of data and eliminates the confusion of different consultants having their own naming systems. All offices now have to revamp their layer naming conventions to comply. Although the initial adoption phase may be very tedious, the standards are very comprehensive and cover a lot of ground where documents are concerned

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2.3.3. SIACAD Pte. Ltd.

One of the products of BCA's IT interventions is the creation of the SIACAD Pte. Ltd. Originating from the IT implementation committee in the Singapore Institute of Architects (SIA), the company was first set up 2 years ago partly to assist firms in Singapore with the e-submission process. Since then company has produced three major software products namely, SiaCad, Info-base and APEX.

SiaCad is the only application that works with CP83. SiaCad was written to solve the problem of CP83. SiaCad is affordable, workable on its own with all software. The software automates the CP83 layering process and various other tasks.

Monetary considerations into how to fund the company resulted in the creation of Infobase, a central database containing design and technical information about various building products. Suppliers of the products in the database pay to be part of it, hence relieving the financial strain from user to supplier. Information can also be shared among participating architecture firms to create a knowledge base. This has considerable implications for the collaborative potentials of Information technology and also the development of knowledge-based practice in Singapore.

The APEX system is an office management system that takes care of mainly Administration, Projects and Events. Linked to a calendar and PDAs, one's schedule is no longer personal but shared with the group. Also the system automates time sheets, letters and contact sheets.

Previously, the role of managing manpower and datelines might fall on a senior draftsman whose job it is to physically go around coordinating everything. If a team lacks manpower, someone would have to around the company asking if anyone is available. APEX changes the way this social ballet works by making transparent the availability of all staff. Both the firms case studied in the paper are using APEX.

2.3.4. Construction 21

The Construction 21 aim is to 're-invent' the construction industry so as to be a 'world class player in the knowledge age'. This blueprint is the construction industry's response to Singapore's economic vision of becoming a globally competitive knowledge economy.

Construction 21 (C21) seeks to increase the use of prefabricated materials in order to reduce unskilled labour requirements on site. IT is seen as an avenue to achieve this. As part of Construction 21, there is the establishment of a rewards

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system called the “Design Buildability Score”. The BCA gives awards to projects with the highest scores. Software is available to assist in the computation of the score. If the IBS (Integrated Building System), a software that will be launched in November 2003 that can automatically compute information required by authorities, is successful, there will no doubt be a similar software will be designed to fully automate the buildability score.

This, combined with the push for more Design and Build projects has serious implications for the role of architects as designers as firstly, the Builder/Developer has the last say in design, and secondly, automated scoring systems integrated into design mediums like CAD is likely to affect design thinking.

2.3.5. Government building projects

Several government projects, for example the water re-cycling plant by the PWD (Public Works Department) requires the use of Microstation. This compels every company involved in the project to acquire the software if they do not already have it. Though this is good news for Bentley that major infrastructure work in Singapore are procured with Microstation, the companies involved incur cost not only financially, but also in term of time and money lost in re-training staff as well.

3. Case Studies

The two firms studied are a medium and a large sized practice respectively. They are studied in terms of how Information Technology had been incorporated, and the effect it has on organizational and social structures, work processes, as well as design thinking. Both firms were formed in the pre-IT 70s and were one of the first firms to acquire computers in the mid 80s. Both are now fully computerized, and deal with Information Technology in ways specific to their operating strategies.

3.1 FIRM A

3.1.1. Organization

Firm A is a medium sized firm of about 50 people, dealing medium to large sized residential, industrial and educational projects. Comprising a staff strength of about 50, the firm’s projects include commercial, residential, industrial,

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education and also won a many local architectural awards from the SIA and BCA among others. One of the earliest to adopt IT, it also has its own animation department that keeps the firm competitive by keeping everything in house.

The firm is organized into one big studio that is split into Design, Visualization and Production. Architects are encouraged to follow through projects as this will result in a better end product. When the firm was larger, there was a distinction between design and project architects, but now with a trimmer staff size, this distinction is no longer as clear.

Staffing configurations respond more to market conditions rather than IT. New graduates need to be computer literate and know CAD before gaining employment. Also, new young architects do more work compared to the past where a draftsman is available to assist. Experience ranks higher as criteria for employing senior staff. There seems to be a trend that draftsmen are reducing in numbers. There are now more architectural assistants that short of doing designing, are involved with everything from project management, site visits, meetings, and so on.

3.1.2. IT and resources

The offices use a wide range of software including AutoCAD (Version 13 to 2002), 3DSMAX, IntelliCAD, Sketchup, Microstation, Photoshop, Freehand, Pagemaker, Flash and Maya. The reason for the different versions of CAD is due to the high cost of upgrading. Most of the architects in the office use only CAD in the 2D capacity, though the firm is experimenting with the 3D program Sketchup. Most of the other software is only used in the Graphics Team. There is more software evaluation done by the Graphics team than other staff in the firm. All machines in the office range from Pentium 200 to Pentium 4. Computers are used for five years before upgrading, and this works out fine, depending on how the machines are used. Graphic Team computers are upgraded every two years as the work they do more intensive.

AutoCAD is the standard in Singapore, but the firm has to use Microstation for a LTA (Land Transport Authority) project where it is compulsory to use Microstation. The firm also uses local software solutions SiaCad, Info-Base and APEX. Also the company is experimenting with software recommended by SIACAD like Sketchup. The firm finds SiaCad very useful as it provides a design module and elaborates on it. Also, their own databases are built up with the system as well as allowing them to access the information base of all the companies participating in the project. SiaCad automates a lot of things

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including the laying process, which frees staff from the drudgery of repetitive drafting and checking.

IT training is not frequent, as most staff members already know CAD when they come in. Company IT policies are decided by an IT committee that is part of the ISO Committee. All the groups in the company are represented. This committee implements IT standards, and there is a standard filing procedure for confirmed projects that everyone has to follow. Presentation structures are also standardized.

3.1.3. Information Sharing and Communication

There is shared information on the network, including a library drive where all staff can access information about updates in authority requirements. The company had acquired the APEX system and was evaluating it at the time of the interview. The office has an existing intranet system called FileMaker created by the IT manager that automates office tasks like faxes and letters. Asked if there was a conflict between the two systems, the IT manager indicated that the two systems complemented each other as they performed different functions. However, it is a matter of time before APEX becomes the only office management system.

Most communication outside the office, locally and overseas, is done via email or ftp servers. The firm has a branch office in Shanghai. Working from home is still a rarity, and the firm would prefer operating in an office environment.

3.1.4. Using CORENET

All staff members have their own email addresses and have access to the Internet. Although it is technically possible for architects to electronically submit documents to CORENET, all submission from the office is done through a central server. The reason for this, as indicated by the IT manager, is the unreliability of the CORENET system. Hence, if everything is done through only one computer in the office, any errors can be more easily handled.

The company experiences problems that seems be caused by slow reaction times and network capacity of CORENET. As most projects are on a timeline, the uncertainty of a virtual submission process creates tension especially when replies from BCA come in faster than replies from CORENET. There are times when files are too large to be downloaded from Corenet, and a dispatch has to be

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sent down to burn the data to CD. Other problems that arise are strictly internal. For example, firewall setting has to be adjusted in order to e-submit.

3.1.5. Design thinking and Future trends

The perceived effect that IT has on design in the firm is that designs can be produced faster and that there is now more time to look at the design. Computers and Design are perceived to be separate entities, though presentations are now more corporate and more depth can be achieved because of the computer. Experience is very important although most of the architects in the firm now are quite young. However, these younger architects are able to do more because of their computer skills.

In terms of virtual reality, 3D modeling is only done by Graphics Team members. Architects have always worked in 2D, but are now experimenting with 3D designing. As 3D models and visualizations are done from the very beginning of the design with ever demanding clients wanting visualizations for even the smallest detail, it can be said that VR is used in the design process as evaluation tools. Other forms of VR are considered too expensive, especially for a time as the present when the market is down.

Asked what it would take for OOCAD to take off in Singapore, the reply was that market conditions are very important. If the markets picks up, there would be more interest in exploring various ways of working with CAD. The government is the main driving force behind IT use and the BCA is leading the way. When sufficient guidelines are made available regarding the rules, submission procedures, etc. to facilitate the 3D process, then the firm would not hesitate to go into OOCAD use.

3.2. FIRM B

3.2.1. Organization

Firm B is one of the largest architectural firms in Singapore with a group of companies that included interior design, project management, and computer visualizations. The firm mainly engages in larger projects like commercial buildings, condominiums, and the like. With about 200 people on staff, the office has a very comprehensive IT system to deal with the massive amounts of information and data required for the day-to-day workings of the firm.

IT skills as a prerequisite for gaining employment decreases up the ranks. Experience is still the major factor for employment for more senior positions

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while young graduates will not obtain an interview if they did not know CAD. According to the director of the company, young architects with good IT skills, like 3D CAD skills for example, move faster up the corporate ladder. In terms of allocation of responsibility, it depends on the job. With design and detailing work, experience is still the main factor.

The only tangible role added to the company because of IT is the IT manager. There is also the establishment of the Drawing Standards Committee comprising of staff members that implement all templates in the office. The IT making structure within the company falls under the ISO committee. This committee spearheads the company IT direction.

3.2.2. IT and resources

The firm uses the Microstation CAD software, which posed a problem, as it is AutoCAD and not Microstation that is the unofficial standard in Asia. The firm has branch companies in other parts of Asia and all of them use Microstation except for the ones in China and the Philippines. However, Microstation Version 8 that can read and write in native AutoCAD formats has recently solved this problem.

The firm uses Microstation Version 8 as their main operating software. Most of the work is in 2D and many features of the software are not utilized. The feeling is that here is a bottleneck in the features in CAD and the industry from project management to building. The CAD industry churns out more and more new features that are not used by the construction industry.

3.2.3. Information Sharing and Communication

Mass emailing is a common form of communication in the office. The office also has an ftp server. There are project sites that can be set up on the web to coordinate efforts between all parties. Commercial sites such as IC Fox and Project Point offer this service. Such portals offer e-tendering services as well as communication between various parties. Setting up this project portal is the client's call, but this would mean additional costs to all people. One has to pay to set up an account.

In terms of working from outside the office, there have been a few cases where previous staff collaborated on their unfinished work via email from overseas. The real problem in net-based collaboration is bandwidth. For exchanging large parcels of data, high-speed Internet access is really needed. Most countries that the firm is working with do not have large bandwidth. As

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soon as broadband access is available to all side, then the capability of the Internet can be maximized.

Most clients are not IT savvy. One exception is an Indian project. As this is a company with executives spread across three cities (2 in India and 1 in USA), a URL was registered and the clients can review the project online. This is much faster than trying to get approval via email. It would have taken a longer time if not for the website.

3.2.4. Using CORENET

The process of submission involves the architect preparing a set of drawings, which is given to a staff member who deals specifically with authority submissions. It is not necessary for this person to know CAD. When it is made sure that all regulations are complied with, formats of forms are correct, drawing formats are correct, etc., the documents are passed back to the architect who electronically signs and e-submits.

3.2.5. Design and Future Trends

The main change is that concept design and schematic design progresses at a faster rate. Because clients know this, they ask for more options, when in the past, they would have hesitated to request for more options. More options do not necessarily mean better design. Hence, computerization resulted in less time and more work.

For similar projects, it is possible to take previous unused designs. Similar programs can be easily adapted. However, there is no less of designing from scratch as for most projects, the design is not repeatable. The APEX system allows for information from previous built projects to be available. Hence one can retrieve the information (CAD, costs, people) to get a feel of the scale of the space, or the cost.

Compared to the past, the drawing up of perspective/ design representations are taken away from the architect. Traditionally, the architect would still be involved in the visualization. When digital presentations first came into being, architects became removed from this process due to lack of skill. However, the new generation of architects is increasingly able to create their own visualizations and depend less on the graphics team.

The target for design generation in the firm is hopefully the acquisition of more staff with OO CAD skill. That way, the use of a 3D model would provide consistency when changes are made to the design (immediate update on plans,

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section, elevation). There is however a concern that is a person does all and if the time allocated is not balanced, the architect might not be as interested in exploring creativity in design.

With project management, everything is still paper based. With finances, paper is also the main medium of work. Even though Micro station can do quantity-surveying work, the firm does not utilize this function as this belongs to the domain of the quantity surveyor. There is no assignment of non-graphic values to graphic elements. The project management part of architecture does not utilize 3D CAD as the other partners in the industry do not utilize CAD to the full extent. At the moment, legal concerns are not inhibiting the switch to 3D CAD but rather that the industry is more used to 2D drafting.

4. Summary of findings

4.1. EXTERNAL FACTORS HAVE A LARGE IMPACT ON THE FIRMS

The Building Construction Authority of Singapore is in a position where it exerts considerable influence on practice, much more than pre IT times. At the moment, BCA lead initiatives change the medium through which architectural documents are created and also balance of time and effort spent of certain aspects of the building procurement process. There is a lot of authority pressure for firms to computerize. C21 directives, also driven by BCA encourage Design and Build projects, and also provide incentives to architectural firms and developers to adopt the Design Buildability Score. Many awards are given out by the BCA to encourage a good score in new building.

Later this year, the BCA will launch an expert planning checking software, the Integrated Building Plan (IBP), that will automate plan-checking procedures. If successful, it would be very likely that a similar system will be designed to automate the computation of the Design Buildability Score. Already, the BCA has a semi-automated system, the Electronic Building Design Appraisal System (E-BDAS) that assists in the computation of the score. Used as an add-on to CAD programs, this electronic tool when used as part of the design process will no doubt have consequences on design paradigms and results.

IT Committees in both companies are part of the ISO committee. Since ISO standing is audited based on a self-declared objective and not an externally imposed objective, it can be seen that the two companies see IT as an important part of the ISO standing. As ISO itself does not require IT to be included into the audit, it seems that it is the national policies that provided the push for the inclusion of IT.

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4.2. ORGANIZATIONAL CHANGES ARE SLOWLY OCCURRING LOWER IN THE HIERARCHY

Organizational structures are slowly being affected by IT from the bottom of the hierarchy where young IT savvy architects are. Since workflow processes between manual drafting and 2D CAD are similar, pre-IT social structures still hold. Electronic documentation (2D) simply fast tracked information processes without altering it on a primary level.

In the context of larger practices, pre-IT divisions were based on the perception of the role of the architect as opposed to that of a draftsman (Design versus Documentation). Early IT adoption reinforced the divisions and also split the architects work further by the creation of the graphics team where most visualizations are done, and where most of the IT resources are concentrated. Architects were removed from the visualization process due to lack of skill. However, new architects are now skilled enough to retake some of the work lost to the initial adoption of IT, and the dichotomy becomes that of adequate experience and adequate IT skills.

Given the pattern of adoption of IT into local practices in Singapore, the integration of IT skills and experience levels is likely to be slow and dependent on educational institutes. The interest showed by educational institutes like the National University of Singapore and the BCA in OO CAD has the potential to alter even further current work practices and social structures within a practice as the information flow processes will be different. More integration of experience levels and IT skills is needed for the technology to be optimized, and the effect this will have on practice will make interesting study when it is finally implemented.

4.3. DESIGN

The main response to the question of how IT as affected design seems to be that conceptual and schematic designs can be done faster. There is an increase in client demands for more options and more amendments to the design. The architect's work is devalued as he/she ends up doing more work for the same amount of money, and not necessarily achieving a better design at the end. As mentioned earlier, new software designed to automate government regulation requirements like IBP and SiaCad are integrated as part of CAD. This altered digital design medium will have an affect on design.

5. Concluding statements

So far, the fieldwork seems to indicate that it is the government bodies that drive the propagation of imported technology. Also, the pattern of use of these technologies, and the local developments that resulted (e.g. SIACAD) indicate that the local culture play an important part in what can be successfully implemented. Hence, the application of IT in architecture in Singapore seems to be least affected by the technology, and affected more by the technological climate and culture surrounding it.

For example, moving into 3D designing is less of a cost problem because most CAD software used by practices already has 3D functions. People's attitudes play a larger role and despite constant innovations on the part of the software company to produce new features, architectural practices in Singapore simply do not use them.

Within the context of Singapore, the more compelling question that arises from the case study is how exactly should Singapore engage in the global economy via the use of Information technology? IT does not mean knowledge; especially not design knowledge.

Going back to an earlier cited examples of collaboration between well-known overseas firms and local practices - Given the unfamiliarity of these overseas firms with the local procurement process, they are obviously valued for their architectural ideas and knowledge, not documentation labour nor procurement efficiency.

Land is limited in Singapore. Hence, Singaporean firms will have to expand to overseas markets if they were to survive. One of the interviewees stated that it is impossible for Singaporean architects to compete with say, Chinese architects who can carry out the construction process at a similar pace, but at a significantly lower cost to the client. Thus, one might want to question the validity of a construction-based evaluation of good architecture if Singapore's architects are to internationalize and stay competitive in the global economy.

The definition of what constitutes good architecture is a subjective matter. However, the implementation of a pervasive national IT policy into architecture via the BCA seems to tilt the focus of architecture more towards the construction aspect of building. Construction systems are a localized matter as different regions build differently. Could the immense amount of energy expended to apply IT in the localized construction and procurement aspects of building be better put to use in exploring more classic architectural concerns like space, theory and ideas? Should there be a re-thinking of what 'Knowledge' really means in the architectural context?

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