however, were structured in a sequential process beginning with description and understanding, continuing through the survey and information systems design. This in turn was enhanced through system modelling, which then moved into a design phase in which alternative plans were generated and evaluated often through predictive and prescriptive system models (Drummond and French, 2008; Harris and Batty, 1992; Klosterman, 2009).

The shift from planning as a process of optimising spatial allocation, in terms of limited efficiency and equity to one based on much more general, broader-based issues of equity, served to increase perception that the use of GIS represented the way forward to better planning (Batty, 1991; Carsjens and Ligtenberg, 2007; Drummond and French, 2008; Harris and Batty, 1992; Klosterman, 2009). The computer revolution in mid-1970s began to make GIS widely felt in a personal context with the development of the microcomputer. It clearly provided advances in graphics enabled computer mapping to become routine (Drummond and French, 2008; Klosterman, 2009).

As planning become more pragmatic and concerned with individual systems, the demand for data systems relating to facility location and scheduling, such as emergency services, to resource management and conservation, to property and to tax registers increased the need for GIS (Harris and Batty, 1992; Rushton, 1993). Thus, GIS was developed in as simple a form as possible so that it could be adapted to a wide variety of basic tasks of planning activities and processes and required planning staff with strong GIS knowledge and skill.

A SOCIO-TECNICAL FRAMEWORK

Many researchers have highlighted issues in using information technology, such as GIS, which are not only limited by hardware and software but depend largely on how organisational factors and individual users accept and utilise the technology (Batty, 2005; Drummond and French, 2008; Eason, 1993a & 1993b; Henry-Nickie *et al.*, 2008; Nedovic-Budic, 1997; Reeve and Petch, 1999; Yeh, 2005). Organisational factors can play a significant role in the optimisation of information technology use because they determine how to use the system and the types of tasks performed (Turk, 1993). In this paper, the organisational factors include how well the staff of planning departments understands GIS and its role, and the ability of the planning organisations to use information technology.

Therefore, the investigation of the socio-technical factors in which GIS is used in planning organisations is based on how the individual characteristics and organisational factors interact with the technology and how these relationships contribute to both the practice of technology, and to the construction of users and their technologies. These relationships are based on five major elements. They are:

i) The Organisational Context;
ii) The People;
iii) Change and Instability;
iv) Centralisation and Decentralisation; and
v) The State of Computer-based Development.

a) The Organisational Context

The first set of element emphasizes the organisational context in which GIS technology is implemented. Studies which focus on computer equipment propose that the nature of the technology determines the outcome of the implementation process (Campbell, 2005; Nedovic-Budic, 1997). This suggests that the experiences of planning organisations are significantly influenced by the organisational context and dealings between individual planning staff. This section examines the contribution of the organisational context to the evolution and utilisation of information systems, particularly GIS, in planning organisations. This contextual factor is subdivided into two levels; the internal organisational context and the external environment. Together, they provide the background against which computer usage takes place (Nedovic-Budic, 1997). The external environment include the availability of independent sources for funding, the authority's population size and individual per capita income while the internal environment include the presence of a professional chief executive and the location of control over computing decisions.

The internal organisational context relates to the characteristics of the planning organisation in which the computer-based system is located. These include features such as the organisational structure, administrative arrangements and procedures for decision-making in general and, specifically, with regard to computing resources. Many organisations are sub-divided into many sections (Nedovic-Budic, 1997). This means that the adoption and subsequent implementation of GIS in planning organisations is not simply embedded within one context but must also take into account the individual characteristics of each unit. The diverse range of environments in each of this unit is therefore likely to inhibit the implementation process of GIS in the planning organisations. This in turn has implications for the succeeding implementation and utilisation of the systems.

The existing administrative arrangements may also hamper the introduction of new technology while the potential of a system, such as GIS, to enhance accessibility to information is likely to be viewed with suspicion as it opens up the decision-making process of individual units to greater scrutiny (Campbell, 2005; Masser and Campbell, 1991 & 1995; Nedovic-Budic, 1997). Consequently, each departmental unit may refuse to allocate information systems resources to such a project or, at a later stage, prove unwilling to agree on standards or share data. Thus, as Nedovic-Budic (1997) states, there is a need to motivate each departmental unit for incorporating GIS, with a recognised gap in organisational performance as the most common motivation behind organisational engagement in adoption of innovations.

Features of the external environment also influence the utilisation process of information technology in organisations (Masser and Campbell, 1991 & 1995; Nedovic-Budic, 1997). Computer manufacturers and suppliers obviously have a significant role to play, particularly in terms of their research, development and marketing strategies as well as their posts-sales support and training programmes. However, a number of agencies can also influence the pace of GIS adoption and the effectiveness of its implementation. These include other organisations in the same field, central governments, professional opinions and, perhaps, even trends in society. These elements provide the personal and more general communication channels through which knowledge of new developments and opinions as to their value are transferred. The skills of staff may also influence the effective use and implementation of a technology such as GIS.

Consequently, the internal and the external environments of the planning organisations provide the background against which the implementation of GIS is embedded. The detailed nature of the key characteristics varies between planning organisations but the underlying concept remains useful. The emphasis placed on the influence of contextual factors should not, however, be assumed to suggest rigid determinism as these elements interact with the individuals present within planning organisations. It is noted that these characteristics are either associated with the context or the activities of individual members of planning staff in local authority planning departments. This demonstrates the contribution of the internal and external planning organisational context to the implementation of computer-based information system. For instance, it cannot be presumed that a large planning organisation is automatically an extensive computer user or that a small planning organisation has little experience of automation.

b) The People

The context of the planning organisation and the operation of political processes in the planning organisation have a substantial impact on the outcome of computerisation. However, there is also a need to consider the activities and characteristics of the individuals. Thus, this section explores the contributions of individual planning staff to the adoption, implementation and utilisation of GIS in planning organisations. The activity of individual planning staff can substantially affect the development and utilisation of computer-based systems. It is emphasised that individual staff members within planning organisations have different values and motivations, and that computerisation tends to challenge their interests; threatening some and offering opportunities to others. This suggests that individual planning staff can perform an important role in the process of GIS implementation in planning organisations. It is also important that the role played by the planning staff includes the necessary ability, willingness and awareness to implement and use GIS in the planning organisation. Furthermore, it is unlikely that the goals of the planning staff necessarily coincide with those of the planning organisation in which they work.

In many instances, key individuals often play an important role in both the initial acquisition of new technology and the subsequent processes of achieving effective utilisation (Kraemer and Dedrick, 1997). This means that the purchasing of GIS by the planning organisations is frequently associated with the awareness and readiness of the individual users of the planning staff. Consequently, each planning staff must possess the necessary ability, willingness and intimate knowledge to implement and use GIS successfully (Masser and Campbell, 1991 & 1995).

Generally, the activities of planning officers in using GIS help to encourage other planning staff to use GIS. These include their contributions in acquiring GIS skills, training and knowledge towards the institutionalisation of GIS in planning organisations. In addition, the awareness and encouragement given to other planning staff to use GIS also play an important role which can determine whether the system is actually used. These individuals are likely to be members of the senior management in planning organisations as they are most closely involved with the committees which are responsible for budgeting although, in certain circumstances, a middle ranking officer may be able to take the initiative (Campbell, 2005; Masser and Campbell, 1995). For example, the role played by the Planning Director or the Head of Department concerning the distribution of GIS within the planning organisation is pivotal in ensuring the effective use of GIS. However, a lack of mutual understanding between them and computer experts can affect the development of GIS in the planning organisation. Failure on this part can lead to wasted and redundant resources of technology in the planning organisation.

Furthermore, the tendency to utilise information technology has been linked to personal characteristics such as age, sex, length of time spent in the same job, educational qualification, membership of professional body and training or experience in computer-related field (Kraemer and Dedrick, 1997). Kraemer and Dedrick (1997) state factors such as computing skills and experiences of working with computer support the significance and the degree of confidence of the end-users. This suggests that the successful use of GIS is associated with the personal characteristics of the planning staff in the departments. For example, the training and experience in computer-related skill help the planning staff to easily understand and use GIS smoothly.

c) Change and Instability

The third set of element is the impact of change and instability. It must be noted that no organisation is static (Campbell, 2005). A highly volatile technical, social or political environment is liable to impede the effective development and utilisation of automated systems (Campbell, 1994; Campbell and Masser, 1995). This means that the degree of instability present within a planning organisation as well as the level of change in the external environment have an important influence on the implementation and adoption of GIS. Changes in the organisational structure and consequent shifts in the paths of information flow are therefore fundamental disruptions in the functioning of the organisation and are justifiably interpreted as threats to the organisation itself (Campbell and Masser, 1995).

Changes in position within an organisation cause changes in the balance of power among units (Campbell, 1994). This view shows that the position held by planning directors and heads of planning departments which keep changing over the years could affect the process of implementing and utilising GIS in planning organisations. The decision by them to introduce technology or modify an existing system is usually prompted by some changes in the organisational context. Therefore, the redistribution of, and access to, information through the introduction of an automated information system can also lead to the redistribution of power and influence (Campbell, 1994; Campbell and Masser, 1995). Consequently, the impact of instability on the implementation and use of GIS in planning organisations appears to be complex.

Instability is a critical factor in understanding difficulties faced by organisations (Campbell, 1994; Campbell and Masser, 1995; Masser and Campbell, 1994). This suggests that the implementation of GIS in planning organisations is not designed once and for all. This is due to changing circumstances such as alterations to the format for statutory returns which require modifications to be made (Campbell, 1994; Masser and Campbell, 1994). Therefore, the implementation and utilisation of GIS in planning organisations is an ad hoc and incremental process with amendments to existing systems in the organisation. Computer-based systems prosper in stable conditions where there is a steady flow of resources to maintain routine procedures (Campbell, 1994).

Moreover, the development and subsequent maintenance of systems are also likely to be affected by modifications to, for instance, an organisation's internal structure of the resignation of key personnel (Campbell, 1994; Masser, 1998). The latter in particular can have a very profound impact as new working relationships have to be developed while considerable experience and knowledge may be lost. All organisations face a measure of instability but, in certain instances, the degree of volatility is such as to either inhibit resources being made available for the introduction of technology or to disrupt the implementation and utilisation of an existing system (Masser and Campbell, 1991 & 1995). This suggests that change is not just limited to the nature of the available technology but is an inherent part of the context in which the activities of the organisations are embedded.

d) Centralisation and Decentralisation

The fourth set of element is centralisation and decentralisation of computer-based information systems in organisations. According to Kraemer and Dedrick (1997), the centralisation and decentralisation of computer-based information systems in organisations are important in order to encourage end-users to adopt information technology. They add that the introduction of personal computers (PC) and client-server computing based on standard software packages has encouraged the argument for decentralised computing. Although the size and cost of mainframe computers argue for centralisation of the computing function, PC technologies make it feasible to break that function into smaller departmental units. This suggests that the decentralisation of GIS in planning organisations is undertaken by putting the GIS package under the direct control of end-users (planning staff). The end-users are responsible for helping planning organisations to tailor GIS according to departmental needs and objectives.

On the other hand, the centralisation of GIS in planning organisations is believed to increase the economics of scale in procurement, enhance data sharing within the planning organisations and ease the abilities of the Planning Director and Head of Department to guide computing toward department wide-goals. The case for centralisation has been based on notions of efficiency in the information systems function itself rather than on enhancing the end-users' access to and control over information technology (Kraemer and Dedrick, 1997).

However, despite the trend toward decentralisation, most organisations continue to have a central computing unit and, in recent years, the trend seems to be swinging back toward centralisation as a way to obtain some control over the proliferation of often incompatible end-user technologies in organisations. Whether computing is centralised or decentralised, this is indeed a critical issue. Some argue that centralisation of managerial control rather than facilities and services is the key factor. However, it is frequently the case that control follows the location of facilities and services. That is, the tendency is for managerial control to be centralised when facilities and services are centralised and become decentralised when facilities and services are decentralised. These views suggest that there are instances involving a mix of centralisation and decentralisation of utilisation of technology such as GIS in organisations; for example, centralising the unit of GIS for each department but decentralising the facilities and services.

An organisation that wishes to decentralise can implement information systems that provide necessary information to lower-level officers and permit top management to communicate with those officers. However, in organisations where both are centralised, computing is likely to be used by senior officers in order to substitute technology for middle management functions, such as information processing communication. On the other hand, in organisations where both are decentralised, computing is likely to be used by middle officers in order to enhance their values to the senior management and increase, or at least, retain their numbers. These scenarios highlight the appropriateness of the concept of technical determinism which assumes that the theoretical capabilities of technology will be achieved in practice. These suggest that the result of computerisation reflect the underlying aims of the senior staff. Therefore, the introduction of automated systems produces, for example, centralised decision-making on its own.

e) The State of Computer-based Development

The final set of element is the state of computer-based development in organisations. It is clear that the key determinant of organisations in the implementation and utilisation of subsequent technology, such as GIS, involves the ability of organisations to tailor information technology according to their needs and characteristics. Kraemer *et al.*, (1995) argue that computing can be characterised by various states of development and these states determine the effectiveness of computing within the organisations. Three pure states are identified, namely skill, service, and control while the fourth consists of a mixed state.

In the skill state, information system management controls computerisation and applies computing resources to technical interests (Kraemer and Dedrick, 1997). In the service state, the departmental management controls computing, and the operational interests of the department are served. In the control state, the senior management controls the computerisation, and its broad managerial interests are served. A mixed state exists in the absence of any of the three pure states. That is, the mixed state encompasses any set of conditions in which the level of control and the level of interests served do not directly correspond.

These perspectives suggest that the implementation and utilisation of GIS in the planning organisations are based on three states as identified above. They focus on the management action, whether direct or indirect, as the controllable driver of computer-based implementation and utilisation. It also permits the identification of the current state of GIS in planning organisations as well as the prediction of future trajectory of computing. Moreover, it shows how the trajectory of computing is governed by the management action of the planning organisations.

METHODOLOGY

This paper employs a case study method eliciting data which includes a questionnaire survey and a semi-structured interview. A case study approach has been selected in order to obtain the depth of study required to investigate the complex and interrelated institutionalisation processes underlying the use of GIS at the DUP and the MPD, KLCH. The DUP and the MPD of the KLCH had been chosen on the basis of statutory responsibilities, active involvement with the development of GIS in the development control and the support and willingness given to facilitate the study.

a) A Case Study Approach

A case study approach was employed as one of the stages of collecting data. It provides the most appropriate basis for exploring the complex processes influencing the utilisation of information technology in organisations (Khalfan, 2004). This approach refers to an in-depth study or investigation of a contemporary phenomenon using multiple sources of evidence within its real-life context (Khalfan, 2004; Yin, 1994). A case study approach is the most appropriate approach for exploratory and explanatory research since it is able to capture a greater depth and breadth of detail on the subject's activity. It helps to construct validity which will be established by triangulation, chain of evidence and formal review by the interviewees for verification. It has been suggested by researchers within the GIS community that a case study approach is appropriate for researching a range of GIS implementation, utilisation, and diffusion issues (Budic and Godschalk, 1993; Onsrud *et al.*, 1992; Onsrud *et al.*, 1993). The issues include identifying the forms of decision-making which have utilised GIS, identifying factors and processes leading to rejections of previously embraced GIS, and identifying organisational and societal consequences of GIS.

b) Questionnaire Survey

A stratified random sampling technique was adopted in selecting the sample in order to represent the planning staff that have used GIS or are learning to use GIS. For this purpose, the planning staff from the DUP and the MPD, KLCH was stratified they still wish to attend GIS training and courses in order to update their knowledge on GIS.

The analysis indicates that most of the planning staffs need at least 1 to 6 months to change from manual to the use of GIS. This shows that changing from the manual method to computer-based systems required more time for staff in order to understand GIS before it can be used for planning activities. The important role highlighted here is the way the planning departments and officers have encouraged the staff to use GIS. The continuous GIS training and courses provided have been identified as important steps for helping staff in using GIS. In addition, based on the perceptions by the respondents, most of them (88.2%) agreed that the use of GIS in planning activities has changed the nature of their jobs compared to before they started using GIS. There are no longer drafting boards, scale rulers, sets of water colour and technical pencils used in the planning processes and activities. Everything is now based on the commands on computer screens.

The analysis shows nine purposes for using GIS in relation to planning processes and activities. Out of that, three purposes have indicated a high percentage; four purposes have a moderate percentage; and two purposes have a low percentage (Table 1). The results indicate that, for both the MPD and the DUP, GIS is mainly used for keying-in data (MPD=94.4%; DUP=81.9%), retrieving data (MPD=93.0%; DUP=80.7%), plans printing (MPD=72.0%; DUP=67.5%) and reports printing (MPD=77.2%; DUP=54.2%). Since GIS has only been introduced for less than 10 years, which is considered relatively new, it is still at the early stage of implementation which is still locked into the data capture phases. This finding is also similar to those by other researchers who suggest that the main purpose for using GIS in the early stage is to for keying-in and retrieving the data digitally (Masser, 2002 & 2001; Shepherd, 1991; Yeh, 1991). For both departments, data is still in hardcopy, thus, a lot of effort is channelled towards keying-in data. For the MPD, keying-in data is important in order to develop plans while for the DUP it is for the purpose of planning applications. The result indicates that GIS is also highly utilised for presentation purposes (MPD=94.4%; DUP= 73.5%) because of the need to see the immediate visible impact of using GIS during the planning committee meeting. This also explains the need to impress upon the top management on GIS implementation at planning departments. This finding correlates with a view by Gill et al., (1999) which mentioned that GIS provide an important and useful first stage data handling and presentation within problem-solving processes.

Table 1: The purposes of using GIS according to departments

Purposes	Department MPD (N=70)	(Percentage) DUP (N=83)
Key-in data	66 (94.4)	68 (81.9)
Retrieve data	65 (93.0)	67 (80.7)
Print plans	50 (72.0)	56 (67.5)
Process applications	30 (42.9)	60 (72.3)
Analysis	58 (82.9)	46 (55.4)
Prepare and print reports	54 (77.2)	45 (54.2)
Presentations	66 (94.4)	61 (73.5)
GIS models	45 (64.4)	38 (45.8)
System management	33 (47.2)	35 (42.2)

The independent-samples t-test is conducted to compare the mean differences for using GIS between the MPD and the DUP. Nine purposes for using GIS have been tested. Five purposes showed significant differences. They are keying-in data (t=3,247, p=0.001); retrieving data (t=2.607, p=0.010); printing plans (t=4.265, p=0.000); preparing and printing reports (t=2.828, p=0.005); and conducting presentations (t=2.674, p=0.008) (Table 2).

Table 2: Mean differences of the purposes of using GIS according to departments

Purposes	Departments	N	Mean	t	df	p
Key-in data	MPD	70	4.36	3.247	151	0.001
	DUP	83	3.94			
Retrieve data	MPD	70	4.29	2.607	151	0.010
	DUP	83	3.95			
Print plans	MPD	70	4.39	4.265	151	0.000
	DUP	83	3.81			
Process applications	MPD	70	3.70	-0.316	151	0.752
	DUP	83	3.75			
Analysis	MPD	70	3.93	1.958	151	0.052
	DUP	83	3.65			
Prepare and print reports	MPD	70	4.01	2.828	151	0.005
	DUP	83	3.61			
Presentations	MPD	70	3.96	2.674	151	0.008
	DUP	83	3.58			
GIS models	MPD	70	3.60	0.899	151	0.370
	DUP	83	3.46			
System management	MPD	70	3.39	0.083	151	0.934
	DUP	83	3.37			

The results indicate that the mean differences of keying-in data, retrieving data, printing plans, preparing and printing reports and conducting presentations at the MPD are higher than the DUP. This shows that the visibility use of GIS at the MPD is important in order to see the impact for the development and preparing plan processes. Thus, this helps management officers at the decision-making stages as it will support the monitoring processes. There are eight benefits agreed upon by respondents on the use of GIS (Table 3).

The results indicate that the use of GIS is mainly for improving data management (MPD=87.1%; DUP=83.2%), such as processing planning applications as well as storing and collecting land-related information. This result is in line with findings in previous studies which have discussed the benefits of using GIS in data management (Alterkawi, 2005; Batty, 2005; Klostermann, 2001; Yeh, 1991 & 2005). At the MPD and the DUP, if the planning staff used the manual method for data storing, they have to keep the hardcopy data, such as plans and drawings, in the store using the manual filing system. Whenever there are new applications, the planning staffs need to refer to these drawings. If there are amendments, the planning staffs have to update them manually. Sometimes, certain hardcopy drawings might go missing. Thus, with the use of computer-based system, the planning staffs at the MPD and the DUP only need to keep the data in a database. The database is also accessible to all staff which in turn helps them to access the same information. Similarly, it helps the planning staff to manage the database effectively compared to the manual filing method.

Table 3: Benefits of using GIS

Benefits	Departments (%)	
	MPD (N=70)	DUP (N=83)
Improved data management	61 (87.1)	69 (83.2)
Improved data sharing	60 (85.7)	63 (75.9)
Time saving	59 (84.3)	61 (73.5)
Data standardisation and centralisation	58 (82.8)	58 (69.9)
Increased productivity	59 (84.3)	55 (66.2)
Ease of use	57 (81.4)	51 (61.4)
Improved decision-making	51 (72.8)	54 (65.0)
Less workload	52 (74.2)	50 (60.2)

The independent-samples t-test is conducted to compare the mean differences in the benefits of using GIS between the MPD and the DUP (Table 4). Based on the independent t-test, there are mean differences of the benefits of using GIS between the two planning departments at a significant level of $p=0.05$. The study identifies six benefits which differentiate the two departments. They are improved data sharing ($t=2.146$, $p=0.033$), time saving ($t=2.495$, $p=0.014$), data standardisation and centralisation ($t=2.743$, $p=0.007$), increased productivity ($t=3.520$, $p=0.001$), ease of use ($t=2.478$, $p=0.014$) and improve decision-making ($t=2.305$, $p=0.023$).

The results show that the highest mean differences between the MPD ($M=4.10$) and the DUP ($M=3.82$) is time saving ($t=2.495$, $p=0.014$). This corresponds to findings from other researchers that GIS is a useful tool for reducing time taken for processing planning applications, development controls, plans and reports printings and assisting in the planning decisions (Batty, 2005; Campbell, 2005; Comber et al., 2008; Carsjens and Ligtenberg, 2007; Fedeski and Gwilliam, 2007; Klosterman, 2009; Yeh, 1991, 2005).

Table 4: Mean differences of the benefits of using GIS between planning departments

Variable	Department	N	Mean	SD	t	df	p
Improved data management	MPD	70	4.01	0.577	0.973	151	0.332
	DUP	83	3.90	0.790			
Improved data sharing	MPD	70	4.01	0.648	2.146	151	0.033
	DUP	83	3.77	0.738			
Time saving	MPD	70	4.10	0.640	2.495	151	0.014
	DUP	83	3.82	0.735			
Data standardisation and centralisation	MPD	70	3.99	0.625	2.743	151	0.007
	DUP	83	3.66	0.801			
Increased productivity	MPD	70	4.07	0.621	3.520	151	0.001
	DUP	83	3.69	0.714			
Ease of use	MPD	70	3.96	0.669	2.478	151	0.014
	DUP	83	3.65	0.833			
Improved decision-making	MPD	70	3.89	0.649	2.305	151	0.023
	DUP	83	3.63	0.728			
Less workload	MPD	70	3.83	0.816	1.857	151	0.065
	DUP	83	3.58	0.843			

Despite the widespread availability of GIS in the local government, there is evidence that the potential of GIS as a planning tool is not being exploited. The findings of the survey have raised important issues concerning the problems in using GIS in the MPD and the DUP. Results indicate that more than half of the respondents from the MPD (60%) and the DUP (69.9%) have experienced problems in operating GIS (Table 5).

Table 5: Problems in operating GIS

Departments	Problems in operating GIS	Total	Percentage
MPD	Yes	42	60.0
	No	28	40.0
	Total	**70**	**100.0**
DUP	Yes	58	69.9
	No	25	30.1
	Total	**83**	**100.0**

When asked about the nature of the problems, the respondents indicated three problems normally experienced while using GIS which in turn hampered the use of computer-based system. They are database problems (MPD=62.8%; DUP= 61.4%), data updating problems (MPD=58.5%; DUP=68.7%) and lack of IT/GIS skills (MPD=71.5%; DUP=59.1%), (Table 6).

Table 5: Problems in operating GIS

Problems	Department (%)	
	MPD (70)	DUP (83)
Database	44 (62.8)	51 (61.4)
Data updating	41 (58.5)	57 (68.7)
Lack of IT/GIS skills	50 (71.5)	49 (59.1)

When the respondents were asked about the problems related to the lack of IT/GIS skills, they indicated that GIS is not easy to understand, difficulties with IT language as well as GIS commands and terminologies. As Yeh (1991 & 2005) predicted, lack of training and understanding of GIS potentials seem likely to impede the maturation of GIS applications. This also explains why the planning staff still needs to acquire more training on GIS in order to gain the appropriate skills in operating GIS at the advanced level. Other than needing advanced skills in GIS, the staff also needs to learn about the nature of computer-based system.

b) Perceptions of GIS Management

The 16 management officers interviewed include three planning directors (PD), two deputy directors (PDD), four senior town planning officers (STP), and seven planning officers (PO) from the planning departments and agencies. Each respondent was given a code according to their position. For example 'PD1' represents respondent number 1 of the three planning directors interviewed. The results and analysis of the management officers suggest that the uses of GIS are dependant on the organisational and individual characteristics of planning departments. Organisational factors are shown to have a significant influence on the nature of the information systems developed, while individual characteristics and the relationship between GIS and users are found to be more important aspects.

i) Factors That Encourage the Use of GIS in the DUP

The management officers agreed that GIS plays a major role in planning processes. They suggested that GIS is the right tool for urban planning activities such as storing data, keying-in data, retrieving data, sharing data and processing planning applications. A Planning Director (PD2) states:

> *"Town planning by profession or nature of work is a multi-disciplinary activity; it is not a specialised job like engineering. To carry out town planning, you have to accommodate all disciplines in order to obtain the end-results. So, we often need to refer to other agencies just to come out with a decision on how to advise somebody. We need data from other agencies, and that is where we become dependent on other agencies' technology. If other agencies are using IT, we need to use technology (GIS) also; otherwise we cannot obtain the data (from other agencies)."* – PD2

PD2 further comments about the need of GIS in planning activities:

> *"...Basically it is a natural move from the ways of doing jobs manually to the digital approaches...so you know that...I do not have to get into details...because you know the benefits of digital technology... we are now in the IT era, so it is not a question of to consider or not to consider...it is just a natural step from preparing plans manually with the introduction of computer...so you obviously exploit this technology...and you exploit the technology of IT."* – PD2

This therefore shows that the importance of using computer-based system in handling planning works. As the local government moves toward an electronic-government (e-government) approach, there is a need for planning departments to utilise technology such as GIS in their practices. It helps the government to have good governance over local authorities. According to PD2:

> *"So we have to keep abreast with the various technologies where we require data. We are talking about land-based data; land-based agency data, we definitely need it for our assessment of problems; we need topography data, we need it for administrative purpose, cadastral data, we need the aerial photo, so we need all this data. So, we need to apply and exploit the benefits of the technology (GIS)"* – PD2.

The management officers believed that moral support obtained from the management level is a very important aspect that influences the utilisation of GIS in planning departments. The use of technology is strongly influenced by users' understandings of the properties and functionality of a technology (Orlikowksi, 2000; Orlikowski *et al.*, 1995). This view has been strongly supported by the encouragement and support from officers within the departments. When questioned whether the mayor supports the application of GIS at the DUP, a Deputy Director from the department made a similar comment:

> "*...our director shows us the benefits of GIS for our planning activities.*" – PDD1.

Another senior town planning officer (STP2) made a similar comment:

> "*We have support from the top-management to use GIS.*" – STP2.

According to STP2 (a Senior Town Planning Officer), the supports that they had received are mainly from the planning director and the mayor. He adds that their Planning Director is aware of the importance of GIS for the planning works, especially in plan making. Meanwhile, the Mayor is aware of the use of GIS in order to help the government to have good governance over local authorities.

In terms of budget and financial support, the management officers of the DUP indicate that there have been no financial constraints for planning departments at the KLCH. The financial aspects include purchasing the hardware and GIS software and sending planning staff to attend GIS training and courses.

ii) Perceived Benefits of Using GIS

This section identifies the opinions of the management officers on the perceived benefits of using GIS in planning departments. With more than ten years in implementing and adopting GIS in the planning departments, the staff at the DUP, KLCH can eventually see the benefits of GIS. All the management officers indicated six main benefits of using GIS in the planning departments. They are time saving, ease of use, using GIS in decision-making processes, improved data management, improved data sharing and data standardisation and centralisation. The results presented here are in line with results of the questionnaire survey discussed above and studies by researchers on this subject (Alterkawi, 2005; Batty, 2005; Klostermann, 2001; Yeh, 1991 & 2005).

All the management officers agreed that GIS has helped them to save time in processing planning applications, preparing and printing maps and plans, producing reports, colouring plans and checking plans. A Planning Director (PD1) certainly agreed that GIS has helped planning staff to save time, for example, on the use of GIS to print plans. According to PD1:

> "*...definitely it (GIS) will save time.*" – PD1.

PD2, a Planning Director, made a similar comment which specifically mentions that GIS has helped the planning staff in processing planning applications. He adds that, with the use of GIS, it can save time and speed up the process of planning applications. PD2 states:

"...*it is faster to process planning application...save time.*" – PD2.

Another Planning Director (PD3) also made a comment which supports PD2. PD3 certainly agreed that the use of GIS in planning activities, such as plan checking and colouring plans, is faster than the drafting method. According to PD3:

"...*it is definitely faster than manual.*" –PD3

Other than GIS as a planning tool, most of the management officers agreed that GIS has assisted planning decision-making processes because of the quality of GIS data: it is accurate, useful, complete, reliable and current. Up-to-date and reliable information are needed by planners in the processes of making decisions as well as for policy plannings and plan implementations (Masser, 2001). The use of updated and current information allows automatic linking between statistical and mapping information (Al-Ankary, 1991; Alterkawi, 2005). These processes allow large quantities of data to be processed quickly and combined in many ways. According to PD1:

"*GIS is a tool that contributes to decision planning processes*". – PD1.

Another Planning Director (PD2) and Senior Town Planning Officer (STP3) made similar comments:

"*GIS is the ideal tool to assist decision-making*". – STP3 & PD2

PD2 further explains how GIS supports decision-making in planning processes:

"*We used GIS to identify the development and conservation areas... we used it (GIS) to understand and find out about areas that are prone to disasters and all the areas affected that have resulted in disasters due to the development...how far a certain development has encroached conservation areas. We always zone the areas, and we will know whether a certain development has encroached into water catchments area, for example, which is not ideal for development.*" – PD2

In many respect, data are crucial resources and are very expensive to collect, store and manipulate because large volumes are normally required in solving substantive geographical problems. The use of GIS helps to improve data management. According to PD2:

"*We are dealing with a large volume of data, and this situation can be improved by using GIS to handle the processing and management of data.*" – PD2.

This response emphasizes the management of digital data through the use of GIS. A Deputy Planning Director (PDD1) also made similar comments but highlighted the contribution of the system in avoiding the repetition of data:

> *"We can easily update the data and detect any new information of certain areas. So, GIS helps us to avoid a repetition of data."* ~ PDD1.

All the management officers agreed that data sharing has always been a major reason for the development of GIS and it is gaining importance every day. This is true in the context of GIS for it has been easy to share data within the planning departments due to GIS. The importance of data sharing which improve interactions between the public and the government has been supported by researchers on this subject sand has been discussed by Huxhold and Levinsohn (1995) and Nedovic-Budic and Godschalk (1996). As explained by Masser (2000), by using GIS, it is technically possible to integrate large quantities of data collected by different people for different purposes. A Planning Director (PD2) and a Deputy Planning Director (PDD1) supported the views of GIS as mainly for data sharing:

> *"The benefit of digital technology (GIS) in town planning is mainly for the sharing of data."* ~ PD2.
> *"Well, the benefit is easy to share data."* ~ PDD1.

In planning activities, all data should comply with the same standard and follow systematically the same process for all planning applications. According to Yeh (1991), data and maps need to be standardised and centralised if the data are to be shared within the planning departments and with other departments at the same local authority.

A Planning Director (PD3) commented that standard data means the planning staff uses the same base map so, there should be no question whether the information could be inaccurate or false. Another Planning Director (PD2) made similar comments: that standard data means the standardisation of the database structure; thus, when the planning staff would like to carry out analysis, they know where to retrieve the data. In view of the planning application processing, PDD1 stated that the data must be standardised and centralised in order to make the process run smoothly. A Planning Officer (PO3) also made a similar comment which emphasizes the importance of data standardisation and centralisation in planning departments which can help planning staff to retrieve and use the data easily. According to PO3:

> *"The standardisation and centralisation of the data would help planning staff to easily retrieve and use the data."* ~ PO3.

iii) Perceived Problems of Using GIS

Although GIS can be beneficial, its implementation can also bring about problems. The management officers indicated that the perceived problems of using GIS in planning departments are shaped by five ongoing issues. There are the level of GIS adoption, staffing/personnel issues, equipment and data issues, IT/GIS skills, and workload and financial rewards for GIS skills.

Most of the management officers indicated that the planning staff, especially the technicians and the draughtsmen, has faced problems in understanding GIS commands because all commands are in English and that it is difficult to understand the IT commands because they are new to them. According to Yeh (1991), a low level of GIS understanding is one of the impediments in using GIS for planning organisations. A Planning Director (PD2) from the Federal Department of Town and Country Planning (FDTCP) made a comment when asked about the difficulties faced in using GIS. PD2 agreed that GIS is difficult to understand and it is challenging for the planning staff, especially the technicians and the draughtsmen, to use GIS. He suggested that these groups of staff need to be guided by the planning officers in order to ensure the understanding of the IT/GIS language and commands.

> *"It is complex to understand; not an easy subject. The more complicated the tool, the more powerful the tool, the more complex it becomes."* ~ PD2.

The management officers indicated at the beginning of the GIS implementation that there were some planning staffs who refused to change from manual to computer-based systems applications (GIS). According to PDD1:

> *"Especially for senior technical staff with more than 15 years working experience with us…it is difficult for them to accept new technology."* ~ PDD1.

The above responses highlight that the senior technical staff of the DUP, KLCH refused to use GIS. According to PDD1, these senior technical staff preferred to use the manual technique as their planning tool because they were more familiar with the drafting boards and the use of technical pens. Another Deputy Planning Director (PDD2) emphasized the same view:

> *"They (planning staff) have a slow momentum to change. They prefer to use the manual method. The drawing board and the technical pen are very important to them."* ~ PDD2.

In terms of staffing issues, the management officers indicated three aspects of GIS utilisation in planning departments. They include a lack of technical specialists, a lack of experience, and scope of work. A lack of technical specialists is an important issue in the use of GIS in planning department. A response by the Deputy Planning Director (PDD2) made comments focusing on the number of staff involved in GIS. According to him, the department lacked staff who could concentrate on managing and maintaining the database. He states:

> *"We have only a small number of staff that are involved in GIS."* – PDD2.

Some of the management officers indicated that the scope of work and the involvement of planning staff with management tasks and administrative works were also the reasons for the slow utilisation process of GIS in the planning department. A Senior Town Planning Officer (STP4) mentioned that senior staff with 20 years of using drawing boards had given many reasons for refraining from using GIS. According to STP4, these senior staff always said that they have regular jobs (using manual), and provided reasons such as "I cannot", and "I do not have time". As Deputy Planning Director (PDD1) comments:

> *"At one point, some of the planning staff took GIS for granted and, because of this, they could not fully concentrate on adopting and using GIS."* – PDD1.

Some of the management officers indicated that data must be updated and the data needs to be continually updated. Any data which is technically more than one year old is considered old (PD2) and obsolete (PDD2). Other than data updating problems, there are also responses related to database problems. A Planning Director (PD2) focused on the standardisation of the database which in turn corresponds to findings by Batty (2005), Campbell (2005) and Yeh (1991 & 2005). They state that the standardisation of the database is important in order to share the data within the planning department and with other departments at the same local authority. According to PD2:

> *"The existing database is not standardised and not uniform in structure."* – PD2.

A Deputy Planning Director (PDD1) made comments about the importance of database preparation which could help planning staff to understand and use the database. According to PDD1:

> *"For me, preparing the database is a challenge and also preparing how to use the database is also another challenge."* – PDD1.

Some of the management officers indicated that one distinctive aspect to proclaiming knowledge of GIS is that it will lead to extra work. A Deputy Planning Director (PDD1) and a Planning Officer (PO5) state:

> "*Some of them (planning staff) know how to use GIS but refuse to publicise this fact for fear of added workload. This is despite the fact that several senior planning staff have attended at least one GIS course and are able to use the technology. For them (planning staff), new technology equates greater workload.*" – PDD1.

> "*They (planning staff) simply refused to show that they actually know how to use GIS…they thought that it will burden them, more work to do and the workload will increase.*" – PO5

EVALUATION OF GIS AND SOCIO-TECHNICAL RELATIONSHIPS

The role of socio-technical relationships in the use of GIS mediates between organisational contexts and the individual processes of utilisation to produce particular consequences of technology. As suggested by Harvey and Chrisman (1998), the implementation and utilisation of GIS involve not only people but the organisations where GIS has been installed. These results support the notion of emergent causality and the importance of process in understanding the social consequences of technology. Technological utilisation is not solely a technical change; it is a social change affecting the behaviours.

The overall characteristics of computer-based systems and the approach to information management adopted at the MPD and the DUP of the KLCH show that both departments have made considerable investments in equipments and personnel, including staff with computing and GIS skills. The analyses of the planning departments in the KLCH indicate that the extent of the funding obtained in the overall approach to information management and the components of GIS have been influenced by the planning staff and planning officers within the departments. With over 80% of the Kuala Lumpur city data having a locational basis, GIS can play a vital role in their functioning and make the KLCH more efficient and effective in operations, management, policy implementations, decision-makings, and public services. These aspects correlate views by Bernhardsen (2005), Campbell (2005), Gill *et al.* (1999), Gocmen and Ventura (2010) and Obermeyer (1995) on the effective functions of GIS in organisations. The availability of more powerful computer technology in the late 1990s in the KLCH coincided with the increased interest of planning staff in GIS and its intensified diffusion.

The relationship between individual planning staff and GIS suggests that all socio-technical relationships are products of both users and technology. The planning staff is able to interpret the software while GIS is able to display functionality. These relationships suggest a more subtle analysis of the ways in which users and GIS are distributed. It appears that the interactions with GIS and the mediating position of GIS seem such a potent one. This is because, although the planning departments are implicit in the functionality of GIS, it is so dispersed that the technology becomes the central focus of activity. As it generates products such as complex overlays and paperwork, which will not have been possible without it, GIS emerges as an agent, and the technology becomes more animated than the individual human agents associated with it (Lilley, 1999).

The findings indicate that all planning staff at the MPD and the DUP view GIS as a means to accomplish tasks more quickly and easily, improve data management, improve data sharing, standardise and centralise data, save time, increase productivity effectiveness, improve decision-makings, reduce workloads, improve job performances and derive personal benefits in terms of improved professional performances and prestige. The findings show that users' satisfaction is somewhat different for direct and indirect GIS users. Indirect users are those who make use of the technology by relying on other members in the department. For direct GIS users, ease of use, time saving, exploitation of technology, data sharing, data management, improved decision-makings, trainings and documentations are all important for achieving satisfaction. As suggested by Nedovic-Budic (1999) and Gill *et al.*, (1999), regardless of the type of GIS use, quality, timeliness, accuracy, format, reliability, and completeness of the GIS products are of central concern in evaluating user satisfaction.

The results reveal that time saving is one of the benefits of using GIS in the MPD and the DUP. Apart from speeding-up the processes of keying-in data, retrieving data and storing data, the use of GIS helps the planning staff at both departments for the purpose of presentation because of the need to see the immediate visible impact of using GIS during the planning committee meeting. This is important in order to impress upon the management GIS implementation at planning departments.

The findings of the survey and interviews indicate that the planning staff at the MPD and the DUP is more likely to regard GIS as a positive aid for their planning activities and processes. The notion of 'GIS as a tool' has been repeatedly invoked by the respondents. It has been usually accompanied by the assumption that, as a spatial data handling tool, GIS will be a useful tool for planning processes. The term "tool" is readily adopted by the planning staff and GIS has been constructed as a flexible piece of technology that will facilitate efficient working practice. Its usefulness has been reflected by respondents who referred to a number of tasks which they considered would have been more efficiently performed using GIS. These tasks include keying-in data, retrieving data, printing plans, processing planning applications, performing mappings, performing analyses, printing reports, conducting presentations, running models, and operating the system management. The notion that GIS incorporates a range of functionality that enables spatial data to be handled effectively is therefore utilised by respondents in order to support their understanding of GIS as a 'tool'. Most of the staff whose interest in technology is related to their work are not naturally eager about GIS; however, they perceive that knowledge of IT may be advantageous to the departments and the organisations as well as to their individual career advancements. However, there is also a minority of the planning staff who have avoided using GIS and have shown little willingness in learning how to use it.

The findings of the study indicate that the use of GIS in the planning decision-making process is important. It is interesting to note that all respondents, whether interviewed or through the questionnaire survey, have felt that the existence of GIS in the departments is key to improved decision-making. In term of rationalisation and standardisation of a decision, the findings indicate that GIS has made a significant contribution. The evidence suggests that planning officers at the DUP employ information as an aid to ensure that a proposed new development or redevelopment of a certain area in the city of Kuala Lumpur obtains approval in a Town Planning Committee (TPC) meeting. However, this study indicates that the current use of GIS information at the MPD and the DUP to support these decisions is limited to digital maps, graphic presentations and planning reports only. Overall information in these circumstances is likely to be employed selectively in order to fulfil a tactical and perhaps even symbolic function.

The results of the interview suggest that the Planning Director has made a highly significant contribution in obtaining the resources necessary for the development of computer-based information systems in the MPD and the DUP. A primary function of this leadership role is to set clear goals and objectives, to win acceptance among end users for such goals and objectives, and to provide the commitment which enables these goals and objectives to be realised in the utilisation process. The role of the Planning Director can be made easier if he/she receives support from the middle management. In addition, it is often found that the technical skills and interests of the Planning Director play an important role in encouraging the use of GIS among planning staff (Campbell, 2005; Drummond and French, 2008; Yeh, 2005). As GIS is rather new in the planning departments of the KLCH, the planning heads and officers need to gain more skills before they can provide leadership in promoting the use of GIS in their departments. They also need to have a generally good comprehension and appreciation of computer applications. The emphasis that the Planning Director places on the role of GIS/information system in strategic planning processes is also significant. As a result, an information management strategy (the Development Control System within the DUP) has been developed which gives consideration to data accessibility and associated issues such as staff training. This in turn has encouraged the adoption of a centralised approach in the use of GIS in planning departments. Consequently, these findings suggest that the activities of the Planning Director and supported by the Mayor, the Planning Officers, and all planning staff have been responsible for the creation of a favourable internal organisational context in which to utilise GIS in planning departments.

This study has revealed the relationship between the planning staff and GIS as mutually productive, where GIS will not only affect the working practices of the planning departments but where its adoption will impact upon GIS itself. It has been frequently argued that, as GIS becomes embedded in current practice, greater numbers of potential users will become more aware of it and its use will therefore become more widespread. Concurrently, this will promote investments and developments of the software and, as systems become refined and standardised as good practice, it will be increasingly difficult for users to circumvent the system.

CONCLUSION

The development of GIS has progressed dramatically in recent years and its use has proliferated in government planning departments. This study explores the understandings of GIS and assesses the processes by which the technology and its users negotiate and co-construct with each other. The main strategy underlying the whole discussion about conditions for effective utilisation is the use of an incremental approach to system design. Typically, this approach begins with simple forms-driven data system and then progresses through thematic mappings and a single purpose GIS to a comprehensive, multipurpose GIS. This step-by-step approach provides a valuable opportunity for accumulating the practical experience needed for increasingly ambitious tasks. More importantly, it allows the practical value of the system to be demonstrated early on which in turn helps to ensure the political and management support needed to continue the long-term development effort by which a larger system can be developed.

The findings of this study have profound implication for the designs, implementations and organisations of information systems. This study has identified that there is a strong contribution of the socio-technical factors to an understanding of GIS usage in the DUP and the MPD, KLCH between organisational contexts, people and technology. It has been proven that the manner in which these factors interact with GIS determines the processes which affect the utilisation process of automated systems. This study has demonstrated that a situation of mutual dependency whereby these factors influence the utilisation of computing technology and, at the same time the technology, has various impacts (benefits and problems) on planning departments and staff involved. Thus, the identification of the pertinent factors and the manner in which they interact enable greater understanding of the processes affecting the effective use of GIS in the DUP and the MPD, KLCH.

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