Title: **GIS For Plan-Making in Penang Island : The Road to Online Planning**

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INTRODUCTION

The adoption of information technology, including GIS, into the workplace involves complex processes and their successful diffusion is not solely dependent on the state-of-the-art of the technology itself but entrenched social, cultural and institutional habits, practices and preferences (Chai and Williamson, 1999).

In the frenzy to propel the nation into the Information Age, governments at all levels throughout the world have sought to kick-start e-government through various initiatives, typically involving multi-million dollar investments. Consultants, experts in information technology and academics alike all offer solutions for the implementation of enterprise-wide GIS-based systems to fully tap the potential offered by state-of-the-art technology. Usually, these approaches require massive amounts of time, human resources and finance to conduct detailed and comprehensive studies and documentation and investment in the infostructure. Problems abound, including : uncooperative partners amongst participating departments; cooperation turned sour because access to digital data is restricted; inability of the agencies to spell out their systems requirements; migration from one software platform to another requiring re-learning and massive data-conversion; and the consultant's inability to deliver on promises or to fulfill the demands of the clients.

While there are many success stories there are just as many failures. It is therefore not surprising that some agencies and government departments have chosen to ignore the comprehensive approach in the adoption of information technology (including GIS) in the workplace. They prefer to take it one-step-at-a-time, cautiously with a healthy dose of scepticism and suspicion of the technology but nevertheless creating major impacts in the efficiency of the workplace and generating innovative products for the benefit of society at large.

This paper discusses the experience of one such agency, tracing the path it has taken since 1996 and discusses its achievements, set-backs and the future directions in the adoption of GIS (and other technology) as a local planning authority in the long and slow road to creating an online planning system.

PLANNING ON PAPER

The Municipal Council of Penang Island (popularly referred to as MPPP for *Majlis Perbandaran Pulau Pinang* in Malay) is the oldest local authority in Malaysia dating back to British Colonial Administration. The Island covers an area of 299 sq. km. with a population of more than half a million. The City of Georgetown takes up 41 sq. km. but is home for close to half the Island's population.

The laying out of streets was one of the first initiatives from the moment the British set foot on the Island in 1786. This pioneering effort in town planning is still evident as part of the streetscape of Georgetown. Though planning powers in the form of enabling legislation to permit the making of town plans did not come to Penang until the late 1940s, plan-making in various disguises had been carried out since that first layout and was continued by a voluntary body called the Committee of Assessors which was given non-statutory powers to continue the laying out of streets. In 1939, under the Building Bye-Laws, some semblance of a town plan was gazetted under the Municipal Ordinance CAP 133. The bye-law defined various classes of buildings, such as bungalows, semi-detached houses, wooden houses, factories, etc. including their height (number of storeys) as well as minimum plot sizes. There was no accompanying map in the building bye-law but conscientious staff interpreted the bye-law and produced a map demarcating the areas where each class of buildings were permitted. This map became popularly but erroneously referred to as the 1939 Zoning Plan (Lee, et al, 1990).

In 1949, the application of "Part IX – Town Planning" of the Town Boards Enactment CAP 137 was extended to Penang. With this planning powers, Zoning Plans (or more accurately, *General Town Plans*) began to be prepared on a piecemeal basis mainly in response to development pressure. These piecemeal plans however retained the system of classes of buildings from the building bye-law. During the 1960s two planning reports were produced by consultants. The first was called the *Munro Plan* but it was not well received by the government. The second was the *Nathan Master Plan* which is credited with having spurred the industrialisation of Penang State. Both plans contained elements of physical planning but the Munro Plan was never adopted

while the Nathan Master Plan was supposed to be followed up with detailed plans to be used for planning control but this did not materialise mainly because of disagreements over the terms of appointment.

In the 1970s, efforts were made to carry out a comprehensive review and preparation of zoning plans with the formation of the Central Area Planning Unit (CAPU) at the Municipal Council comprising consultants and officers from various technical departments. One of the products of CAPU was the production a composite map of all the piecemeal zoning plans. This map became the basis for future plans, even to this day. The consultants used this composite to generate the Interim Zoning Plan (IZP) 1973 for the whole City of Georgetown. The IZP 1973 was subject to the due process of Part IX CAP 137 including public objection and was approved by the State Authority. A more ambitious effort to prepare a similar plan for the rest of the Island was undertaken by the Penang State Town and Country Planning Department but this effort failed because of legal shortcomings even after the plans had all been laboriously prepared by hand and subjected to all the requirements of the law. Nevertheless, it was adopted by the Municipal Council as a policy guideline for the control of development.

The Town and Country Planning Act 1976 was eventually adopted in full by the Municipal Council on the 1st of January 1985. This resulted in the repeal of the provisions of the Town Boards Enactment under which the previous plans had been prepared. The Municipal Council hence faced a dilemma of a void in a development control instrument pending the completion of the Structure Plan. As such, the previously approved Interim Zoning Plan 1973 for the city area as well as the Interim Zoning Plan for the rest of the Island (which was not approved) were combined, reproduced and adopted by the Municipal Council to be used as a policy guide for the control of development. The plan was called the Land Use Policy Plan 1985 but issues were raised on the legality and enforceability of this policy instrument since it did not appear to be provided for in the 1976 planning legislation.

Hence in 1996, a revised version of the land use zoning plan was prepared and submitted to the State Planning Committee (SPC)[1]. The SPC considered the plans and issued a directive under the Town and Country Planning Act 1976 for the local planning authority to adopt the plan for planning control. This plan was called the *Municipal Council of Penang Island Planning and Development Control Policy Plan 1996.* It is still enforced but will eventually be replaced by Local Plans currently being prepared covering the entire Island of Penang.

Zoning plans are instruments of the local planning authority to guide and control permissible developments or land use for each parcel of land (or parts thereof). As such, zoning plans are produced on cadastral base maps showing legal boundaries of each title. The cadastral base was originally produced by the Survey Department on a scale of 1 inch : 4 chain[2]. Each standard survey sheet measures about 3 feet by 2 feet and required more than 100 sheets to cover the whole Island.

These map sheets were manually painted using Ecoline colours ("town planning colour"). Typically, to produce one set of zoning plans required 3 or 4 technicians working for a period of 3 to 4 weeks. The process is tedious, error prone, time-consuming and requires a lot of office space to work with and display. Achieving a consistent tone is a big feat and slight variations in tone or colour makes it difficult to interpret the maps. Mistakes would result in ugly patches as the technicians correct them by pasting a fresh piece of map over the errors. This of course raised issues on the legality of these patch-work causing the technicians to be extra-vigilant thus further slowing down the map-making process.

In the 1980s, a technician in the then Structure Plan Unit at the Municipal Council single-handedly hand-reduced the original standard sheets to a scale of 1 inch : 8 chains and produced master copies on tracing paper. This base was used in the 1996 revised zoning plan but even at this reduced scale the Department could only produce two certified copies of the plan. An attempt to produce a third copy was abandoned

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[1] The State Planning Committee (SPC) is Chaired by the Chief Minister and is empowered amongst others, to approve Structure Plans as well as to issue directives to local planning authorities on matters concerning the planning and development of land. Local Planning Authorities are required by law to comply with such directives.

[2] One chain is equal to 66 feet; 1 meter is about 3.3 feet.

because of the large number of errors when manually copying the information over from the certified plans. At the scale of 1 inch : 8 chain, the entire Island required 7 separate sheets of maps, each measuring about 8 -10 feet (approximately 3 metres) in length and about 3 feet in width. Arranged side-by-side the map would take up an area measuring 20 feet by 15 feet (see Figure 1). The technicians had to make sure that each of the over 50,000 tiny parcels (or part of parcels) of land on these map sheets were correctly hand painted. In a legal instrument like the zoning map, any mistake would have serious repercussions.
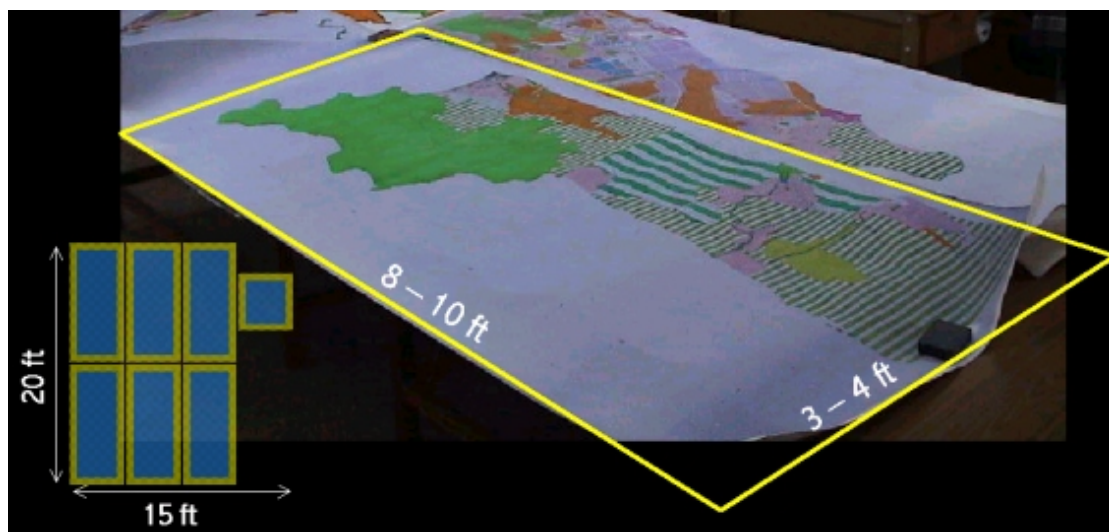

Figure 1 : One Sheet of the 1996 Zoning Plan of Penang Island

THE PILOT GIS PROJECT

In 1995, the Town Planning Department of the Municipal Council started looking for a solution to this problem. It acquired the pc Arc/Info software, an A0-sized digitiser, a large format printer and a 486 PC with 4 Megabytes of RAM. Despite the training given by the software vendor there was very little progress as there was no in-house expertise to lead and spur development. The pc Arc/Info's extremely user-**un**friendly interface and the complexities of having to digitise and join over 200 map sheets of

various scales[3] to create a seamless digital map base for Penang Island was too daunting for the Department.

A Pilot GIS Project was then initiated by the first and second authors as a collaboration between the local government and the local university. In July 1996, the project was launched with three main objectives. The first was to create a digital map base for the entire Penang Island and from that base to create the digital version of the Penang Island Planning and Development Control Policy Plan 1996. The second objective was to develop a planning approval system linked to the GIS. The third and final objective was to train the Department's personnel in the use of GIS.

Even though pc Arc/Info was used to digitise the survey sheets and prepare them for joining, the technology was unable to handle the large size of the maps because of problems with the limitations of 5000 arcs per polygon. We eventually turned to the newer technology of ArcView GIS (then 2.0) to resolve the issue. Since then, the Department have abandoned the use of pc Arc/Info. The entire GIS cadastral map of Penang Island comprises some 50,000 polygons in one seamless layer and takes up more than 30 megabytes of disk space. Details of the data-capture process is reported in Lee (1997).

Obviously, digitisation using paper maps has its weaknesses especially in terms of distortion due to shrinkage and stretching. Nevertheless, the Department needed a digital base map urgently and for planning purposes precise geometric accuracy was not an overriding concern. As such the digitised maps were of acceptable quality. In preparing the GIS cadastral base, we adopted the Malaysian Survey Department's convention for uniquely identifying each parcel of land (see Figure 2). The coding comprised a 9-digit code to identify the location (State code, District code, Town code, section or mukim code) combined with a 6-digit lot number. Later the 6-digit lot number was expanded to 7-digits by the Survey Department. Hence, even if the Town Planning Department were to migrate to the more accurate cadastral base produced by the Survey Department (using coordinate geometry), the attributes could be transferred from the Municipal Council's base map without much problem.

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[3] Survey Sheets for Gazetted Town Limits are available on scales of 1 inch : 1 chain for small towns

However, editing and cleaning maybe required especially in cases where the land parcels had to be split to record land use zoning which do not always follow the exact legal boundaries. The extent of work involved to migrate to the Survey Department's more accurate base could be substantial as the number of thematic layers increases but given the fact that the Survey Department could not supply the digital maps in 1996, creating its own cadastral base was the most feasible option for the Municipal Council.
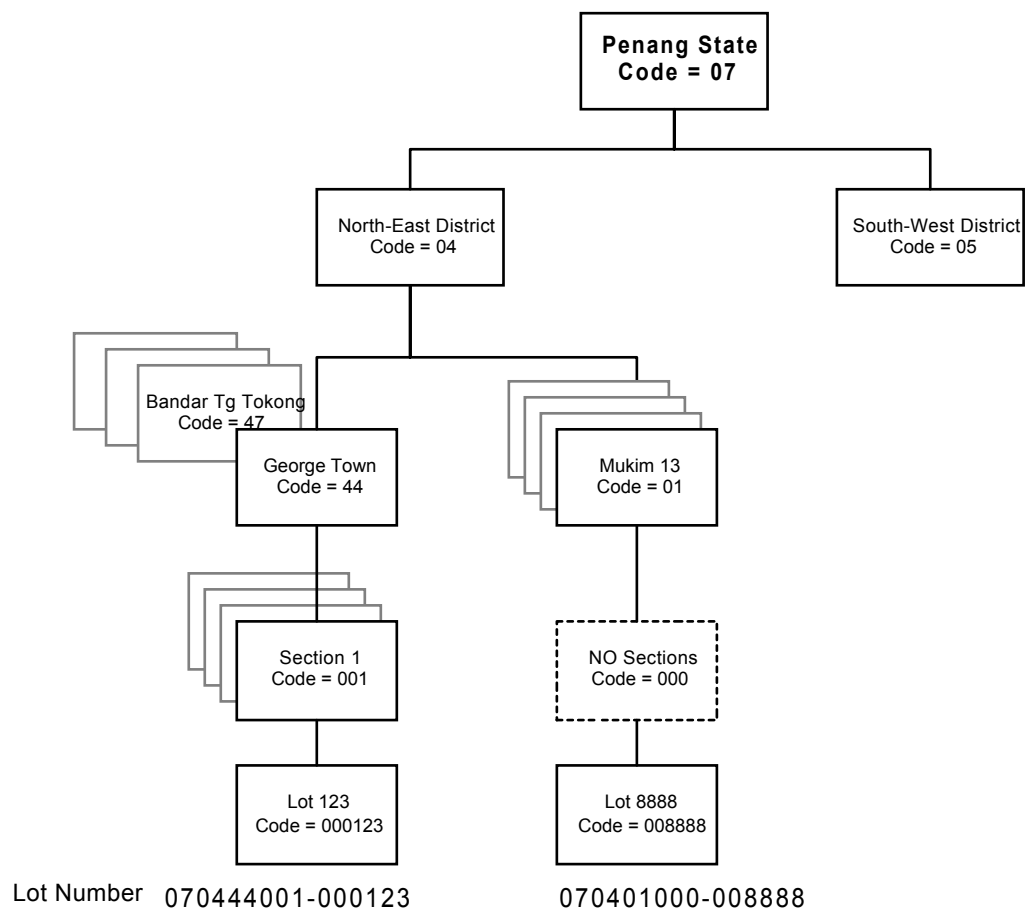
FIGURE 2 : The Coding System Used To Uniquely Identify Land Parcels

According to Survey Department Convention
source : Lee, 1997

POST-PILOT ERA

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and up to 1 inch : 40 feet for major towns.

Since 1997, the Town Planning Department have discarded the brush and Ecoline colours. After additional training at the School of HBP's IT Laboratory, several technical staff became skilled in editing GIS maps and were thus able to create various other thematic layers for specific projects and assignments. They are also able to design professional-looking maps for printing with the large format printer without external assistance. From this core, new recruits to the Department were given on-the-job training by their in-house GIS technicians. Though their skills have not reached the level of the GIS expert capable of implementing GIS projects or undertake sophisticated spatial analysis, there is now a comfortable pool of 6 technicians who are able to handle topological editing and map-making. Other technicians have expressed interest to acquire GIS skills too. More importantly, they understand and are able to implement the fundamental relationship between geographic features and its attributes. Learning the technology is continuous and always on-going. The technicians have learned to turn to the reference books for help (in a limited way because of the language barrier). The first author has also maintained a sustained presence at the Department providing on-the-spot tips, ideas and help to assist the process of skills acquisition. For instance, during its current preparation of local plans, the first author has demonstrated to the Department how to use GIS to more efficiently and accurately select all heritage buildings affected by the "building line"[4] which was drawn long before the idea of conservation took root in Penang. Originally, the Department's officer had only wanted to overlay the heritage buildings layer with the "building line" layer, get the maps printed and then visually identify the affected buildings. Various other ideas are currently being explored by its officers to exploit the GIS technology for plan-making. The approach taken in developing the GIS skills of the staff have to incrementally provide basic skills which are then applied to day-to-day chores and then progressively upgraded to higher levels on a sustained basis.

Various types of maps have been generated using the cadastral GIS map-base created in 1997. These maps are either for inclusion into reports or working papers for decisions by the Municipal Council or State Authority or are being created for the preparation of the local plans. Data or paper maps are obtained from various

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[4] The "building line" demarcates the extent to which new builds are allowed to be constructed.

technical departments such as the Drainage and Irrigation Department, State Town and Country Planning Department and others. With the 1997 digital cadastral base, typically, heads-up digitising is carried out often with the maps scanned and registered to the GIS cadastral base as a guide. Most of the data-capture are carried out in-house with assistance from the first author through the University. To date, the following digital layers have been added to the Town Planning Department's GIS store :

- cadastral map
- rivers
- contour
- existing land use (1998, 2001)
- building footprints
- heritage buildings (with photos; number of storeys, type of usage)
- inventory of buildings
- approved and committed developments (development pressure map)
- Land Use Zoning (1996)
- centre-line of road network with road names (entire Island)

These and others under preparation are created to serve or accommodate specific planning functions, not merely created for a anticipated future need.

So far, the Department have not embarked on the sale of printed maps-on-demand nor has it offered its digital maps for sale or distribution to the public. It is primarily used within the Department while other departments in the Council have not exploited this technology or the data. Public enquiries on zoning is still handled the traditional way by checking the printed maps and various hand-drawn and hand-painted maps.

There are various reasons for the Department putting off pursuing the IT-driven office. One of them is that there are still numerous maps and resources used in planning control which have not been digitised or converted to digital format. Another reason is unfamiliarity and uncertainty about the state-of-the-art and the direction of technological advances. A third reason is that private consultants who undertake the preparation of local plans or structure plans are either unfamiliar with

the GIS technology or are reluctant to aggressively promote innovative solutions or ideas. For instance, the recently (2001) published Draft Structure Plan for Penang Island were offered for sale in both printed and electronic format (in a CD-ROM) but the key diagram (equivalent to a zoning map) and all other maps were merely bitmap images. These "maps" cannot be used by the public to query and analyse the details. This problem will be especially significant for local plans which must be prepared on and be able to identify proposals related to each parcel of land.

Another issue which will require time to resolve is the demand for a very high level of certainly in terms of the details in the zoning plans to avoid legal repercussions. Even after several rounds of checking, the digital version of the 1996 Policy Plan was found to still contain errors, many of which were due to difficulty in accurately interpreting the colours on the original hand coloured maps as well as oversights during the preparation of the paper maps giving rise to inappropriate classification of permissible land use. The Department is also concerned with the security of maps distributed especially in a network environment since anyone could amend the digital copy without leaving a trail. Digital signature as well as migration to high-end GIS systems would offer a solution to this problem in the near future.

Finally, it is necessary to build a culture of IT usage into the day-to-day operations of any office. In the process of our involvement in propagating e-government we have encountered two divergent groups of staff within the same office. There are those who would give IT whole-hearted support while another group would focus on the weaknesses and limitations to resist the penetration of IT into their work culture. Unlike many departments where the tasks are routine and repetitive[5] and therefore are easy to automate and implement with IT solutions, the planning office is complex especially for the processing of planning approvals and the making of plans. A prolonged period of IT acculturisation is necessary to ensure long-term continued usage of IT in the office.

From only one hardware key, the Department has now three licenses for ArcView GIS Core. This is hardly adequate but many users are extremely weary of software

acquisition not only because they are expensive but seems to perpetually require upgrades every few months. In Malaysia we face the addition hurdle in that the software requires a hardware key unlike other countries where a software manages the license from a network server. The hassle of having to retrieve and install the hardware key to the user's computer discourages the staff (especially planners) from impulsively experimenting and exploring geographic data and the GIS technology.

This problems and hurdles notwithstanding, the Town Planning Department at MPPP is now exploring more innovative and creative solutions in the use of GIS.

THE PREPARATION OF LOCAL PLANS

The Municipal Council, since 1998 have been preparing Local Plans for 25 areas[6] to provide the instruments for planning control, replacing all the previous maps and written policies. Details in the plans would include building setbacks, road-widening line, proposed roads and backlanes, building height limits, densities, plot ratios and permissible land uses. In the Conservation Areas of Georgetown, the relevant policies on conservation of buildings will be included in the local plans.

The majority of these local plans are being prepared by an in-house team at the Municipal Council's Town Planning Department but preparation of several of the plans in the City area are being assisted by the Federal Department of Town and Country Planning and private consultants.

From the initiation of the various local plan projects, the Town Planning Department at the Municipal Council had insisted on the usage of a common digital map-base as well as a uniform or compatible file system (i.e. ArcView shapefiles). Unfortunately, the funding agency which also acted as coordinator of these projects insisted that their digital map-base be used while the consultants resisted using the same software as the

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[5] Example, cashing a cheque over the counter, renewing a license at a government department or paying a bill.
[6] Another Local Plan for Bukit Bendera (Penang Hill) has already been approved. Local Plans in Malaysia are similar to the British system.

Municipal Council allegedly because of high cost and unfamiliarity with the software. These decisions proved to be catastrophic. Amongst the problems encountered were :

- **Different cadastral base** – the cadastral base not only did not register properly with the Municipal Council's own base but were also not prepared using the standard Survey Sheets from the Survey Department. In some areas, about 90% of the lots were actually plots showing buildings as observed on the ground, not the legal boundaries according to land titles as shown in the standard survey sheets.

- **Inadequate GIS skills and knowledge** - In producing the existing land use maps, the consultants created separate thematic layers for each of the different types of land use. Annotations (sometimes on the same layer sometimes on another layer) were then used to identify the land use of each parcel (i.e. there were no attributes in the map's tables). The technicians who undertook the GIS work were obviously not familiar with topological editing because closer examination by zooming in revealed gaps between adjacent parcels (polygons) and holes within polygons which are not only visually ugly but raises issues of quality of the product. We have also found "polygons" which were not closed but remained undetected the maps were not subjected to the rigours of cleaning and building of topology which would have detected these defects. Most of these technicians are trained in CAD but have not had the benefit of proper instructions or guidance GIS. Professional planners in private firms are also mainly from a generation not exposed to information technology during their studies and the majority are contented to leave computers and technology to the experts. But since there are no experts in their firm, the supervision and quality of GIS products from these firms are of inferior quality[7].

- **Error-prone Conversion** - Though there are many import and export utilities to transfer files from one system to another, the process has potential pitfalls. For instance, when we tried converting a MapInfo file to the ArcView (Shapefile) format, we discovered that polygons of regular right-angled shapes (e.g. squares and rectangles) were separated out into a different layer from the non-regular shaped polygons.   Polygons which are not closed become

polylines when converted. Sometimes, as many as 4 separate files are created for each layer during the process of conversion. This all means that there is a tremendous amount of additional work to convert all the files to a common base

This has resulted in the Municipal Council having to carry out remedial to work to correct the errors.

The Municipal Council's in-house team at the Town Planning Department on the other hand have relied on its original cadastral base and had been adequately trained to handle the job at hand. Paper prints of the GIS cadastral map base are used for site surveys. Technicians then use a digital copy of the GIS cadastral to create a new layer for the existing land use map. This may involve a straight forward keying-in of a standard land use code into the attribute table or it may involve some minor editing to split parcels if more that one major land use delineated by a clear boundary is identified on a parcel of land (this usually happens on big land parcels). All other maps such as utilities, infrastructure, amenities and so on are also generated with the same map base.

Proposal Maps showing permissible land use are also created directly from the cadastral base. Typically, a colour print of the 1996 Policy Plan is used by the Town Planner to indicate proposed changes for the local plan by using lines and notations drawn and written on the printed maps. These maps are then used as the basis for editing and modifying a digital copy of the 1996 Policy Plan to become the Proposal Map for the respective Local Plan. The first draft of the Proposal Map is then printed and again examined by the Town Planner and amended as necessary. Each local plan will go through more than 5 rounds of such amendments and each of the printed and amended drafts are filed to provide an audit trail of the changes. It would seem that the use of IT in this case have resulted in more rather than less usage of paper but it has definitely increased the efficiency, accuracy and speed in which the Town Planners have been able prepare 25 local plans simultaneously. Ideally, we hope that the future generation of town planners can personally make the proposals on the

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[7] However, this situation will change as the new breed of IT-empowered planning graduates are

digital copy and then pass them to the technicians for the cosmetic treatments and production of professional cartographic maps and products. This will not only require a re-examination of the curriculum for town planning degrees but software tools which are geared towards the specific needs of planners.

The process of plan-making is still dependent on the time-tested regime of professional and reasoned judgments based on an assessment of the past trends, existing development on the ground, approved and committed developments and projected future needs. Urban Models has never been applied for generating alternative plans in Penang. In its current plan-making exercise, the use of GIS have been restricted mainly for the preparation of maps with little or no emphasis on utilisation of GIS spatial modeling or analytical capabilities.

Instead of pinning up the cumbersome and enormous printed maps, the Town Planning Director now presents the proposed plans to the Municipal Councilors and State Authority using a notebook and ArcView GIS with the maps projected on to a large screen. The presentations have so far been straight-forward using the zoom and pan features and hotlinks to display impressive photos. The decisions-makers are no doubt very impressed but they are only getting a taste of what the technology offers. For instance, they have not learned that with the technology, they could engage the town planners in interactive spatial queries and even analysis which could provide them with a better understanding of the issues or problems. In this regard, the first author has committed to demonstrate to the Town Planners how to add more sophistication to their presentations in line with the objective of creating an IT culture in the planning office and the agenda for continuous skills acquisition by the staff.

These issues and problems notwithstanding, the Town Planning Department at the Municipal Council is pushing ahead to revolutionise how planning documents will be distributed and accessed by not only professionals, administrators and people in the development industry but by the public-at-large through the e-local plan initiative.

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absorbed into the planning firms.

The 25 Local Plans under preparation together with the one already approved for Penang Hill will cover the whole Island of Penang (see Figure 3).

FIGURE 3 : Local Plan Areas outside the

City of Georgetown, Penang Island

(This image was produced from the MPPP GIS.

In the background is the digital cadastral base map created in 1997)

THE e-LOCAL PLAN INITIATIVE

In the State of Penang, the two local authorities have recently revised their respective Structure Plans. In line with the requirements of the Town and Country Planning Act 1976, copies of revised Draft Structure Plans were made available for purchase by the public to facilitate public participation. For the first time, the documents were sold in electronic format (in addition to the printed version). The word-processed reports were converted directly to either HTML or Acrobat's pdf format complete with hyperlinks. Maps and diagrams were converted to image files and provided with a

feature to zoom-in for a closer look. On the Mainland side (Seberang Perai), several Draft Local Plans were also distributed in this format.

Though the distribution of the electronic versions of the plans was a major milestone towards online planning, the Town Planning Department at MPPP is not satisfied and want more innovative solutions which could tap the potential of information technology for more flexible and creative access to not only the written documents but the details in the maps.

We have thus formulated the ***e-Local Plan Initiative*** which encompasses the following components :

- **The Written Statement** – this contains the Local Planning Authority's Policies on the use and development of land. It will mainly consist of text supported by diagrams or illustrations.
- **GIS Maps** – The Proposal Map will be the most critical as it will identify the permissible land use of each parcel (or part of parcel) of land as well as other relevant guidelines such as building line, road reserve, building height, density, plot ratios, etc. These could be organised into various layers for easy reading. In the Conservation Areas, an additional Heritage Building layer provide details on conservation policies and guidelines.

To implement the above Initiative, we have tested the following technologies.

eBook Technology

The Open eBook Forum (www.openebook.org) is working towards a set of standards for publication of eBooks based on the HTML technology. This open standard will allow writers to prepare manuscripts in an electronic format ready for publication by any eBook Publisher. It still has a long way to go but the eBook offers functionalities beyond mere hyperlinks within a document or to external resources. It includes features such as :

- Bookmarks and the "most recent location read" features which allow for quick access to information

- Annotations which allow the reader to write notes in much the same way we write notes on the margins of the printed report. This would be extremely useful for the public or professional to add comments or personal observations to assist in public participation or for future reference and reminders.

- Drawings can also be made on the eBook. This might be used by the reader to illustrate some policies of the Council or to highlight areas in a diagram.

- Searching by keywords will help the reader to quickly access all policies related to a certain subject, e.g. low-cost housing or car parking requirements, etc.

- You can also go to specific pages, or use the slider to browse the eBook and even use the dictionary to search for meaning of words.

- It is reading and eye-sight-friendly. The width of the book is designed to improve the speed of reading while the size of text can be increased or decreased by the reader to accommodate disabilities.

An added attraction is that creating the eBook is a breeze, requiring only the click of a button to activate the conversion utility. All we need to produce this eBook version of the Local Plans is to convert our word-processed document (such as Word documents) to the eBook format and use an eBook Reader (such as Microsoft's Reader software) to read the eBook either with a personal computer or special gadgets (including PDAs). The best part, of course, is that the conversion utility and the MS Reader can be downloaded free of charge. (www.microsoft.com/reader/default.asp and www.readerworks.com). If so desired, the eBooks could be published and sold through numerous eBook Publishers (e.g. http://www.netlibrary.com/).

The eBook technology holds great promise to enhance the reading experience and Microsoft's Reader has attempted to make reading on screen less stressful with its ClearType fonts. However, there are still serious limitations in the current standards. For example, animation and multimedia is still not supported and the size of the display area does not benefit from large-size screens. Furthermore, its handling of tables is problematic and limited to very basic tables. We have experimented

converting the written document for the local plans into the eBook format and found that it is easy and straightforward. Graphics and photos of the appropriate sizes are handled with ease while complex tables such those showing demographic data with multiple nested columns are impossible to convert in the current version of the ebook reader. Another serious limitation is that external hyperlinks (e.g. to a WWW resource or an external file on disk such as spreadsheet or GIS map) is currently not available.

To make the reading of the electronic version of the Local Plans an enriching experience, we will have to experiment with how the document is formatted. Currently, eBooks appear to have maintained the chapter-by-chapter structure of the traditional printed book without exploring and exploiting the non-sequential mode of reading offered by hypermedia technology. eBooks have not made a major impact in terms of sales but it is a technology which holds potential to facilitate online planning and be explored further with continued advances in the technology. However, the technology does meet the expectations of a published local plan.

GIS MapViewer

The current state-of-the-art in eBook technology does not offer interactive and dynamic access to GIS maps from within the eBook itself. This would require the eBook and GIS software to merge together to enable the user to perform GIS functions on a map window (e.g. query, zoom, pan and even geoprocessing) without leaving the eBook. Such an *eMapBook*[8] could potentially revolutionise the learning of geography in schools, enrich the tourist guidebook (perhaps with GPS capability) and numerous other applications which could benefit from the use of maps.

Until the merging of these two technologies, MPPP intends to distribute the GIS maps of its future Local Plans (especially the Proposal Map) in ArcView Shapefile format. We will configure them to work with the ArcExplorer GIS viewer which can be

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[8] We have not come across this term in the literature as yet. The term first appeared in our email correspondence with Daniel Boey (Country Manager for ESRI South Asia based in Kuala Lumpur) discussing ideas for this paper.

downloaded free of charge from the ESRI website (www.esri.com). The goal of the Town Planning Department is to eventually combine all the Proposal Maps from the 25 Local Plans into a single seamless map for the whole Island.

We have experimented with both the ArcExplorer 2 and ArcExplorer 3 (Java version) and found the Java version to be intensive on computing resources when handling large maps. The Java version has the additional feature to create buffers so logically we should allow the user to select their own choice of GIS explorers. The problem is that ArcExplorers cannot reuse legends created in ArcView and neither can the legend created in one version of ArcExplorers be used in the other. Since our target users include the general public with little or no background in GIS, these legends must be created for them and a decision must be made whether to commit resources to both versions of the GIS explorer.

ESRI has also announced the introduction of ArcReader which is similar to ArcExplorer except that users will not be able to add data or additional layers to the "project" or map. The intention of ArcReader is to offer the ability to disseminate dynamic high quality cartographic products. But for purposes of distribution of local plans, our goal is to empower the public to use digital data to facilitate public participation, including obtaining data (maps) from other sources to be used to examine the proposals in the local plans and as such the ArcReader does not satisfy our requirements.

STATUS REPORT

It has been more than five years since the Town Planning Department at MPPP initiated its Pilot GIS Project. The purists amongst the GIS specialists and experts may lament that after what may be considered a whole generation in information technology "age", the Department has progressed very little beyond data capture and mapping functions.

The professional town planning officers are totally dependent on the pool of technicians for all map productions. They have not acquired the skills to handle even basic GIS-based analysis (such as modeling using overlay procedures) for planning studies. Even though the planners constantly express the interest and desire to acquire GIS skills, the priorities of the Department dictate that they focus all their time and skills on the preparation of the local plans with no time to spare for skills acquisition or upgrading either through self-study or sponsored training. The limited number of GIS licenses is also a contributory factor in discouraging usage of the technology but perhaps the greatest deterrent is that there is no incentive in the form of recognition for having such skills. In fact, having high-tech skills often becomes a burden when other staff conveniently direct all assignments requiring IT skills to these so-called *in-house experts*.

The amount of expenditure specific to GIS at the Town Planning Department at MPPP have been modest. About RM 60,000[9] was spent initially to acquire the hardware and software but only the large format plotter and digitiser has survived the technological advances (the 486 PC and pc Arc/Info have been abandoned by the Town Planning Department). In addition, less than RM 150,000 have been spent for data-capture, training and development of the planning system mainly through collaboration with the local university. The three ArcView keys have been acquired over a period of 4 years and cost less than RM 20,000 in total. Numerous PCs and a Server have been acquired but these are not dedicated to GIS work. Thus, we estimate that a total of less than RM 250,000 (less than USD 100,000) have been specifically spent on GIS-related work in the Department over a period of 5 years. This is a modest sum compared to the more than RM 2 million spent to engage private consultants to undertake the preparation of only 3 or 4 of the Local Plans (and with not entirely satisfactory results, we might add).

In a neighbouring country, tens of millions have been spent on developing a State-wide GIS system but the project had not produced any tangible product or system after ten years of development because it failed to meet the high expectations of its users from multiple departments. The project also failed to deliver the GIS software it

was supposed to develop. Penang State itself initiated an ambitious project to centralise and coordinate a state-wide GIS through a body called PeGIS (for *Penang GIS*). PeGIS is also a multi-million Ringgit project which has been extremely successfully in collating and digitising numerous sources of data relevant to development planning. Unfortunately, it has failed to extensively propagate the culture and usage of digital data, especially GIS data, amongst its stakeholders, that is, the numerous government departments which had contributed and could benefit from its huge datasets. It's dynamic map website is currently restricted to selected users only. Certainly, PeGIS is responsive to student requests for data for academic purposes and have collaborated with Federal Departments in distributing its digital data. However, much of its data is "held in trust" for other government departments and access can only be given with written permission from the respective departments. In the Klang Valley in Malaysia, there have been several multi-million Ringgit GIS projects which have not received resounding endorsement by the users in the agencies concerned. A typical remark from the officers is that they are "not getting the results expected after spending so much money". Yet, there are numerous agencies and government departments who are unable to embark on their GIS projects because of lack of funding and inability to get the cooperation of other agencies, especially in terms of sharing of digital data.

MPPP's GIS Initiative with a modest expenditure has inculcated a culture of use of GIS in its daily chores by its staff, albeit for very rudimentary functions at the moment. The GIS technology is continuously contributing to greater efficiency for updating and map-making. And in the next few months, GIS technology will be employed to provide the public a richer experience when reading its e-Local Plans. We intend to see this culture eventually permeate the entire Department. When the Local Plans have been prepared and the officers have more time, it is hope that the Department will place more priority and emphasis on the acquisition of IT skills (especially GIS) as an integral skill of the analyst-planner.

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[9] In 1995, the exchange rate was about RM (Malaysian Ringgit) 2.50 to USD 1.00; RM60,000 would be about USD24,000

The Town Planning Department at MPPP is taking it one step at the time. Along the way, it is seeks the advice from a GIS specialist from the local university (i.e. the first author) to ensure that its continuous effort in developing the Department's GIS will not become undone because of failure to appreciate the intricacies of the GIS technology. For instance, the Town Planning Department technicians undertook the transfer of the Georgetown Inventory of Heritage Buildings to the GIS format from the Word document submitted by its private consultant. The first author then examined the product and guided the staff in cleaning the data and setting up the interface with a simple search facility (by street name) and integration with various GIS layers generated earlier (including cadastral base, street network, rivers, etc) (see Figure 4).
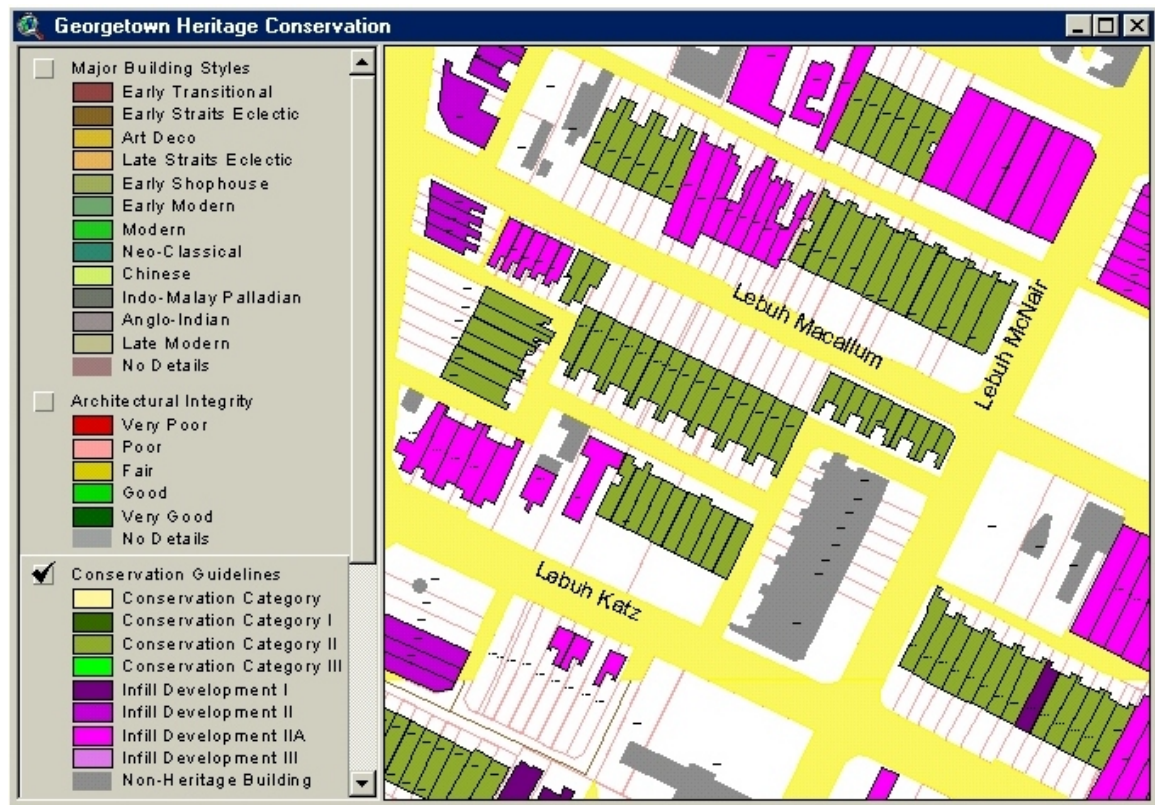

Figure 4 : GIS View of Georgetown Inventory of Heritage Buildings

In addition, a 3D version of the Inventory was created to demonstrate the possibilities of using it for modeling the impact on urban form as the result of the conservation policies of the Municipal Council.

This incremental approach may be painfully slow but if success was measured by the successful integration of GIS into the work culture at the Department and the proposed extensive dissemination of GIS data to all users, we must conclude that the Town Planning Department has achieved a resounding success. Very often, large sums of money are pumped in to finance high profile IT projects and just as often the expectations have not been fulfilled. The problem is that we are trying to change several decades and even centuries of work habits and culture within an unreasonably short period of time. We cannot turn the traditional paper-based planning office (or any other office) into the electronic paperless office overnight. Certainly, reliance on external consultants to deliver packaged solutions or products may not sustain the agenda for creating knowledge workers for the planning office.

THE ROAD AHEAD

Distribution of the eBook versions of the Local Plans serves the specific purpose of providing an innovative and creating alternative to the printed documents. Nevertheless, it suffers from the same disadvantage of the printed document in that updates and revisions to the approved plan would be difficult to disseminate to the purchasers. Hence, we are also exploring the possibility of using the Internet as a central depository where the most up-to-date version of the Local Plans would be kept, updated by the Town Planning Department as and when amendments are approved. This would require the use of a web engine for the written text and an Internet Map Engine for interactive and dynamic access to the GIS maps. However, deploying the technology will involve very high costs in terms of not only the software but the hardware and infrastructure. It will require multiple high-end servers and broadband access to provide a reasonably fast response time for public access. As an agency cautious in spending public funds, we recommend an incremental approach which will initially make access to this planning information system from MPPP's Intranet to share information to other technical departments. The public may be allowed access to the system from within the Council's premises at KOMTAR.

The question which arises is, will there be a need for the eBook (off-line) version of the Local Plan then? We foresee that the eBook will merge with the Internet version.

In other words, the eBook will be online and this will be made possible with cheaper broadband access through wireless technology. The Internet will be pervasive. It will be everywhere whether you are in the office, at home, traveling, in private or public transport or walking on the sidewalk of the city. You will always be connected to the Internet with your mobile device and be able to access your personal and up-to-date copy of the e-Local Plan from anywhere in the world. But why would you want such a facility? If you were a developer, a planner, an architect or an activist with an environmental lobby, you would constantly have a finger on the pulse of development to permit you to respond in the appropriate and timely manner. Many communities around the world demand timely access to information on development proposals in their neighbourhoods as they collectively keep watch to protect the quality of their amenities and lifestyle.

We are also working towards developing a model *Local Government GIS* (tentatively nicknamed *LoGIS*) which will integrate various databases relevant to a local government such as master lists of people and their place of residence over an extended period of time[10], land records, building records, property information and various data generated during the process of controlling development (building, engineering, planning, valuation, licensing, etc) in the local authority area. To create such a enterprise-wide system we will adopt a model for data-sharing which will not threaten department jurisdictions (as used in the successful model for Tasmania; Twin, 2001). We hope to initiate a tripartite partnership between the local government, the local university and the software vendor to carry out this project.

CONCLUSIONS

MPPP is not a new-comer in the use of information technology. Amongst its pioneer applications were the systems for payroll and valuation and tax collection developed in the 1980s. The Town Planning Department have also been using computers for planning studies since the 1980s and daily office chores since the early 1990s but these are limited to word-processing and occasional use of electronic spreadsheets or statistical packages. The Planning Approval System developed as part of the Pilot

Project is still online but used by only a handful of staff who are responsible for storing the data and retrieval of information rather than as part of the work-process. The System while acknowledged to be sophisticated appears to be too complex for users still struggling to come to terms with technology in the workplace. But all is not lost. Based on the experience from the Pilot, the Director has directed his staff to undertake the development of a simpler system mainly for tracking of planning applications. Needless to say, the inexperienced staff require a lot of guidance especially in data-modeling and the structuring of the database to comply with normalisation principles as well as to ensure that the database can be linked to the GIS maps. This process of learning is being facilitated by the first author through hands-on instructions and training as well as critical feedback on the system being developed by the Department's staff. The process is slow but the objective is clear. We want to build a culture of IT usage which is not limited to clicking buttons and selecting menus in a pre-packaged system.

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[10] This can facilitate planning studies of migration patterns as well as to serve as a historical record of the living heritage of a city.

Note :

An earlier version of this paper was presented at the *10TH ESRI South Asia User Conference* (Lee and Tan, 2001).

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