



MALYSIAN INSTITUTE OF PLANNERS

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B-01-02, Jalan SS7/13B, Aman Seri, Kelana Jaya
47301, Petaling Jaya, Selangor Darul Ehsan, MALAYSIA
Tel: +603 78770637 Fax: +603 78779636
Email: mip@mip.org.my



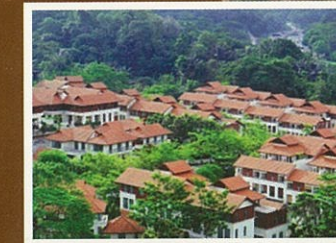
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47301, Petaling Jaya, Selangor Darul Ehsan, MALAYSIA
Tel: +603 78770637 Fax: +603 78779636 Email: mip@mip.org.my

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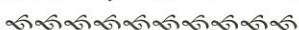
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“Whoever travels in search of knowledge is on Jihād until he returns”

(Transmitted by Tirmidhi & Darimi)





VEHICLE OWNERSHIP AND QUALITY OF LIFE IN URBAN RESIDENTIAL NEIGHBORHOODS, NORTHERN PENINSULAR MALAYSIA

Abdul Ghapar Othman¹, Hassim Mat²

School of Housing, Building and Planning

UNIVERSITI SAINS MALAYSIA

Abstract

It is widely believed that owning a vehicle affects one's quality of life. In the United States, owning a car contributes positively to quality of life while in countries such as New Zealand, this impact is not always apparent. Private cars, particularly, has become a leading mode of transport due to its inherent advantages such as privacy, comfort and unrestricted freedom. Other than income, road infrastructure, urban land use pattern and government policies are all influential factors in determining vehicle ownership and usage. It is widely believed that vehicle ownership increases accessibility to better jobs, urban facilities, and social meeting places. This study examines the relationship between owning a private vehicle and social and economic satisfaction, as well as accessibility to public facilities. A total of 1,563 households were surveyed in six urban areas of northern Malaysia. The sample was stratified according to low-, middle-, and high-income neighborhoods. Cross tabulation analysis was done on levels of vehicle ownership and other variables to determine the level of satisfaction in economic and social quality of life. Approximately 99% of those surveyed owned at least a motorcycle while roughly a third owned both a car and a motorcycle. Majority expressed indifference to public transport and considered owning a vehicle a necessity for daily activities. A direct relationship was observed between the number of owned vehicles and the level of job and income satisfaction. Similarly, social interactions with neighbors, participation in community activities, satisfaction in ethnic relations, and attendance in religious services indicated a positive relationship with car ownership. These social satisfaction and economic fulfillment, as well as access to public amenities, are positively enhanced by vehicle ownership.

Keywords: Vehicle ownership, Quality of life, Private vehicles, Public transport, Residential neighborhood

¹Abdul Ghapar Othman is a senior lecturer at the School of Housing, Building, and Planning of Universiti Sains Malaysia. His research interests include urban transportation, GIS, and land use planning. (Email: gthapar@usm.my)

² Hassim Mat is an associate professor at the School of Housing, Building and Planning of Universiti Sains Malaysia. His interests focus on traffic impact assessment (TIA) study, road accident audit study, and transportation planning study. (Email: hassim@usm.my)

pursue knowledge, and attaining a standard of living which surpasses the fulfillment of the basic and psychological needs of the individual, to achieve a level of social well-being compatible with the nation's aspirations.”

Quality of life is considered to have improved when the society's situation has reached a level that is regarded as better. As illustrated in Table 1, the components and indicators of quality of life within the Malaysian context are presented in the Malaysian Quality of Life Index (MQLI) instituted by the Malaysian Economic Planning Unit under the Prime Minister Department.

Table 1: Eleven Components of the Malaysian Quality of Life Index (MQLI)

No.	Components	Indicators
1	Income and distribution	Real per capita income Gini coefficient and incidence of poverty
2	Working life	Unemployment rate Trade disputes and man-days lost due to industrial action
3	Transport and communications	Private motorcars and motorcycles Commercial vehicles and road development index Telephones and Internet subscribers Average daily newspaper circulation
4	Health	Life expectancy at birth and infant mortality rate Doctor-population ratio
5	Education	Literacy rate Pre-school, secondary school, and university participation rate Primary school teacher-student ratio Secondary school teacher-student ratio
6	Housing	Average price of medium-low cost house per capita income % of low-cost housing units to total low-income households % of housing units with piped water % of housing units with electricity
7	Environment	Air quality and water quality % of forested land
8	Family	% of divorces; crude birth rate; household size; juvenile crime

9	Social participation	Registered voters Membership in registered non-profit societies Number of registered residents' associations
10	Public safety	Crime; road accidents
11	Culture and leisure	Membership in public libraries; TV viewers Domestic hotel guests

(Source: Yap (2005))

TRANSPORTATION

Transportation refers to the movement of people, goods, and information between points of origin and destination, passing through one or more points of interchange via a network in space. Each movement is associated with activities that need to be facilitated such as employment, education, recreation, shopping, and so on. Transportation is regarded as one of the key economic boosters in modern society (Dimitriou, 1992). Nowadays, motorized transport is predominant, regardless of distance. Nevertheless, non-motorized modes of transport such as walking, bicycles, and pedicabs remain significant especially for short trips of up to five kilometers (Rimmer, 1986). The impact of technological transformation in the transport sector since the late 19th century has contributed significantly to people's lifestyle, thus enhancing quality of life (Simon, 1996).

According to Kubani (2005), quality of life is considerably related to transportation. People generally aspire to live a balanced life, where they can spend more time with family rather than being confined in traffic. A combination of proper infrastructure and adequate mode of transport can make this possible. The automobile is a widely available form of transport, and owning one has become common and essential. While it may be presumed as a luxury, majority of daily activities require some mode of transport.

In developed countries such as Australia, Canada, and the United States, car ownership per 1,000 people falls within the range of 450 to 610 in 1990. European countries and Japan, meanwhile, record a slightly lower rate of ownership, between 200 to 400 cars (Barter, 2000). In Asia, as more countries like Korea, Malaysia, and China become players in the automotive industry, vehicle ownership has steadily risen. In Malaysia, for example, vehicle ownership—both motorcycle and car—was pegged at 560 per 1,000 people in 2007, with an annual increase of roughly 20 vehicles per

1,000 people since 2005 (Road Transport Department, Malaysia, 2008). Although public transport services such as bus and taxi are available in the majority of towns and cities, quality and reliability have yet to be improved. With an increasing level of vehicle ownership, private motorcycles and cars remain to be the preferred choice for commuting.

VEHICLES OWNERSHIP AND QUALITY OF LIFE

As previously stated, the level of vehicle ownership is associated with quality of life because it may signify status and personal wealth, important factors for assessing QoL. From an individual perspective, owning a vehicle helps ease the burden of realizing one's daily activities: commuting to work, attending school, shopping, and so on. Daily schedules are better managed in the arms of freedom, comfort, and privacy.

In helping residents to own a vehicle, the City of San Antonio in the United States, for example, launched a Working Family Vehicle Purchase Program (WVFP) in 2007. The program is a joint partnership between the city's Department of Community Initiatives (DCI) and Ford Motor Company. For a down payment of US\$3,000 (US\$2,000 contributed by DCI and Ford plus US\$1,000 contributed by the owner), the owner is required to pay only monthly payment on the purchase of new or pre-owned vehicles. By providing access to affordable vehicle ownership, the program has helped its participants find better jobs, increase their salary, spend more time with their family, and enjoy a better quality of life.

A study undertaken by the Vehicle for Change in 2003 revealed that 73% of 155 participants who own reliable cars have secured better jobs or promotions and raised their annual income by an average of US\$4,558. Owning a car allowed them to be more involved in their children's school and community activities as well (City of San Antonio, 2008; Vehicle for Change, 2008).

Since 1990, Asian countries such as Malaysia, Thailand, and Taiwan have been experiencing a substantial increase in private vehicle ownership; these are among the highest in the region in terms of motorcycle ownership in their cities (above 100 motorcycles per 1,000 people) (Barter, 2000; Kenworthy and Laube et al., 1999). By the end of 2005, there were approximately 15 million vehicles on Malaysian roads, with almost 90% of all motor vehicles privately owned. The motorcycle, being the cheapest and most affordable among the different forms of motorized transport, accounts for the largest share at 7 million (47%), followed by private cars at 6.5 million (43%) (Kasipillai and Chan, 2008). Such an increase in vehicle ownership is seen to be directly stimulated by gross national product (GNP) growth, which increases

the disposable income that influences purchasing power. GNP measures the value of goods and services that the country's citizens produce regardless of location. It is an indicator of a country's economic condition and is positively correlated to quality of life.

According to Simon (1996), there is a linear relationship between countries' GNP per capita and level of vehicle ownership. In general, high-income countries tend to have higher vehicle ownership rates than low-income countries. A country such as the United States has by far the highest car ownership rate, followed by Australia and Canada; France and Great Britain trail closely behind. There are exceptions, however, as Tokyo, Singapore, Seoul, and Hong Kong record low vehicle ownership despite substantially higher GNP per capita (Barter, 2000).

As Table 2 illustrates, there exists a linear relationship between Malaysia's GNP per capita and vehicle ownership based on the statistics of newly registered cars and motorcycles from 2003 to 2007. A steady increase in the country's population and GNP per capita was recorded in comparison with newly registered cars and motorcycles, with the exception of newly registered cars for 2006 and 2007. This declined in 2006 but climbed slightly in 2007, caused by poor trade-in value for used cars and the difficulty in acquiring hire purchase financing and sales. Furthermore, the escalating price of petroleum resulted in a slowdown of car sales and the country's economy.

Simultaneously, average adult population (15 to 64 years) from 2004 to 2007 in Malaysia was approximately 63% of the total population. The latest update for 2008 from the Department of Statistics, Malaysia reported an average of 63.5% (17.6 million). Adult population can be indirectly interpreted as representing the working population, a contributing factor to the rise in the number of private vehicles. As household income is commonly the product of the number of workers in a household, the increase in the number of workers per household is strongly correlated with the increase in household income. With a household of three or more workers, the demand for transportation and options for commuting behavior will be affected in many ways (Pisarki, 2006). For the majority of low-income households with at least one worker, the motorcycle is preferred since it is widely available and affordable and offers accessibility even in congested urban areas. For medium- and upper-income households, owning at least one car has become a necessity to meet daily needs.

Table 2: New Registered Cars and Motorcycles for Year 2003-2007, Malaysia

Year	Population	GNP Per Capita (RM)	Cars	Motorcycles
2003	25,048,000	15,819	424,224	321,234
2004	25,581,000	17,577	471,780	397,977
2005	26,128,000	19,079	537,900	422,255
2006	26,640,000	20,885	458,294	448,757
2007	27,174,000	23,114	477,647	485,236

(Source: Department of Statistics, Malaysia)

The existence of various car assembly facilities is another contributing factor to the rise of vehicle ownership in Malaysia. Between 1926 and 1980, there were 11 automobile assemblers, most of which were foreign-owned companies producing commercial and passenger vehicles. In 1983, Malaysia began to venture into the automobile industry with the establishment of Proton, Perusahaan Otomobil Nasional Berhad (National Automobile Enterprise Co. Ltd.) (Spencer and Madhaven, 1989). Exempted from high import duties, the price for a Proton car is significantly lower than imported ones. Proton has enjoyed a high share in the passenger car market in the country, from 11% in 1986 to 74% in 1993. The sharing percentage has slightly decreased in recent years because of competitive prices offered by foreign-made passenger cars. In 1993, another national car manufacturer was established under the name of Perusahaan Otomobil Kedua Sdn Bhd, widely known as Perodua. Its main objective was to strengthen the local automotive industry before the start of the Asean Free Trade Area (AFTA), a trade bloc agreement to reduce or eliminate tariffs on intra-ASEAN trades. Perodua is well-known for producing small passenger cars at an affordable price. Both Proton and Perodua are protected by the Malaysian government. Their cars are affordable to middle-income households and, since the year 2000, both have recorded a total domestic car market share of 90% (Mohamad and Kiggundu, 2007).

Ironically, the increasing level of vehicle ownership can be detrimental to quality of life as well, especially in the case of neighborhoods and urban areas at large. Oftentimes, the number of vehicles exceeds road capacity, resulting in traffic congestion. This condition ultimately increases the need for adequate road space and other related transport infrastructure. Thus, the development of new highways, ring roads, and parking facilities attract more vehicles and discourage public transport. In Kuala Lumpur, for example, there are so many toll highways and ring roads that heavy traffic congestions are reported during peak hours. A recent visit to the Duta Toll Plaza in Kuala Lumpur during normal hours confined the Minister of Public Works Malaysia

himself in a 15-minute queue on the cash toll-lane. Congestion further worsens in the event of accidents or heavy rain. Despite all these, conditions in Kuala Lumpur are not considered critical yet, with an average flow of 28km/h in the central business district (CBD) during peak hours (Poboan, 2000).

Traffic congestion is known to be a major cause of air and noise pollution in urban areas. Motorized vehicles release poisonous gases and heat daily, deteriorating air quality and affecting visibility. Evidently, these have increased cases of asthma, conjunctivitis, and other related diseases (Pendakur, 1995). Emission from two-stroke motorcycle engines emit approximately 10 to 15 times more hydrocarbon and are roughly half as fuel-efficient as four-stroke engines. They release more smoke, carbon monoxide, and particulate matter which can increase the risk of respiratory illnesses. Approximately 50% of motorcycles plying Malaysian roads are equipped with two-stroke engines. This engine type, which incinerates a mixture of oil and gasoline, burns even dirtier if loaded with extra weight (Potera, 2004). Statistics from the Royal Malaysian Police reported that from 2002 to 2007, the average death toll from fatal road accidents reached 6,196. This figure is considered high and alarming for a country with an average population of 26 million. In 2007 alone, there were 6,282 fatal road accidents, with motorcycles having the highest casualties at 58% (3,646), followed by cars at 20% (1,228) and pedestrians at 10% (636). Various studies have been conducted to promote road safety issues in Malaysia (Radin Sohadi, 2005; Mohd Yusof et al., 2003; Nhan et al., 2009). In addition, the Malaysian Institute of Road Safety Research (MIROS) was established in 2007 to study and evaluate the current procedures for road safety in the country.

Losing a loved one is tragic, especially if it involves the household's sole breadwinner. It poses detrimental effects on the acquisition of basic human needs such as food, shelter, clothing, and education, which are important in sustaining a sound quality of life. In the majority of developing countries, public transport is a means of traveling to work, school, and commercial areas. It is likewise a means of providing greater freedom, access, opportunity, and choices for the urban poor and those who cannot afford private vehicles. For example, the public bus service connotes the 3Cs: convenient, comfort, and cheap. Commuters seek for convenient and comfortable services at cheaper and affordable prices. While the 3Cs serve as the main motivation of public bus transport operators, quality and efficiency are often being sacrificed (Iles, 2005). In privately owned and operated bus transport systems, financial success is measured based on economic profits while operating performance is determined by ridership. Services on low-demand routes with revenues that drop below the marginal cost are reduced to cut cost even though overall input costs such as capital, fuel, and labor are stable (Fielding, 1987; Hensher, 1987).

Table 4: Number of Respondents by State, Urban Area, and Housing Scheme

State	Urban Area	Housing Scheme			Total
		Low-Cost	Medium-Cost	High-Cost	
Perlis	Kangar	100	100	78	278
Kedah	Alor Star	98	94	47	239
Kedah	Sungai Petani	95	100	86	281
Kedah	Kulim	100	94	77	271
Penang	Seberang Perai	100	100	54	254
Penang	Penang Island	100	100	40	240
Total		593	588	382	1,563

By comparing the distribution of respondents based on housing schemes, participation from high-cost housing is much lower compared to low- and medium-cost housing. Within the high-cost housing scheme, larger urban areas like Alor Star, Seberang Perai, and Penang Island have lower respondents compared to small urban areas such as Kulim, Sungai Petani, and Kangar. Since many of the high-cost houses are in the form of a gated community, accessibility to the household is a problem in addition to unwillingness to participate in the survey.

The survey questionnaire on the transportation component was structured to examine three important elements: ownership of motorized vehicles, mode of transport to work and school, and utilization of public transport services. Further, other elements being surveyed included household characteristics such as income and workers, perceptions on public facilities (physical environment), social and economic aspects of life (See Table 5). Questions on perception were devised based on respondents' level of satisfaction and perception, which were ranked from "very dissatisfied" (-2) to "very satisfied" (2). Respondents were likewise asked regarding their satisfaction in the public transport available in their neighborhoods to determine whether the quality of services influenced household decisions and attitudes on daily transport modes. For those who did not use public transport despite its availability in their neighborhoods, a list of "reasons for not using public transport" was provided. Data from the survey were cross-tabulated to examine relationships and vehicle ownership's significance as an instrument for measuring quality of life.

Table 5: Structure of Questionnaire for Transportation Component

Component	Element
Household	<ul style="list-style-type: none"> • Size • Monthly income • Working member • Hours worked/day
Perception -2 - Very dissatisfied -1 - Dissatisfied 0 - Neutral 1 - Satisfied 2 - Very satisfied	<ul style="list-style-type: none"> • Public facilities (education, health, commercial, recreational, religious, public transport service, community, security) • Social aspect of life (neighbors, ethnic and societal interactions, public safety, religious services, politics) • Economic aspect of life (employment, income, employment benefits and promotion, cost of living, housing value/investment)
Vehicle ownership	<ul style="list-style-type: none"> • Type and number of motorized vehicles owned (car/motorcycle) • Sufficient parking space • Mode of transport to work/school • Distance traveled to work/school
Public transport (bus/taxi)	<ul style="list-style-type: none"> • Availability of service • Usage and frequency/week • Reason for not using public transport

FINDINGS

Level of vehicle ownership

In the questionnaire, respondents were asked about the model(s) of the car(s) and motorcycle(s) they owned, both local and foreign-made. The summation of this data represents the total number of vehicles owned by each respondent. Results from Table 6 below revealed that merely 1% (22) of the respondents did not own any motorized vehicle while 99% (1541) owned at least one vehicle, either a motorcycle or a car, or both. From this group, approximately 94% (1,444) owned at least one car and merely 6% (97) owned motorcycles only. Over half of the respondents (56%) owned both, at least one car and one motorcycle, and 63% (980) possessed at least one motorcycle. For those who owned a car, having a motorcycle is an advantage, especially for making short trips to sundry shops and places of worship, visiting friends, or sending children to school or religious classes. It requires less petrol and is convenient in terms of accessibility and time consumed for short-distance and light-load trips.

Table 6: Vehicle Ownership (Car and Motorcycle)

Vehicle Ownership	Total (%)
No vehicle	22 (1)
0 Car and 1 motorcycle	62 (4)
0 Car and > 1 motorcycle	35 (2)
1 Car and 0 motorcycle	238 (15)
1 Car and 1 motorcycle	458 (29)
1 Car and > 1 motorcycle	99 (6)
> 1 Car and 0 motorcycle	323 (21)
> 1 Car and 1 motorcycle	252 (16)
> 1 Car and > 1 motorcycle	74 (5)
Total	1,563 (100)

On the ownership of the national car, over three-quarters (77%) of the total respondents own at least a Proton or a Perodua and the majority dwell in low and medium-cost housing. The national car is affordable and the quality is comparable to other imported cars with similar sizes, standards, and specifications.

Cross tabulation analysis between levels of vehicle ownership and household income (N=1536, Pearson Chi-Square=169, $p < .001$) reveals no direct relationship between increasing household income and level of vehicle ownership. Average household income in this study is RM4,400 (USD1,222). A similar pattern is visible when level of vehicle ownership is cross-tabulated with household size (N=1536, Pearson Chi-Square=48, $p < .001$) and the number of workers per household (N=1511, Pearson Chi-Square=113, $p < .001$), which is fairly associated with household income. Approximately 85% of the respondents (1,317) have less than three workers per household and the level of vehicle ownership is dominated by those who own one to two vehicles (68%). As the number of workers per household increases to three or more workers, the level of vehicle ownership begins to decrease. Although household income or the number of workers in a household is presumed to be extremely related to vehicle ownership, the findings do not support this hypothesis. The need to own a vehicle depends on necessity and the importance of mobility in fulfilling diverse daily activities as well as in sustaining quality of life. However, the ability to own a vehicle is relatively associated with income, which determines purchasing power. As Barter (2000) pointed out, factors that influence vehicle use in addition to income include the cost of owning a vehicle, land use pattern, road infrastructure, public transport service, and policies related to transport demand management.

In general, 69% (1,073) of the respondents are satisfied with the availability of parking space in their neighborhoods. Parking space in this study pertains to on-street parking within different neighborhoods. A mere 13% (197) are dissatisfied, most of them owning two to three vehicles. On the question of parking space availability for each housing unit, 67% (1,014) of respondents affirmed that parking space is adequate while 33% (495) deem it insufficient. Again, majority of those who consider that parking is inadequate own at least two to three vehicles. Such a scenario is expected, especially from those living in high-rise, low-cost housing where limited parking space is shared among residents. In the case of medium-cost housing (landed or high-rise), each unit is commonly allocated with one parking space for a car. Those who own more than one car will naturally perceive this as inadequate.

Mode of transport to work and school

Further examination on the mode of transport to work revealed that approximately 93% (1,447) of respondents worked outside their home, with 45% (648) needing to travel between 5 to 50 km to reach the work place. Approximately 78% clock in over seven hours a day and over 90% of trips are made via private vehicles; public bus accounts for a mere 1%. Although 38% of respondents know of a bus service in their housing areas, utilization of this service is very low. This indicates high dependency on private vehicles and reflects the importance of possessing a reliable mode of transport for commuting to the work place. For long-distance trips, owning a private vehicle offers better accessibility, comfort, and less time to travel to the work place. It improves QoL, whereby users enjoy the freedom and opportunity to run errands before reaching their work place.

Similarly, mode of transport to school (N=885) is dominated by private vehicles (58%), followed by van/school bus (19%), or a combination of both (11%). Other modes include walking (7%), others means (4%), and public bus (1%). A mere 18% of respondents have children who go to school located less than one kilometer away while the majority (58%) have schools between one to five kilometers from their homes, followed by over six kilometers (25%). Regardless of distance, private vehicle is the preferred choice because it offers convenience and safety for children. Furthermore, it provides respondents with the opportunity to send their children to school before continuing their journey to work, thus saving cost on additional modes of transport to school.

Public transport service

Utilization of public transport service by respondents in the study area is extremely low. As mentioned earlier, a mere 38% (599) of respondents acknowledge that a public bus service is available in their neighborhood. From this figure, only 29% (173) utilize this service for trips to work or school, shopping, visiting friends, and entertainment

while the rest rely on private vehicles for such trips. Majority of those utilizing the public bus reside in low-cost housing (61%). The frequency of availing of this service is low, with majority (51%) using it less than twice a week.

Not all areas offer a bus service, especially in areas with medium- and high-cost housing. The low utilization of the public bus service is inversely related to the high rate of private vehicle ownership. The availability of such a service is not critical or in great demands as the majority of respondents (99%) own a private vehicle. More than half of the respondents who do not avail of the bus service available in their respective areas (N=426) attribute this non-use of public transport to “having and using private vehicle” (57%) as the major reason, followed by “unscheduled bus journey” (16%), “long bus journey” (11%), “uncomfortable conditions (8%), and others (8%). This result demonstrates that the level or quality of public bus service is not a major factor influencing decisions on mode of transportation. By possessing a private vehicle, quality of life is enhanced through better accessibility, freedom, comfort, privacy, and time.

Perception

The questionnaire on the respondents' perception of quality of life is based on three major elements, namely, public facilities, social, and economic aspects of life. The respondents' answers are structured based on the level of satisfaction, and are assessed by applying a five-point scale ranging from a score of -2 for “very dissatisfied” to 2 for “very satisfied.” Those who answered “neutral” are coded as 0. The Cronbach-Alpha of this scale is 0.827.

Public facilities

Perception assessment of the physical environment focuses on the quality of physical facilities and services available within the housing areas in relation to the level of vehicle ownership. As Table 7 illustrates, the majority of respondents, regardless of the number of vehicles owned, are satisfied with the quality of facilities and services available in their housing areas, with the exception of public transport. This has a mean score of -0.23, representing the dissatisfaction of those who do not own a single vehicle. Compared to other elements, public transport has the lowest overall mean score (Mean* = 0.14). This clearly indicates that quality of public transport service and facilities are not within the respondents' acceptable standards, especially those who do not own a vehicle and forced to rely heavily on public transport as their daily mode of transport. The low mean scores of respondents who own vehicles likewise signify a strong dependency on private vehicles as their mode of transport, many of which may be attributed to the low satisfaction on the public transport service and facilities in their housing areas.

Table 7: Mean Score: Public Facilities by Level of Vehicle Ownership

QoL-Public Facilities		Educational Facilities	Health Facilities	Commercial Facilities	Recreational Facilities	Religious Facilities	Public Transport Service/Facilities	Community Facilities	Security
Level of Vehicle Ownership	0	0.77	0.68	0.32	0.14	0.59	-0.23	0.09	0.14
	1	0.81	0.74	0.77	0.47	0.72	0.07	0.30	0.40
	2	0.94	0.88	0.90	0.49	0.85	0.16	0.43	0.53
	3 – 4	1.02	0.99	0.97	0.50	0.81	0.18	0.43	0.54
	More than 4	0.95	0.92	0.89	0.32	0.95	0.24	0.34	0.34
	Significant level	p < 0.001	p < 0.001	p < 0.001	p < 0.001	p < 0.05	n.s.	p < 0.05	n.s.
	Pearson chi-square	43.10	43.20	47.53	39.37	25.87	19.70	27.08	20.81
	Mean*	0.94	0.89	0.89	0.48	0.81	0.14	0.40	0.50

Scale range from -2 for “very dissatisfied” to 2 for “very satisfied”

0 vehicle (N=22), 1 vehicle (N=300), 2 vehicles (N=724), 3 – 4 vehicles (N=479), More than 4 vehicles (N=38)

n.s.: not significant

Mean*: overall mean score for each element

Meanwhile, the satisfaction level on education facilities ranks among the highest in this group, with an overall mean score (Mean*) of 0.94. In addition, the mean score rises moderately as the level of vehicle ownership increases, but decreases slightly when the level of vehicle ownership reaches over four vehicles. This may be caused by comparisons made by respondents with over four vehicles between schools being attended by their children and schools situated in their housing areas. As mentioned

above, approximately 25% of respondents have children who attend schools located more than six kilometers away from home. This may be attributed to the better quality of education and excellent facilities offered compared to those in their housing areas. Traveling to such distances, however, requires a mode of transport that is not only reliable and convenient but provides accessibility as well. In this case, having over four vehicles in a household is a natural advantage.

Social aspect of life

Table 8 presents the mean scores of respondents' satisfaction on the social aspect of life in their respective neighborhoods. In general, majority of respondents are satisfied with the social aspect as the majority of social elements have high overall mean scores (mean*), with the exception of public safety, which has an overall mean score of 0.48. The mean scores for public safety reveal a moderate increase as the level of vehicle ownership increases from zero to two vehicles, but begin to decrease as it reaches beyond four vehicles. This may be attributed to property crime in their neighborhoods such as vandalism and car and motorcycle robbery, which are currently on the rise in most parts of the country. Since parking space in the majority of houses (landed property only) can only accommodate a maximum of two cars, owners with over two vehicles have no choice but to park these along the road. These vehicles have a higher risk of being stolen or vandalized. This problem is worsened by the lack of police visibility.

Although the means score for public safety decreases as car ownership increases, other elements associated with social interactions display a positive relationship with car ownership. These include interaction with neighbors, participation in community activities, satisfaction in ethnic relations, and attendance of religious services. In this case, owning more cars may mean increasing mobility as these interactions require movement from one place to another. In other words, owning more cars enables residents to be involved in more community activities, hence improving their social quality of life.

Table 8: Mean Score: Social Aspect of Life by Level of Vehicle Ownership

QoL-Social Elements		Interaction with Neighbors	Public Relations	Ethnic Relations	Public Safety	Religious Service
Level of Vehicle Ownership	0	0.71	0.64	0.48	0.14	0.48
	1	0.85	0.84	0.67	0.47	0.72
	2	1.00	0.95	0.78	0.50	0.84
	3 – 4	0.96	0.98	0.72	0.49	0.83
	More than 4	1.00	1.00	0.89	0.34	0.97
Significant level		p < 0.05	p < 0.05	n.s.	n.s.	p < 0.05
Pearson chi-square		35.44	27.10	21.94	14.84	29.01
Mean*		0.96	0.94	0.74	0.48	0.81

Scale range from -2 for “very dissatisfied” to 2 for “very satisfied”

0 vehicle (N=22), 1 vehicle (N=300), 2 vehicles (N=724), 3 – 4 vehicles (N=479), More than 4 vehicles (N=38)

n.s.: not significant

Mean*: overall mean score for each element

Economic aspect of life

Respondents were likewise asked regarding their satisfaction with overall economic quality of life (Table 9). Five aspects were examined: job satisfaction, income generation, employment benefits, cost of living, and property investment. Based on the mean scores, the table indicates that the respondents are rather satisfied with their current economic condition in all aspects. However, they are dissatisfied with the cost of living, as reflected by the negative mean scores throughout the level of car ownership. Those without a vehicle and those with two vehicles display the highest level of dissatisfaction.

The table likewise indicates a positive relationship between the number of vehicles and the job satisfaction level. Similarly, there is a direct relationship between the number of vehicles owned and the level of income satisfaction. This may be attributed to the fact that people who own and enjoy access to private vehicles can choose jobs to their liking or have jobs with better income. The fact that people who own private vehicles have better jobs and increased income has likewise been observed in a study conducted by the Vehicle of Change (2008), as discussed earlier

Table 9: Mean Score: Economic Aspect of Life by Level of Vehicle Ownership

QoL-Economic Elements		Job Satisfaction	Income	Employment Benefits/Promotion	Cost of Living	Property Value/Investment
Level of Vehicle Ownership	0	0.60	0.50	0.45	-0.32	0.32
	1	0.63	0.43	0.50	-0.10	0.38
	2	0.76	0.53	0.48	-0.40	0.49
	3 – 4	0.89	0.70	0.56	-0.20	0.58
	More than 4	0.92	0.76	0.55	-0.26	0.45
Significant level		p < 0.001	p < 0.001	n.s.	p < 0.001	p < 0.001
Pearson chi-square		44.23	39.19	13.89	38.26	42.61
Mean*		0.78	0.57	0.51	-0.28	0.49

Scale range from -2 for “very dissatisfied” to 2 for “very satisfied”

0 vehicle (N=22), 1 vehicle (N=300), 2 vehicles (N=724), 3 – 4 vehicles (N=479), More than 4 vehicles (N=38)
 n.s.: not significant

Mean*: overall mean score for each element

CONCLUSION

In many cases, it is observed that as household income increases, so does the number of vehicles owned by a household. However, this study observed that the number of owned vehicles is not directly related to income. The need to own a private vehicle, in this case, depends on the necessity to move around and perform daily activities.

In the Quality of Life survey conducted in 2002, the same importance of private vehicle ownership was detected as well (Economic Planning Unit, 2002). The study determined that over 60% of those surveyed mentioned cars as their main mode of transport to work, while a mere 5% availed of a public bus for the same purpose. This current study takes a step further to ascertain the reasons behind the reluctance to use public transport. Surprisingly, the quality of public bus services (or the lack of it) is not the main reason for non-use, rather it is freedom, comfort, privacy, and time-saving qualities offered by private vehicle mobility that are cited as the driving factor behind the pattern. Owning private vehicles likewise offered better accessibility and consequently contributed significantly to one’s quality of life.

This finding is significant considering that crime rates, especially property vandalism, are higher in areas where the residents own more than two cars. On-street parking, result of a lack of space inside a gated compound, has become a target for vehicle burglary and break-ins. However, although security and safety are compromised and are low in satisfaction level, these do not deter the residents from owning private vehicles.

By and large, those who do not own private vehicles are generally found to have lower satisfaction in QoL compared to those who own a private vehicle. Non-ownership of a private vehicle implies limited mobility and restricted freedom. This is widely believed to hinder the achievement of a better quality of life. This is especially true in terms of access to public facilities and social activities. Increased social interaction is observed to be positively related to vehicle ownership and access to high-income jobs. In other words, vehicle ownership contributes to one's quality of life as it increases social interaction opportunities, economic advancement, and job satisfaction.

The observation that quality of life is closely linked to vehicle ownership is understandable, given the ways houses are structured in a housing development. Little consideration was accorded to public transport as a main mode of mobility when these housing schemes were designed. Given the lack of pedestrian walkways, friendly bus stops, and lay-bys, the design itself indirectly suggests private vehicles as an option for mobility. Unlike a number of developed countries, Malaysia has still a long way to go in reducing the level of private car ownership.

This leaves policy makers with two options: to educate the general public in order to increase public transport usage because it is more environmentally friendly, cost-effective, and accessible to public facilities and to reverse the notion that car ownership means a better quality of life; and to mitigate the impact of air pollution on the environment by introducing friendlier vehicles such as electric and solar-powered ones. Evidently, the latter option will not deter private ownership

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ANALYSIS OF COMMUTE CHARACTERISTICS AND RESIDENTIAL LOCATION CHOICE OF IIUM GOMBAK CAMPUS EMPLOYEES OF MALAYSIA

Mohammad Abdul Mohit¹, Mootaz Munjid Mustafa

*Kulliyyah of Architecture and Environmental Design
INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA*

Abstract

Higher learning institutions, particularly universities, are important nodes which can help in decentralizing the monocentric stigma of urban areas by encouraging employment and housing growth in metropolitan areas. The case study Gombak Campus of International Islamic University Malaysia (IIUM), located 15 kilometres to the north-west of Kuala Lumpur City, is currently an employment node in the Klang Valley region. Being a node of employment, it is expected to generate residential development in the vicinity of its location by supporting the determining two factors of residential location - commuting cost and rent. Although there are certain truths that rent and commute cost are important determinants in households' residential location, other factors also influence residential location decision making. This paper, therefore, attempts to identify an array of factors and the extent to which these factors influence commute and residential attributes of the employees of IIUM Gombak Campus. Findings of this study reveal that there is a significant relationship between commute behaviour and residential characteristics and a number of other factors normally overlooked by the mainstream residential location choice models.

Keywords: Residential location, Commute cost, Rent, Workplace, IIUM, Socio-Economic Factors

INTRODUCTION

Studies on residential location choice mainly consider two factors – friction or distance from the work place, and rent (Alonso, 1964; Muth, 1969). Others include the variable or factor of the size of the housing unit as a determining factor of residential location as manifested in the access-space trade-off model (Maclennan, 1982). In both cases, however, modern location theories cast the economic behaviour of households in a

¹ Professor, Department of Urban and Regional Planning, Kulliyyah of Architecture and Environmental Design, International Islamic University Malaysia (Email: mohd.mohit@gmail.com)

Urban simulation models have been developed in the land use and transportation planning by applying the gravity model which states that the level of human interaction tend to vary inversely with distance. Lowrey's (1964) model of the metropolis based on the assumption that the place of basic employment determines the place of residence is a pioneering work on the gravity model. Wilson (1973) and Puttman (1983) developed the practical use of the gravity model for residential location predictions for metropolitan planning, primarily for transportation planning. Goldner (1968, 1972) successfully implemented Lowrey's framework in an operational forecasting model and developed the Projective Land Use Model (PLUM). This model was later modified by Putman (1976) as DRAM (Disaggregated Residential Allocation Model). Wilson (1973) reformulated the Lowrey model by using the entropy framework to find the most probable distribution of home-to-work trips. Other researchers who operationalised the Lowrey model are, Garin (1966), and Batty (1971). The most significant extensions and operational applications of the Lowrey type of gravity models is the disaggregated model of the Integrated Transportation and Land Use Package (ITLUP) by Putman (1980, 1983), which predicts employment location based on a lagged distribution of workers, access to residents and a set of workplace attractiveness variables. Despite these developments, the basic criticism of the gravity type of model to date has been the lack of a theoretical foundation for its implementation and its simplistic use of an analogy drawn from physics.

Waddel (1997) used a multinomial and nested logit model to examine the spatial aspects of labour supply, housing demand and transportation service demand for white, black and Hispanic workers. The MEPLAN model was constructed using three economic concepts – input-output model, price function and random utility (Echenique, et al., 1990). The METROSIM model of Anas (1994) embodies the discrete choice method with economically specified behaviour and a market clearing mechanism. The model iterates between three markets – labour market (job assignment), housing and commercial space market (location equilibrium) and the transportation service market (equilibrium of transportation flows). UrbanSim (Waddel et. al., 2001), a GIS based model, takes two key inputs from external model system – a macro economic model to predict future population and employment by sector, and travel demand model system to predict travel conditions such as congested times and composite utilities of travel between zones. The common feature of all the models discussed so far is that these are all virtually land use demand allocation models and the demand is determined by taking input of regional forecast of various variables such as population, employment, travel demand, etc from external model system. Therefore, the very notion of the formation of urban spatial pattern as a result of interactions among various land use distributions within an urban area is ignored in these models.

Other empirical studies to explain the underlying factors determining household location decisions within an urban area cover wide-ranging aspects. Linneman and Graves (1983) found that job search and residence decisions are intimately intertwined over both short and long distances. Wienberg (1979) observed that individuals can adjust accessibility by adjusting workplace location or residence location or both. Although individuals do not make simultaneous decisions regarding their residence and workplace locations (Gordon and Vickerman, 1982), some individuals will make workplace decisions based on predetermined residence location while others make residence decisions on the basis of predetermined workplace locations. Beesley and Dalvi (1974) argued that residential choice is primarily the decision of the household head, with the likely implication that secondary workers in the household choose their workplace on the basis of a predetermined residential location. Homeowners face higher relocation costs than renters and are likely than renters to choose their workplace on the basis of their residential location. Blacks face discrimination in housing choice, their residential location opportunities are restricted and they are more likely to be forced to choose a job based on their residential location. Schwartz (1973) found that more educated workers adopt a larger job search radius, confirming that higher socioeconomic status confers greater flexibility in the choice of both residential and workplace location. Smersh (2003) explored the role of transportation, large-scale development, employment nodes, existing patterns of development and regulation on the spatial pattern of residential development in Alachua County in Florida, USA. Mootaz (2008) studied the residential location factors of IIUM employees and found variables such as monthly commute cost, type of transport used, employment in the family, house tenure and duration of job as predictors to the dependent variable - commute distance between residence and work place. Wan Nurul Mardia (2005) studied residential locations of ICT sector employees of Kuala Lumpur in her teleworking perception study.

The above review of literature on the factors determining residential location encompassing theories, models and empirical studies indicates that a host of variables are related to the process. These variables may be grouped as economic, social, cultural and political. Although existing studies, particularly the models focus more on economic determinants, less attention has been paid to the social, cultural and political determinants of the process. The choice of a job given the location of the firms, the choice of residence location given the spatial distribution of housing supply, the choice of housing tenure and the choice of travel mode to work are all related decisions made by employed households (Waddel, 1997, p.2). Therefore, the present paper intends to focus on the behavioural aspects of residential location decisions from the social, economic and cultural perspectives.

SOCIO-ECONOMIC, RESIDENTIAL, TRANSPORT AND COMMUTE CHARACTERISTICS OF IIUM STAFF

Analysis of demographic and social-economic characteristics of IIUM staff presented in Table-A1 in appendix-A shows clear differences by academic and non-academic categories. Mean age, educational qualifications, service length and gross monthly income of academic staff are higher than the non-academic staff. On the contrary, female staff, singles or unmarried, secondary employment and multiple employment are higher among non-academics. Housing characteristics presented in Table-2A in Appendix-A shows that while large percentage of academics own houses, large percentage of non-academics live in the rented accommodation. Whereas non-academics dominate in owning apartments/flats, detached and semi-detached houses are largely owned by the academics. Both mean housing rents and mean monthly housing instalments paid by the academics are higher than the non-academics. While only 15 percent of non-academics own houses priced above RM 250,000 (US\$78,200), percentage of academics owning similarly priced houses are 45.5. Moreover, academics appear to have longer period of occupation in their present residences (mean: 8.5 years) than the non-academics in which case the mean is 7.0 years. Transport and commute characteristics of IIUM staff have been analyzed in Table-3A in appendix-A, where it can be seen that mean commute distance travelled by the academics between residence and the university is slightly higher (13.2 KM) than the non-academics in which case it is 12.6 KM. However, the noticeable thing is that the spatial dispersion of residence location from IIUM is higher in case of academics than non-academics (Figures 2 & 3).

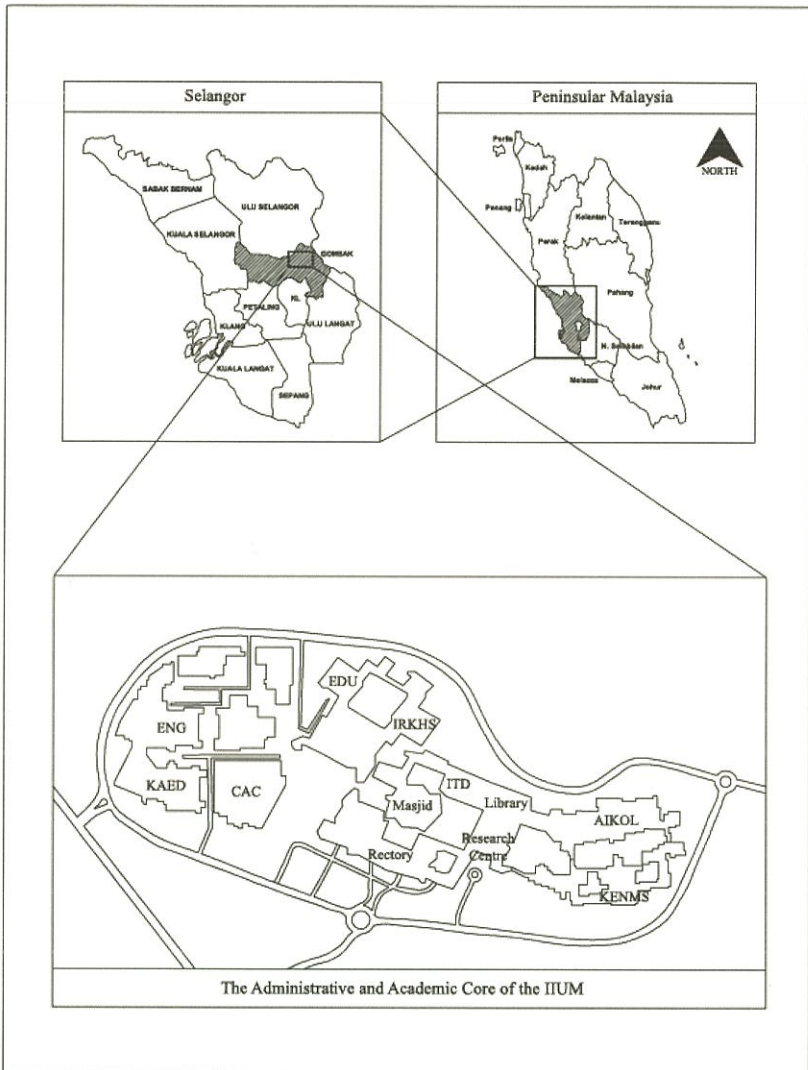


Figure 1: Location of IIUM Gombak Campus within Local, Regional and National Settings

A similar pattern is observed with commute times from residence to IIUM and from IIUM to residence, the only exception being that the spatial dispersion of the non-academics is higher than the academics. Monthly commute cost of non-academic staff is higher with wider dispersion than the academic staff of IIUM. The distribution of monthly commute expenditure as percentage of monthly income shows that whereas 96% of academic staff spends up to 15% of their monthly income on commuting

Location of Residence, Employment and Children’s School

Existing literature claims that types of job, i.e., primary and secondary and location of children school influence residential location decisions. Therefore, we examined the distances between residence and job locations by primary and secondary employment and found that both mean and median distances between residence and primary employment is higher than the mean/ median distances between residence and secondary employment in the family (Table 2). This implies that spouse’s job selection is influenced by residential location decisions.

Table 2: Distance between residence and locations of primary and secondary employment

Statistic	Distance between residence and location of primary employment	Distance between residence and location of secondary employment
Mean	26.4KM	10.8KM
Median	7.8KM	5.7KM

(Source: Analysis based on primary data)

Similarly, the location of the children’s school(s) was also found to have an influence on residential location (Table 3). Both mean and median distances between residence and work place are higher than the mean and median distances between residence and children’s school.

Table 3: Distance between residence and IUM and children’s school.

Statistic	Distance between place of residence and IUM (KM)	Distance between place of residence and children’s school (KM)
Mean	13.1	5.8
Median	5.9	3.0
Minimum	0.3	0.1
Maximum	120.0	50.0

(Source: Analysis based on primary data)

Commute to Work Place, Housing Characteristics and Employees Category

The relationships between staff category and commute behaviour and housing characteristics have been examined by using both Pearson correlation (r) and Spearman correlation (ρ) and the results have been presented in Table 4, where it is seen that both types of correlations have almost similar results.

Table 4: Pearson correlation (r) and Spearman correlation (ρ) between employment category and respondents' socio-economic variables.

Variable	Pearson (r)	Spearman (ρ)
Gender (N=97)	.29**	.29**
Age (N=94)	.43**	.42**
Marital status (N=96)	.34**	.35**
Level of education (N=96)	.83**	.85**
Kull/Unit (N=92)	-.36**	-.34**
Monthly income (N=96)	.69**	.71**
Monthly spouse income (N=96)	.40**	.44**
Type of employment (N=97)	-.44**	-.44**
Distance between residence and secondary employment (N=89)	-	-.24**
Monthly family income (N=55)	.34**	.34**
House tenure (N=97)	-.25*	-.25**
Monthly house loan repayment (N=38)	.40**	-.41**
House price(N=54)	.40**	.43**
Monthly housing expenditure(N=72)	.43**	.43**
Monthly house rent (N=34)	.35**	.37**
Mode of housing expenditure (N=77)	.30**	.30**
Type of transport used(N=96)	.30**	.30**
Transport mode used (N=97)	-.27**	-.33**
Commute cost % income(N=94)	-.33**	-.33**
Monthly commute expenditure % of income(N=93)	-.27**	-.23**
Distance between residence and school (Child-1) (N=85)	-.29**	-.42**
No. of school-going children (N=42)	.31**	.41**
Average monthly commute cost (N=96)	.24**	.27**

(Source: Analysis based on primary data)

*Notes: **Significant at .01 level; *Significant at .05 level.*

Variables such as gender, age, marital status, education, income, house loan, house price, housing expenditure, type of transport used, number of school-going children and average monthly commute cost, have significant positive correlations with staff category. Significant negative correlations are noticed in job unit, type of employment, distance between residence and secondary employment, house tenure, transport mode used, monthly commute expenditures as percentage of employees' or spouse incomes, distance between residence and children's schools.

Determining Factors of Residential Location

In order to determine the factors responsible for residential location decisions of IIUM staff, we run three multiple linear regression models. The first model used square root of daily commute cost as the dependent variable; the second one used square root of daily commute distance as the dependent variable; and the third one used square root of daily commute time (MCT) as the dependent variable. Of the three models, the last one is the best-fit, because it satisfies almost all the statistical requirements (see Table 5).

Table 5: Multiple Linear Regression (MLR) Model with Statistical Characteristics.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
Regression Model	.990	.979	.976	1.702	1.986

Regression Model	Unstandardized Coefficients		Beta values			Collinearity Statistics (1-Ra ² = 0.024)	
	B Error	Std.		t	Sig.	Tolerance	VIF
(Constant)	30.630	3.090		9.914	.000		
Commute time to work place (CTWP)	.385	.027	.608	14.444	.000	.138	7.230
Commute time from work place to residence (CTTR)	.221	.020	.451	11.223	.000	.152	6.573
Distance between place of residence and workplace (DRWP)	.004	.001	.092	2.916	.005	.244	4.104
Monthly commute cost (MCC)	.121	.058	.181	2.107	.038	.890	1.124
Monthly House rent (MHR)	.004	.001	.049	2.979	.004	.903	1.107
Length of service (LS)	-.078	.032	-.042	-2.438	.017	.818	1.222
Type of transport used (TTU)	-5.677	1.222	-.175	-4.647	.000	.173	5.794
Mode of transport used (MTU)	-1.572	.396	-.165	-3.966	.000	.142	7.059
Distance between residence and school (Chld-2) (DRS)	-.230	.076	-.048	-3.020	.003	.974	1.027
Commute distance (CD)	1.291	.492	.058	2.625	.010	.499	2.002
House tenure (HT)	-.705	.343	-.034	-2.054	.043	.893	1.120

DEPENDENT VARIABLE: SQRT OF DAILY COMMUTE TIME TO WORK PLACE AND RESIDENCE



THE RELATIONSHIP BETWEEN URBAN POPULATION DENSITY AND TRANSPORTATION FUEL CONSUMPTION IN MALAYSIAN CITIES

Neoh Siew Yin, Ho Chin Siong¹
Faculty of Built Environment
UNIVERSITI TEKNOLOGI MALAYSIA

Abstract

This paper describes an exploratory study to analyze the relationship between urban population density and transportation energy consumption in the context of urban planning. Urban population density is used because it is commonly accepted as “proxy” for urban form pattern analysis in terms of degree of centralization. This paper reviews sustainable urban form, relationship between urban transportation and urban population density. Based on the secondary data, multi regression analysis on the relationship between urban population density and transportation fuel consumption on Malaysian cities are carried out. In this analysis, three main variables are explored: population density, private vehicle ownership and transportation fuel consumption. In order to understand the relationship between population density and transportation energy consumption, other selected global cities are used as benchmarks in relation to selected Malaysian cities.

Keywords: Urban Population Density, Transportation Fuel Consumption, Urban Form, Private Vehicle Ownership

INTRODUCTION

The future of our cities lies in the actions we make today. Achieving sustainable cities are crucial in the urbanization of the world. This is reflected with the increase of population in settlements known as the urban areas. In 1950, 30% of the world's population lived in urban areas. By year 2008, these figures would have dramatically risen to almost 50%. According to the United Nations *Report of the World Summit on Sustainable Development 2002*, approximately 61% of the world's projected population will be urban by the year 2030. Almost all will take place in developing

¹ He is currently a professor at the Department of Urban and Regional Planning, Faculty of Built Environment, Universiti Teknologi Malaysia, Skudai, Johor, Malaysia. (Email: csho59@yahoo.com)

URBAN POPULATION DENSITY PATTERN ANALYSIS

The degree of centralization among the selected cities is analyzed, using the urban population density of the metropolitan area as a parameter of comparison (person per km²). Two sub parameters are analyzed to determine the densities of population among selected cities. The greater metropolitan area is used to study the degree of *distribution* density, given the definition of each boundary area and population of the selected cities. The Inner City Centre is used to study the degree of *concentration* located within the core of the metropolitan. Table 1 shows the urban population density pattern analysis among selected cities in year 2000. The data on the urban density of metropolitan and inner city centre have to be obtained from various sources as shown in the endnote. Definitions of metropolitan and inner city centre boundary to determine the urban population density are based on the official sources of the report.

TOTAL URBAN POPULATION DENSITY OF THE GREATER METROPOLITAN AREA VERSUS INNER CITY CENTRE

Table 1 shows city island states such as Hong Kong and Singapore have the highest population density of more than 5,000 persons per sq km at metropolitan level. Georgetown city has the highest urban population density of about 4,700 persons per sq km among the Malaysian cities at metropolitan level. Most of the other selected cities are 1,000-2,500 persons per sq km at metropolitan level. However, urban population density at inner cities can be very different if compared with metropolitan level between cities.

The metropolitan area of Georgetown in Penang exhibits a higher density in comparison to other Malaysian cities within the greater metropolitan area of 4,683 persons per km². This indicates the existence of a denser population structure beyond the population density of inner city centre (3,384 persons per km²). This would suggest the existence of an urban structure which leads towards suburbanization, as reflected by the distribution pattern of the population density.

Table 1: Urban Population Density Patterns Analysis in Selected Cities, 2000

SELECTED CITIES	URBAN FORM PATTERNS	
	GREATER METROPOLITAN AREA	INNER CITY CENTRE
	Urban Population Density (person per km2)	Urban Population Density (person per km2)
^{1, 12} Kuala Lumpur	1,050.62	5,694.69
^{2, 13} Georgetown	4,682.89	3,383.96
^{3, 14} Johor Bahru	2,180.05	3,475.83
⁴ Singapore	5,884.96	6,858.64
⁵ Hong Kong (Hong Kong Island)	6,104.28	16,693.36
⁶ Sydney	2,075.87	6,581.88
⁷ Melbourne	1,520.19	1,982.78
⁸ Adelaide	1,374.49	1,136.80
⁹ New York	2,515.89	6,813.68
¹⁰ Los Angeles	2,379.39	2,982.63
¹¹ San Francisco	2,130.56	1,238.62

Note: The hedged population data shows that inner city centre population density is 50% more than metropolitan population.

(Source: Adapted from various resources, 2008. Refer to endnotes on the detail of the sources)

The Metropolitan area of Kuala Lumpur indicates an otherwise reverse urban form pattern which shows a dense urban density in the inner city centre of 5,695 persons per km² in comparison to 1,050 persons per km². This could be explained that there is a similar pattern which exists in proportion of the employment density located in the city centre of Kuala Lumpur. Studies have shown that employment density increases with the location of the business district centre or central area of the particular city (*Chung et. al*). This may also be the case for Kuala Lumpur. Further research could be implemented to research the pattern of employment density between greater metropolitan area and inner city centre.

Hong Kong shows the highest population density among the selected cities, both in terms of the greater metropolitan area (6,104 persons per km²) and inner city centre (16,693 persons per km²). Hong Kong Island is a highly urbanized metropolitan in comparison with Malaysian cities. This is reflected by the equal distribution of population in proportion of the urban structure of the greater metropolitan area.

While other cities in the likes of Melbourne, Adelaide and Los Angeles also indicate a constant distribution in greater metropolitan area and inner city centre, the figures also shows that Hong Kong comprise the densest of the selected cities. This suggests that Hong Kong is increasingly becoming “vertical” in both physical development and population distribution.

TRANSPORTATION ENERGY CONSUMPTION PATTERN ANALYSIS

In transportation planning, the use of private vehicles is related to the intensity of urban activities and how cities provide for its automobile and non-automobile modes (Newman, 1989). Usage of private vehicles also strongly correlates with fuel use. Therefore, energy consumption of end use fuel products is essential to understand consumptions of vehicles among selected cities. Supported by two variables using private vehicle ownerships per capita and transportation fuel consumption (derived from national average population data), energy consumption patterns are studied to correlate with urban form patterns using regression analysis. Table 2 shows transportation energy consumption pattern analysis among selected cities in year 2000.

PRIVATE VEHICLE OWNERSHIP PER CAPITA

Private vehicle ownership represented in total private vehicle ownership per capita shows that Malaysian cities, comprising of Kuala Lumpur, Georgetown and Johor Bahru are among the highest among selected cities, with Georgetown being the highest figure at 2.52 vehicles per person. This is equivalent of one person having 2 private vehicles. Whereas the comparison among selected cities shows that Hong Kong indicates the lowest vehicle ownership per capita with 0.08 vehicles per person, equivalent of 12 people sharing one private vehicle (which includes automobiles and motorcycles).

TRANSPORTATION FUEL CONSUMPTION PER CAPITA

With reference to Table 2, fuel consumption of private vehicles represents the intensity of urban and human activities which takes place in the metropolitan area. The data derived from the private vehicle patterns and fuel consumption variables covers the context of the greater metropolitan area. With relation to private vehicle ownerships per capita, the measurement of fuel consumption are also supported by other transportation factors such as passenger trips, split modals by types of vehicles and trip distribution according to human activities (Newman, 1989). This would justify

the complex relationship which exists between human activities and fuel consumption and thus the regression analysis to correlate between these variables.

Table 2: Transportation Energy Consumption Pattern Analysis in Selected Cities, 2000

SELECTED CITIES	TRANSPORTATION ENERGY CONSUMPTION PATTERNS		
	PRIVATE TRANSPORTATION	FUEL CONSUMPTION	
	Private Vehicle Ownership per Capita (vehicle per person)	Transportation Fuel Consumption (MJ)	Transportation Fuel Consumption per Capita (MJ per person)
Kuala Lumpur	0.71	538,573,115,380	128,012.01
Georgetown	2.52	78,818,035,071	56,611.17
Johor Bahru	1.82	135,280,395,786	202,188.93
Singapore	0.2	282,302,703,392	70,086.79
Hong Kong (Hong Kong Island)	0.08	131,326,388,202	11,275.59
Sydney	0.82	1,039,337,485,882	296,784.60
Melbourne	0.68	938,430,933,854	296,784.43
Adelaide	1.09	297,377,544,504	296,783.03
New York	0.38	10,394,997,890,468	527,343.69
Los Angeles	0.75	7,292,635,238,803	527,343.08
San Francisco	1.3	2,805,468,180,666	527,342.82

(Source: Newman, 1989 and Researcher's Study, 2008- based on several sources as noted in the endnotes)

Among Malaysian cities, Johor Bahru records the highest of fuel consumption per capita with 202.19×10^3 MJ per person in comparison to Georgetown's 56.61×10^3 MJ per person. Given the comparison in terms of private vehicle ownership and usage of fuel use, the variations in the intensity of fuel consumption per capita is independent of the private vehicle ownership per capita. Despite having the highest ratios of vehicle ownership of 2.52 vehicles per person, Georgetown remains one of the lowest fuel consumers per capita among Malaysian cities, which is 56.61×10^3 MJ.

With regards to the variations for the measurement of transportation energy consumption patterns, two main points are to support the use of the parameters. Firstly, the private vehicle ownerships are used to measure the extent of balance of automobiles between the dependency of private and public transportation. Secondly, fuel consumption allows the study of vehicle usage intensity by human activities and how it correlates with urban structure of cities. The next analysis will explore correlations between both parameters and position Malaysian cities in this relationship among selected cities.

RELATIONSHIP BETWEEN URBAN POPULATION DENSITY AND TRANSPORTATION ENERGY CONSUMPTION PATTERNS

Regression analysis between urban density (population density) patterns and transportation energy consumption patterns are compared among selected cities. The study will explore the characteristics which each city portrays using greater metropolitan area and inner city centre as the constant of the analysis. With context to Malaysian cities, the characteristics that the benchmark cities carry will then be deduced towards planning implications in Malaysia.

Based on Figure 4, the regression line shown describes the position of Kuala Lumpur, Georgetown and Johor Bahru among selected cities. Based on the range of densities portrayed by the proximities of selected cities, four distinctive clustering of cities may be identified, in correlation with the total private vehicle ownership per capita, as shown in Table 3.

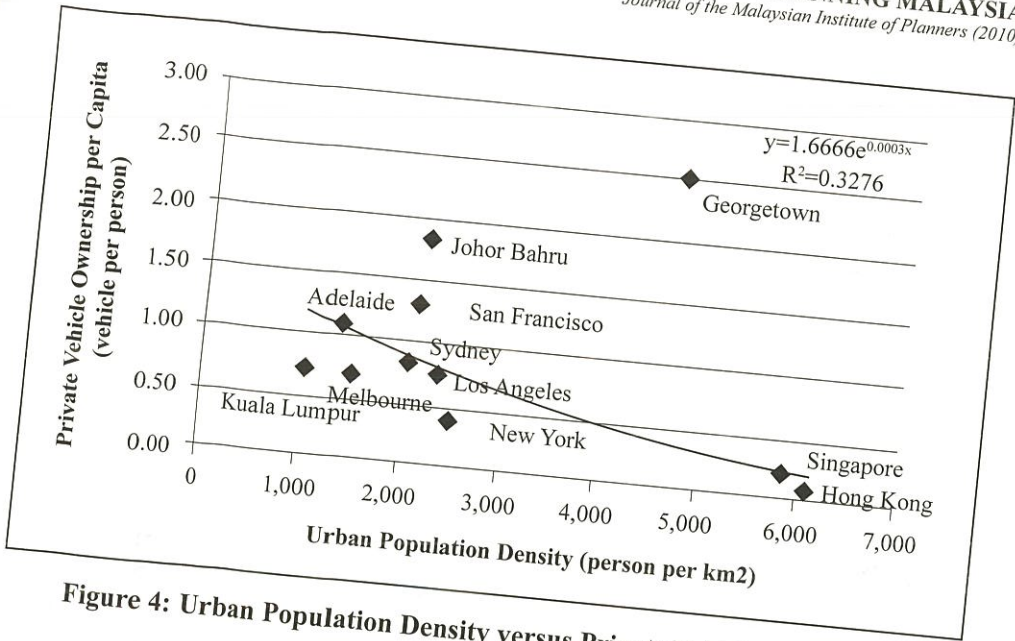


Figure 4: Urban Population Density versus Private Vehicle Ownership per Capita, 2000

(Source: Researcher's Study, 2008)

Table 3 features the range of clustering which allows the analysis of pattern of relationship between urban population density and private vehicle ownership to be analyzed. Based on the total average of densities among selected cities, the average point of 3000 person per km² is chosen. The selection is used as a breakeven point to determine "High" or "Low" for urban population density. One vehicle per person is used as breakeven point for private vehicle ownership. From this analysis, relatively speaking, Georgetown represents the high density – high private car ownership, while Johor Bahru represents the low density – high private vehicle ownership. Kuala Lumpur represents the low density– low vehicle ownership.

In relative terms, the four (4) clusters shows the degree of compactness of the city measured by the population density and private vehicle usage shown by private vehicle ownership data. In the case of Malaysian cities, Georgetown is the most compact among the other 3 Malaysian cities but it is still a very private vehicle dependence urban centre. On the other hand, Kuala Lumpur is less compact but it has a lower private vehicle ownership as compared with Georgetown. This may be explained with better provision and more choices of public transportation.

Based on Figure 5, there is a pattern of clustering among the selected cities, based on the total fuel consumption. Based on the regression analysis, we have assumed

that since there are no specific standards to comply in determining the proximity range of urban densities in the greater metropolitan area an assumption of 3000 person per km² is used, based on the average density among the selected cities. Similarly, the measurement of 2.0 X 10¹² MJ per person is used for the total fuel consumption energy. This value may vary based on the number of cities used in the measurement or throughout time period. Based on the range of densities situated within close proximity among the selected cities, four distinctive clustering of cities may be identified, in correlation with the total fuel consumption, as shown in Table 4. Table 4 shows that all the 3 Malaysian cities are categorized as low fuel consumption in relative to other selected cities.

Table 3: Clustering of Selected Cities based on Proximity of Private Vehicle Ownership per Capita

Range of Clusters		Pattern of relationship Density- Private Vehicle ownership	Selection of Cities		CLUSTER
Urban Density (person per km ²)	No. of Private Vehicles per Capita (vehicle/person)				
>3000	<1.0	High - Low	Singapore, Hong Kong	1	<i>Compact and lower private transport oriented</i>
>3000	>1.0	High - High	Georgetown	2	Compact and higher private transport oriented
<3000	<1.0	Low - Low	Kuala Lumpur, Melbourne, Sydney, Los Angeles, New York	3	Less compact and lower transport oriented
<3000	>1.0	Low - High	Johor Bahru, Adelaide, San Francisco	4	Less compact and higher private transport oriented

(Source: Researcher's Study, 2008)

From this analysis, Georgetown, together with Hong Kong and Singapore fit into the theory of compact city having lower fuel consumption or the higher the density the lower fuel consumption relation. However, the result in Table 4 shows that low density cities have lower fuel consumption in the case of Kuala Lumpur, Johor Bahru, Sydney, Melbourne and Adelaide contradict the compact city theory. Based on the theory less compact city or lower density city usually have higher private car ownership and lower public transport usage. Hence this will contribute to higher fuel consumption.

The possible explanation of the low fuel consumption of the 3 Malaysian cities may be influenced by factors such as in relative terms there is a greater use of public transport and non motorized vehicles, trip frequency and shorter trip distance. Whereas in the case of New York, Los Angeles and San Francisco, in relative terms trip frequency and trip distance may be higher than the Malaysian cities.

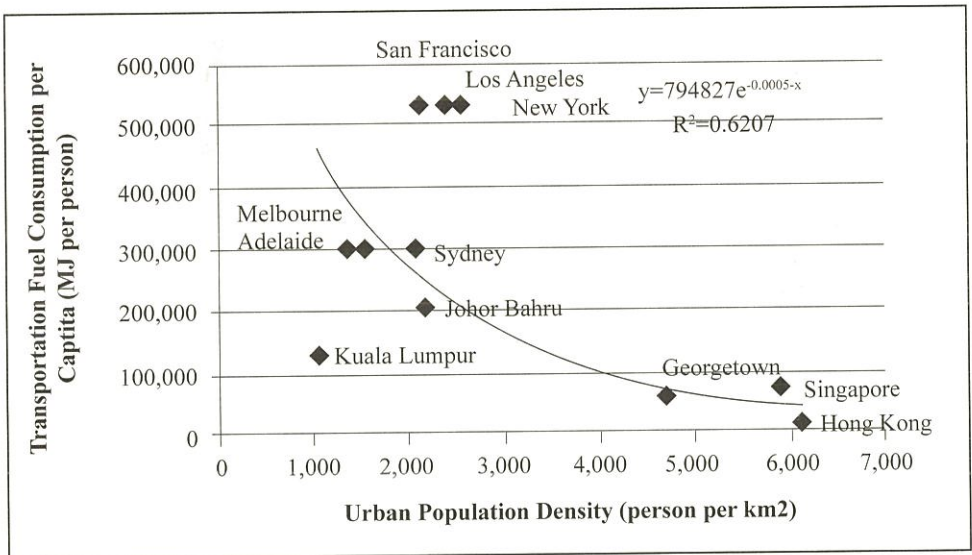


Figure 5: Urban Density versus Total Fuel Consumption per Capita, 2000
 (Source: Researcher's Study, 2008)

Table 4: Clustering of Selected Cities based on Proximity Range of Total Fuel Consumption (MJ)

Range of Total Fuel Consumption (MJ)		Pattern of relationship between Population Density and fuel consumption	Selection of Cities	CLUSTER	
Urban Density (person per km ²)	Total Fuel Consumption (MJ per person)				
>3000	<2.0 X 10 ¹²	High– Low	<i>Georgetown, Hong Kong, Singapore</i>	1	<i>Compact and low fuel consumption</i>
>3000	>2.0 X 10 ¹²	High - High	Nil	2	Compact and high fuel consumption
<3000	< 2.0 X 10 ¹²	Low - Low	<i>Kuala Lumpur, Johor Bahru, Sydney, Melbourne, Adelaide</i>	3	<i>Less compact and low fuel consumption</i>
<3000	>2.0 X 10 ¹²	Low - High	<i>New York, Los Angeles, San Francisco</i>	4	Less compact and high fuel consumption

(Source: Researcher’s Study, 2008)

CHARACTERISTICS OF CORRELATION BASED ON URBAN FORM PATTERNS

As mentioned in the regression analysis, we will examine the characteristics of these relationship, mainly urban density patterns and transportation energy consumption patterns. The study will examine existing urban form and land use planning theories in the context of Malaysian cities. Specifically, this study will benchmark Malaysian cities to compare efficient correlation, i.e. efficient urban density against the selected cities. This form of classification allows benchmarking of the current position of Malaysian cities in terms of energy efficient cities and thus allowing decision makers to make progressive and optimum decision making towards effective sustainable planning implementation.

Table 7: Ideal Characteristics of Correlation for Private Vehicle Ownership Per Capita

IDEAL CLASSIFICATION	Private Vehicle Ownership Per Capita	
Urban Density (Greater Metropolitan Area)	HIGH density – HIGH vehicle ownership	HIGH density – LOW vehicle ownership
	LOW density – HIGH vehicle ownership	LOW density – LOW vehicle ownership

*Note: Hedged column is ideal situation
 (Source: Researcher's Study, 2008)*

Table 8: Ideal Characteristics of Correlation for Total Fuel Consumption

IDEAL CLASSIFICATION	Total Fuel Consumption	
Urban Density (Greater Metropolitan Area)	HIGH density – HIGH fuel consumption	HIGH density – LOW fuel consumption
	LOW density – HIGH fuel consumption	LOW density – LOW fuel consumption

*Note: Hedged column is ideal situation
 (Source: Researcher's Study, 2008)*

Table 7 indicates the ideal classification of the correlation between urban density and private vehicle ownership per capita. This is the qualitative classification based on existing theories on the correlation given. It is commonly assumed that high urban density or compact city will have lower fuel consumption because of better modal split of public transport users. Table 8 indicates the ideal classification of the relationship between urban density and total fuel consumption. Hence, a higher density or compact city will promote better use of public transport and pedestrianization and hence consume less fuel for transportation. Although both projects similar traits of characteristics in terms of the correlation, other complex transportation factors intercept this relationship.

Table 9 describes the summary of characteristics of Malaysian cities with reference to urban form patterns. An example of a correlation is that fuel consumption for urban density (greater metropolitan area) would be a high density – low consumption for Penang as well as low density – low consumption in the case of Kuala Lumpur and Johor Bahru cities (as highlighted in Table 9). When comparison is made between Table 8 and Table 9 to benchmark the position of Malaysian cities among these characteristics, we will then determine suggestions available to decision makers.

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ENDNOTE

**With Reference to the Source of Researcher's Study*

Population in Metropolitan Area

- 1 **KUALA LUMPUR:** Adapted from Structure Plan of Kuala Lumpur (RSKL) 2000–2020, Chapter 6.1: Land Use and Development Strategy http://www.dbkl.gov.my/psk12020/english/land_use_and_development_strategy/index.htm.
- 2 **GEORGETOWN:** Adapted from Laporan Interim Rancangan Tempatan Majlis Perbandaran Pulau Pinang (RTMPPP) Mei 2006 pg 32, population trend in North East and South West Area of MPPP jurisdiction
- 3 **JOHOR BAHRU:** Adapted from Laporan Pemeriksaan Rancangan Struktur Negeri Johor 2001 – 2020 pg 70, Population for Urban Area in Johor Bahru (MJB Jurisdiction, inclusive of Kulai)
- 4 **SINGAPORE:** Adapted from the Singapore Census of Population 2000: Geographic Distribution and Travel, population trend of Singapore <http://www.singstat.gov.sg/pubn/popn/c2000sr4/cop2000sr4.pdf>
- 5 **HONG KONG:** Adapted from the Population by Census Office, Census and Statistical Department of Hong Kong, Population by District Council District, last updated 22 Feb 2007

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 or 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
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								
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	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																				
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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 (Orlikowski, 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 and 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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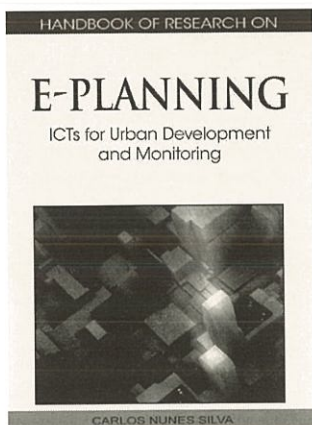
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Handbook of Research on E-Planning: ICTs for Urban Development and Monitoring

Carlos Nunes Silva (Eds.) IGI Global
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This edited book presents 23 chapters with 454 pages of literatures and case studies on the use of information and communication technologies in urban planning, development and monitoring. With its nomenclature E-Planning, the book provides a comprehensive and in depth elaboration on the theory, concept, methods and tools of the current practices of E-Planning worldwide. It is a very useful text for students, professionals, academics and government officers interested in learning and understanding about how different forms of E-Planning research have been developed and used.

Urban planning has experienced numerous changes in its long history but none seems so challenging, for planners and other urban stakeholders, as the methodological revolution associated with the use of information and communication technologies (ICT) in all stages of the planning process. E-Planning, the name given to the new planning paradigm that is emerging in association with the extensive use of information and communication technologies, especially the Internet, geographic information systems and virtual reality technologies, entails a move from a paper based urban planning system, described in this handbook as conventional urban planning, to one based primarily on the integration of various new information and communication technologies and on the interaction of multiple urban stakeholders, referred here as e-planning. Although being this, perhaps, the most visible difference between conventional urban planning and e-planning, the new urban planning paradigm, this move away from a paper based practice, must be seen as more than a simple transfer to a computer system of the traditional paper based routines, requiring also the re-

engineering of procedures, the development of a full ICT integrated back office and, more important of all, changes in the nature and purpose of urban planning.

The term e-planning is used here as synonymous of e-government or digital government applied to the field of urban and regional planning. Like these others terms, e-planning is also employed in the literature as a fairly broad multi-dimensional concept (digital terminology is still far from consensus and other definitions of e-planning can be found in the literature). It refers to urban planning, either as part of a hierarchical oriented form of urban government or as an activity co-initiated and co-coordinated by citizens and other private and public stakeholders within the overall urban governance network. In the literature the term e-planning is often employed to refer other more specific subcategories, such as e-urban management, e-urban services, etc., or categories specified according to the dominant technology used, as those associated with the concepts of ubiquitous government and mobile government. Like conventional urban planning, e-planning is also regarded as an interdisciplinary research field.

Based on this broad and multidimensional concept of e-Planning, the purpose of this handbook is to explore the nature and to examine the impacts of the transformations in the urban planning field that result from the use of information and communication technologies in all phases of the urban planning process and to raise new questions for further research. However, it is not intended to be an exhaustive coverage of themes that make up the field of e-planning, since numerous other critical issues were not included. For that reason readers will certainly find at the end that there is much ground yet to be explored and researched on the theory, ethics, methodology and practice of e-planning.

Students, scholars, researchers and practitioners interested to become familiar with new concepts, methods and technologies applied in e-planning, with innovative approaches to improve citizen participation through the Internet, as well as with ground-breaking planning e-tools, will find here an accessible, updated, and research focused reference. Readers will find in these empirical studies practical guidance on how to do cutting edge research on e-planning and useful ideas for the design of new methods of citizen e-participation in urban planning as well.

The handbook is divided into three interrelated sections. The first section deals with theories and methods in e-Planning. The second is devoted to citizen participation in e-Planning. The last section provides an overview of innovations in specific sectors within the urban planning field. It goes without saying that some of the themes of these essays are interrelated and for that reason they could fall into more than one of these three sections. The 23 chapters of this handbook cover a wide range of issues on the

theory, methods and tools of e-planning, which make it a useful source for different types of readers. It brings together a collection of multidisciplinary studies, on the many faces of e-Planning, written by 41 distinguished scholars and researchers from leading universities, research institutions, or specialized institutions, from 14 countries, with different perspectives about what e-planning is, representing to some extent the diversity of perspectives and methodologies that can be found in the e-planning field around the world.

Each chapter is divided into six parts: (1) an introduction that provides a general perspective of the chapter and of its main objectives; (2) a background providing broad definitions and discussions of the topic, based on a literature review of the issues discussed, as well as the author's perspective about these issues, controversies, and problems. When appropriate, this part also includes a discussion of solutions and recommendations of the problems presented by the author; (3) a section on future research directions where future and emerging trends are discussed and when appropriate also suggestions for future research within the topic discussed in the chapter; (4) a conclusion with a discussion of the overall coverage of the chapter and concluding remarks; (5) a reference and further readings section, and, finally, (6) a list of terms and definitions applied in the chapter.

Section One, titled "Theory and methods in e-Planning", begins with an overview of e-planning followed by seven chapters. These chapters describe and discuss different planning methodologies, based on the use of information and communication technologies in different planning contexts, exploring key facets of the move towards a new paradigm of urban planning.

Chapter 1, "The e-Planning Paradigm – Theory, Methods and Tools: An Overview", serves as the introduction to the book and discusses the relationships between planning theories and the use of information and communication technologies in urban planning. The way information and communication technologies tools are incorporated by the different planning perspectives is considered to be in part responsible for the different forms of contemporary urban planning.

The role of information technologies, particularly internet based geographic information systems, as decision support systems to aid public participatory planning, is examined in the chapter 2 "Planning online: a community-based interactive decision-making model". Tan Yigitcanlar also discusses the challenges and opportunities for the use of internet based mapping application and tools in collaborative decision-making, introducing a prototype internet based geographic information system that was developed to integrate public oriented interactive decision mechanisms into urban planning practice.

In “Modelling and Matching and Value Sensitive Design: Two Methodologies for e-Planning Systems Development”, Yun Chen, Andy Hamilton, and Alan Borning explore two methodologies which can help address the knowledge gap in the methodologies for designing e-Planning systems. Planned to address the needs of diverse user groups and multi-disciplinary cooperation for systems development, these two methodologies offer operational guidance to e-Planning systems developers.

In Chapter 4, “The future-making assessment approach as a tool for e-planning and community development: the case of Ubiquitous Helsinki”, Liisa Horelli and Sirku Wallin, offer readers an in-depth look at an evaluation approach to be used in e-Planning, called the Future-making assessment (FMA), to assist in the monitoring and provision of feedback in the implementation of e-Planning.

The question of the role of the Internet in the production of planning knowledge is addressed by Aija Staffans, Heli Rantanen, and Pilvi Nummi in the Chapter 5, “Local Internet Forums. Interactive land use planning and urban development in neighbourhoods”. The authors describe the results of a research project that tried to gather and to combine local information and knowledge on urban planning through Internet forums. They show that local, place-based knowledge is highly fragmented and that it is difficult to combine informal and formal information and knowledge in urban planning.

The next two chapters look at the use of 3-D images as a method of communicating information in urban planning. In Chapter 6, “Does computer game experience influence visual scenario assessment of urban recreational paths? A case study using 3-D computer animation”, Arne Arnberger and Thomas Reichhart explain the results of a study in which they used a computer-animated choice model to investigate the influence of computer game experience on respondents’ preferences for an urban recreational trail, concluding that the individual experience with computer gaming and the presentation mode influence the evaluation of trail scenarios. Markus Jobst, Jürgen Döllner and Olaf Lubanski, in “Communicating geoinformation effectively with virtual 3D city models”, focus on Virtual 3-D city models and how they can enhance the communication between different urban stakeholders. The authors discuss key aspects of virtual 3-D city creation, the main components of virtual environments, the framework for an efficient communication, and explore future research for the creation of virtual 3-D environments.

The last chapter in Section One, “Political power, governance, and e-Planning”, analyse the construction of a mega geospatial database for the Hajj, the annual Muslim Pilgrimage to Makkah, Saudi Arabia. Kheir Al-Kodmany discusses this complex process, including in his analysis the influence of top-down political power on the

planning process for the Hajj. The chapter provides transferable and useful lessons on GIS application in spatial urban planning, as well as insights on how and when political power may help in advancing the planning process.

Section two, titled “Citizen Participation in E-Planning”, with nine chapters, introduces readers to a range of experiences and practices of e-participation, in different countries and contexts, which provides a good illustration of how citizen participation in the urban planning decision-making process is changing, and the type of challenges faced by planners and planning departments.

Herbert Kubicek, through a comprehensive review of the literature, examines in Chapter 9, “The potential of e-participation in urban planning: a European perspective”, different cases of public participation and argues that the electronic mode of participation by itself will not change the low levels of public participation in urban planning, suggesting that it will be necessary to include these new electronic forms of participation within the formal planning processes and in the respective participation procedures, arguing that if citizens are not interested to participate in the urban planning process, they will not take part only because they could do it via the Internet. The author reveals that ICT tools for citizen participation in urban planning will not substitute the traditional forms of public participation in the near future, arguing that it is necessary to combine both, offering specific recommendations for that.

Next, Domenico Camarda in his chapter “Beyond citizen participation in planning: Multi-agent systems for complex decision-making” examines how to set up cooperative multi-agent systems, and discusses the potentials of multi-agent system for complex decision-making in public participation processes in urban planning.

In “The e-Citizen in Planning: U.S. Municipalities’ Views of Who Participates Online”, Maria Manta Conroy and Jennifer Evans-Cowley examine how online participation tools, regarded as a component of e-government, provide a potential venue for enhancing citizen participation in the urban planning process. However, as e-government participation raises challenges pertaining to trust, exclusion, and responsiveness, the chapter examines how municipalities in the U.S. view the e-participant, concluding that municipal officials view these online tools as a means to advance efficiency and citizen satisfaction, rather than as a means by which to potentially enhance discussion of community issues.

In Chapter 12, “Planners support of e-participation in the field of urban planning”, Mikael Granberg and Joachim Åström discuss what planners really mean when they display positive attitudes toward increased citizen participation via the use of information and communication technologies, based on a survey about the support

for e-participation in the field of urban planning by the heads of planning departments in Sweden, concluding for the existence of confusing or conflicting attitudes among planners towards participation.

Jens Klessmann, in “Portals as a tool for public participation in urban planning”, looks critically how different types of portals and different kinds of participation portals can be used to encourage public participation processes in urban planning.

After that, in Chapter 14, “Can Urban Planning, Participation and ICT co-exist? Developing a Curriculum and an Interactive Virtual Reality Tool for Agia Varvara, Athens, Greece”, Alex Deffner and Vassilis Bourdakis examine how information and communication technologies can help in urban participation processes, mainly because it constitutes a relatively simple method of recording the views of both the public and the planners in a variety of subjects.

Bridgette Wessels, in “The Role of Local Agencies in Developing Community Participation in E-government and E-public services”, discusses the way in which understanding of participation in e-services has evolved through a social learning process within planning and implementation processes.

In “ICTs and Participation in Developing Cities”, Alexandre Repetti and Jean-Claude Bolay provide a review of the use of information and communication technologies for public participation in urban planning, in cities located in developing countries. The authors analyse the challenges and potential of ICT to improve urban planning and public participation, and put forward a number of recommendations for the successful and relevant implementation of ICT in this kind of cities.

In the final chapter of Section Two, “Public participation in e-government: some questions about social inclusion in the Singapore model”, Scott Baum and Arun Mahizhnan examine the case of Singapore’s E-government model, which, despite being considered to be among the best in the world, has still important weaknesses in what respects public participation.

The Third Section, titled “Innovations and challenges in urban management”, with six chapters, explores a number of experiences and innovative practices of urban e-management, in different countries and contexts, as an illustration of the type and extent of the changes going on within the urban planning system.

Antonio Caperna in Chapter 18, “Integrating ICT into sustainable local policies”, analyses the role of information and communication technologies in the promotion of sustainable local policies, the opportunities it offers, potential problems, and the relationship with other local policies.

Chapter 19, “Architectures of motility: ICT systems, transport and planning for complex urban spaces”, by Darren J. Reed and Andrew Webster, examines the implementation of an intelligent transportation system called BLISS (the Bus Location and Information Sub-System), and shows that urban planners need to engage not only with the technical difficulties of technology implementation in the city, but also with the contingent and experiential processes of those who use it, and are affected by such implementations.

In “RFID in urban planning”, Leslie Pang, Vanessa Morgan-Morris, and Angela Howell discuss the application of Radio Frequency Identification (RFID) technology to support the needs and requirements within the realm of urban planning. The authors provide an account of the historic and technical background behind RFID, explore this technology’s potential as a practical tool for urban planners and discuss the issues and challenges associated with RFID.

Stephen Aikins, in “E-planning: information security risks and management implications”, engages with the security risks and management implications associated with the use of information technology to manage urban and regional planning and development processes, and argues that the emergence of e-planning poses enormous security challenges that need to be managed to ensure integrity, confidentiality and availability of critical planning information for decision-making.

The last two chapters in section three present and discuss the situation of e-Planning in two countries, Turkey and Malaysia. In the penultimate chapter, “E-planning Applications in Turkish Local Governments”, Koray Velibeyoglu explores the critical relationship between e-planning applications and their organizational context. The author shows, based on a case study of Turkish municipalities, that the organizational and human aspects of information systems are still the main obstacle in the implementation of information and communication technologies in urban planning. In the final chapter, “GIS implementation in Malaysian statutory development plan system”, Muhammad Faris Abdullah, Alias Abdullah and Rustam Khairi Zahari examine the current state of GIS implementation in the Malaysian development plan system comparing it with the state of GIS implementation worldwide.

In sum, the readings in this Handbook of Research on e-Planning provide a well grounded and research focused overview of the emerging e-planning paradigm and will hopefully point readers to future research directions. Ultimately, this collection of essays will ask each reader to reflect on the planning theories that frame the urban planning practice, which methods to use in the preparation and implementation of urban e-plans, how to organise citizen e-participation in urban planning processes, or how to use new information and communication technologies to collect and manage data in different areas of the urban planning process.

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Alias Abdullah, Ph.D.

Professor of Urban and Regional Planning,
Kulliyyah of Architecture and Environmental Design,
International Islamic University Malaysia
(Email: profdralias@gmail.com)

Carlos Nunes Silva, Ph.D.

Professor Auxiliar in the Department of Geography,
University of Lisbon, Portugal
(Email: cnsilva@netcabo.pt)

NOTES TO CONTRIBUTORS AND GUIDELINES FOR MANUSCRIPT SUBMISSION

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