The Influence of Policy, Economy and Technology in Information and Communication Technologies of a Smart City in Malaysia

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Abstract — **The purpose of this paper is to examine the level of influence of policy, economy and technology in determining the incorporations of information, and communication technologies (ICTs) in a smart city. One smart city in Malaysia was selected as a case study in this paper. The procedure of interviews was used to have a better understanding on the role of these three (3) factors in enhancing the initiatives of the city's administrator. The content analysis on certain documents that were not for public scrutiny was also employed. The findings suggested that all these factors were equally important and they underpinned the capability of the city's administrators to incorporate ICTs in the city.**

Keywords-policy; economy; technology; ICT; smart city; Malaysia

I. INTRODUCTION

The explosion of information and communication technologies has given unlimited impact on the people's way of life. It is changing the way international commerce is conducted [1] and tremendously increases revenue [2].

Too much study has been conducted on the benefits of ICT in the business and profit oriented organizations but not much research has been conducted to oversee how this powerful weapon impacts the non-profit entities generally, and to local authorities particularly. The benefits offered by ICT should be manipulated by the local authority for more efficient and effective administration of their local areas. The futuristic technologies seems never ending, thus gives golden opportunities for the local authority to continuously enhance their work and services to the public and local community.

This has motivated this study to see how ICT will enhance the work of the local authority by looking at three factors – policy, economy and technology as an enabler to drive local authority to incorporate ICT in their daily works.

II. LITERATURE REVIEW

Realizing that the unlimited potential can be offered by technology and ICTs, the Malaysian Government has taken a big step by launching the Multimedia Super Corridor (MSC) in 1997.MSC aims not only to create wealth for business entities but also to create vibrations and developing informative and intelligent community and also drive government bodies at various levels – federal, states and districts to manipulate this technology to benefit society. [3] described that modern ICT should be used by public

organizations to support or redefine the existing and/or future relations with stakeholders such as citizens, companies, societal organizations, other government organizations and civil servants, in the internal and external environment in order to create added values. In the UK, there is a clear commitment to use the Internet by the government to provide services online. In fact, the government of UK has set an explicit target of 100% availability of all public services online by 2005 [4].

The massive introduction and use of the information and communication network in public administration has led to the establishment of complex virtual organizations in the public sector with the intention to create a city that manipulates ICT for its benefits and prosperity. This is known as 'smart city'. The concept of smart city is difficult to define, but generally it is linked with knowledge based economy and using of technology to explore new frontiers in science, industry and commerce [5].

[5] had examined and compared the smart city initiatives in Bisbane (Australia) and Durban (South Africa) and finds that ICT not only enhances effective governance but also exposes users to new opportunities for growth and empowerment. His study is based on the conceptual framework stated that there are six factors that can enhance the ability of the local authority in incorporating ICT in its governance process – policy, economy, technology, culture, society and capacity. [5] argued that the first three are the capstone and most critical factors while the last three only play a a supporting role. Due to this argument, this study will examine the first three factors on the samples selected by this study.

A. Policy

The local authority's effort and commitment to enhance its governance through ICT can first be observed through its policy regarding ICT. ICT as an outcome in promoting economic development and establishing a global knowledge-based economy is evident in the long-term development strategies of the local authority [5].

This documented strategy shall be followed by its various implementation initiatives and continuous assessment of its development. The strategic direction should be clear, mandated and well funded. The policy should also include a plan to build ICT infrastructure to facilitate local investment and industry growth related to ICT.

B. Economy

Economy here refers to adequacy of funds and budget allocated to the local authority in order for them to use advanced technology, a move away from the traditional ways. The funds are required not only for the initial set-up and replacement of equipment but also for maintenance and other necessary expenditure.

The motivation for the local authority to incorporate ICT in its daily operation is also influenced by economic activities in the area administered by it. Economic and business activities that are dominated by ICT-based industries may create a window of opportunity for the administrator to adapt a similar technology.

C. Technology

ICT tools used by the local authority must also be adequately supported by the appropriate technology. Continuous technological development all over the world gives an option to the local authority to choose appropriate tools and systems that fit with its requirements. Advancement in ICT is creating new means and effective ways of governance in utilizing technologies to enhance efficiency and effectiveness of the local authority offices.

III. RESEARCH METHODOLOGY

A semi-structured interview and content analysis was employed to conduct this study. Some of the advantages of embarking on these two methods in one research is the verification of the data collected especially from interviews that can be done to increase its reliability. Other than that, rich information that cannot be accessed in the public domain can be compiled and analyzed.

A semi-structured interview was conducted with the top manager of the information system division of the local authority. He is selected due to his position and expertise in the ICT. In addition, he has direct control and a higher responsibility on ICT matters in the city. A semi-structured interview was used because this method is more appropriate and to get advantages of both the unstructured and structured interview.

An interviewer has a list of questions based on the group mentioned before, refereed as an interview guide. To get a better and accurate response, the interviewee is given leeway to answer the questions. When necessary, questions may not follow the interview guide in an orderly manner, but all the questions must be covered. Similar wordings and questions may be asked and used from the response of the interviewee [6].

The interview protocol was started by asking pre-determined questions set before the interview. These questions were classified and focused into four groups – the first three groups are based on the variables that become the interest of these study namely policy, economy and technology while the last group is concerned with other matters or issues that are not classified under the first three groups.

An unstructured question will be asked to have a deeper understanding of the answers of the structured questions. This follow up question will give the advantage of having rich of information and findings that has not been expected before. It is intended to elaborate and clarify certain issues that might be relevant and useful with the study objectives.

The interview took a total of 3 hours. After the interview, the information collected was tabulated and analyzed.

The content analysis was conducted on the documents that were not for public scrutiny such as the city master plan and its implementation, the ICT master plan and its related documents such as policies, guidelines and circulars.

IV. FINDINGS AND DISCUSSION

The results of the analysis on the influence of policy, economy and technology towards the capability of local authority to incorporate ICT in the city was summarized in Table I and explained next.

TABLE I. ANALYSIS ON THREE FACTORS AND ITS OUTCOME THAT UNDERPINED LOCAL AUTHORITY'S CAPABILITY TO INCORPORATE ICT

Factors	Analysis	Outcome
Policy	Clear and well-defined blue print	Give clear direction to local authority to manage and develop the city
	Strict internal control in which the implementation of the policy subject to three level of auditing	Ensure all action and implementation is complied with the policy
Economy	Much money has been invested to develop ICT infrastructure	Local authority able to use the intended leading edge technology without much limitation and scare in resources
Technology	Explosive development in technology provide many ICT products available in the market	Opportunities to local authority to select the best tools and systems in managing the city
	The smart city has been developed in MSC area	Give advantage to the local authority and the communities to opt for better ICT performance equipment and tools
	No direct involvement by the society in any policymaking	The feedbacks only will be received by local authority after the policy has been implemented, not at the beginning

A. Policy

Argumentatively, a clear and well defined policy is important as a guide for both short term and long-term development of any body and organization.

The local authority in this study also is no exception. They have a development master plan that was launched in February 1995. This master plan becomes the blue print to guide the development and management of the city. Consequently, it has given a clear direction to the local authority on how to manage and develop the city. From its

Development Master Plan, the strategic ICT Master Plan was drawn up in 2001. Due to incompetency, this ICT master plan was jointly developed with highly experienced and knowledgeable ICT consultant.s The main initiatives from this ICT master plan is the creation of a directory of services reference point in May 1997 followed by the creation of a control center to manage all the systems relating to city management in November 1997.

As part of the government administration, all these plans should be in the same direction with the National IT Agenda, launched by the Federal Government through the Commissioner of Telecommunications and Multimedia. The National IT Agenda, launched in 1996 aims to provide foundation and framework on the utilization of ICT in transforming Malaysia into a developed country consistent with the Vision 2020. It is based on five thrust areas of governance namely E-Public Services, E-Community, E-Economy, E-Learning and E-Sovereignty (Figure 1).

The policies, strategies and guidelines of the local authority are realigned to fulfill all the five thrusts, with priority given to the E-Public Services and E-Community.
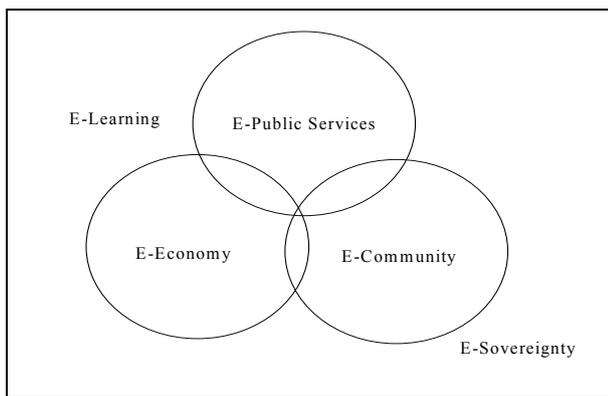

Figure 1. National IT Agenda – Five Thrust Areas of Governance

E-Public Services are the agenda with the objectives to enhance service delivery and value for money through its electronic transactions. The local authority fulfills this agenda through focusing on excellent delivery channels and multiple services including key and end-to-end services that are available through the website. It is geared towards the accelerated service delivery by providing citizens with centric services at the lowest possible costs to the providers and users.

E-community is aimed to enhance confidence in improving the quality of life of the residents and public through electronic interaction. The main objective of this thrust is to narrow, if it is impossible to eliminate the digital divide between urban and rural areas. Therefore, everyone can experience the country's wealth in a more equal manner irrespective their location. In the context of this smart city, people from various levels of residents, businesses and the public as a whole will benefit from these modern technologies and improving their quality of life. For example, solving their problems and complaints just via website provided by the local authority.

The objective of E-economy is to promote the use of ICT in producing goods and services while upgrading the network for information sharing. This thrust is intended to act as a multiplier in generating revenue for business entities such as reaching wider and larger market by leveraging the advertising and promotion costs. This thrust however in the context of this smart city is not crucial, as the city does not intend to become a leader in economic activities and a commercial city center. This smart city initially proposed to become a hub for government administration and resident for the government staff.

E-learning aspires to increase the level of knowledge of the citizens by which useful and powerful information and applicable knowledge is easily available at any time and any place, again with minimal cost. This thrust is more relevant to the local authority as one of its objectives is to use ICT to build an information-based society, known as an information society. In this smart city, this objective is implemented through the Public Community Services initiatives.

Finally, the last thrust, E-Sovereignty has an objective to safeguard the nation against the negative effects of ICT. It can be achieved through the implementation of tight control on the information and website that can be surf by the community. For example, the relevant authority bodies are responsible to ensure that any sensitive information that will affect the stability and harmonious of the country will be prevented to be spread out over the country.

To ensure that the ICT initiatives and action are in accordance and comply with the policies and guidelines enforced by Federal Government and the local authority, the control mechanisms are implemented to ensure the ICT implementation achieves its objectives. There are three levels of control mechanisms applicable for this local authority.

The lowest level is at the Division level where the Deputy Director acts as a quality assurance officer who is generally responsible in ensuring that the entire project, tasks and implementation of ICT conforms to the required standard. Regular site visit, report verification, briefing and consultation are conducted by the operational officers to make sure project development adhered to the pre-determined key performance indicators.

At the local authority level, the control function is performed by the Internal Audit Department. The function of this department is to ensure the work, processes, application and system development, computer networking, information resource services and any related ICT operations and management comply to policies, procedures, regulations and standards of all the departments in the local authority. The Internal Audit Department reports its findings to the head of the local authority. When necessary, modification and improvement will be taken to overcome any weaknesses and deficiencies highlighted by the internal auditors.

The highest level of control mechanism comes from National Audit Department. The auditor's at this level are more interested to examine the quality of the ICT project which includes the process, project implementation and

project management, and payment to the vendor and consultant. This important to make sure all the finance and treasury policies are complied and prevent from any embezzlement of assets, abuse of power, conflict of interest, fraud and any kind of malpractices.

It can be concluded that policy of ICT of the local authority is clear, well aligned and implemented generally. However, no further thorough and details examination can be conducted on the effectiveness of implementation such as on the verification of internal and national level auditor report because these reports are not available for public and research purposes.

B. Economy

Much money has been invested to develop the ICT infrastructure to achieve the Federal Government's aspirations on this smart city. As stipulated in the Development Master Plan, about RM300 million would be invested on ICT in the 15 years of its development. The biggest portion of 60% is assigned to develop and maintain the system and application, another 30% will be spent on hardware and equipment and the remaining 10% would be spend on human capital such training, courses and staff development.

The economic activities that depend heavily on ICT in the area administered by a local authority may influence it to do the same. However, the situation does not happen in the case of this local authority. There is no influence by the economic activities and the type of industry that is based on ICT to drive the local authority in the area administered to apply ICT in its operation. It is because the business development is still not fully implemented at the time this research was conducted so the business community is still small and does not play any major role in the city and community development.

The main factor of ICT application here is to use it to fulfill the aspirations of the Federal Government which is to have a central administration city with the state-of-art technology. There is no influence by business activities here yet. Furthermore, the development on commercial phases will only begin in 2006 and end in 2010. Although this has just begun, the intention of the local authority to develop an ICT-based city had already started at the time the city began the construction.

C. Technology

The continuous technological development around the world gives ample opportunities to the local authority to select and apply any appropriate tools and systems in managing the city. Local authority, with its expertise and mandate will determine the type of application and system, equipment, tool, skill and competency based on the requirement of the City's Development Master Plan. This responsibility is assigned to the ICT Strategic Development and Planning Unit in the Information System Division.

For example, the Development Master Plan requires an intelligent traffic system to be used in the city. Thus, local authority has to find a suitable traffic system which is current at the time of the system is design and can be applied in the city, within the budget assigned so that it meets the requirement of the ICT Master Plan.

Similarly, in the area of financial management and administration, SAP, the integrated Enterprise Resource Planning (ERP) from Germany has been recognised worldwide as one of the best and most comprehensive administration tools for an organization. This technology gives the local authority a better option and because of that, they has decided to develop the application called Enterprise Resource Management Integrated Systems (ERMIS) based on the SAP applications with the appropriate adjustment to fulfill local authority's requirement. This application is developed to support the human resource, financial, asset, real estate, license and compound management operation (Figure 2).
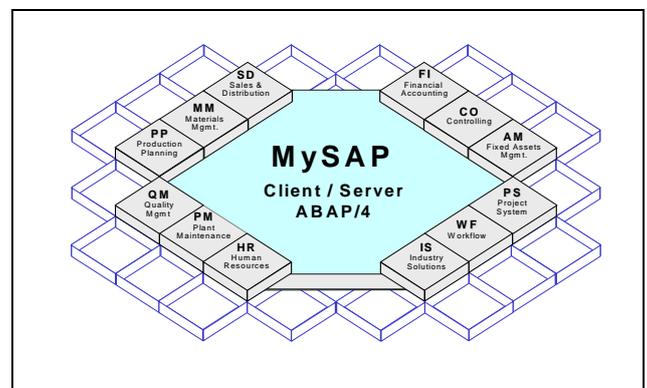

Figure 2. Enterprise Resource Management Integrated Systems (ERMIS)

The empty blocks in Figure 2 show that much more applications can be developed in future as the system has a large capacity to integrate with many other systems. ERMIS has developed and replaced the former accounting system i.e. Standard Accounting System for Government Agencies or SAGA in 2001. This is because ERMIS is more efficient, widely integrated with other systems and user friendly compared to SAGA.

In terms of ICT infrastructure, this smart city, as a part of the MSC flagship has been developed in the high tech ICT infrastructure areas that would give advantage to the local authority and the communities to opt for better ICT performance equipment and tools. This infrastructure which cost about RM5 billion and developed by one of the giant telecommunication company in Malaysia, is a part of the Federal Government initiative to provide an Open Multimedia Network for the whole of the MSC flagship.

The ICT infrastructure in the city consists of SDH fiber optic ring main backbone running up to 10Gbps. It utilises ATM switches to enable broadband and multimedia applications. This infrastructure supports telephone services including automated information network and broadband services such as data communication, digital leased line, cellular communication, cable TV, video on demand and MSC applications.

This infrastructure will divide users into two broad categories - large-scale users such as companies or government departments and individual groups of residences.

Large-scale users are connected directly to the exchange through a high capacity fibre optic cable which runs up to 2.5Gbps. The distribution methods ensure that at least one route continues to function in the event of a fault affecting one cable or one side of the ring.

For residential areas, the connections are distributed to several FDH (fibre distribution house). One FDH can support up to 500 subscribers. Connection to each subscriber is achieved by either copper or fibre, or both, depending on the user's requirements. Besides that, every house in the city is provided with an underground cable to enable residents to have an easy access to the Internet.

V. CONCLUSIONS

This study finds that all the three capstone factors namely policy, economy and technology are very important and might influence the capability of the local authority to use ICT in its working process. The policy on the ICT is clear and no ambiguity, lead with a development master plan and followed by several shorter period of plan. This plan also consistent with the national level IT plan and properly monitored and controlled by the relevant authority at three stages – division level, local authority level and federal department level.

Economy also play a crucial role as the capital and revenue expenditure needs substantial cash injection to make sure that the facilities offered are world class and can be operated without any much obstacles. However, if economy factors referred to the business activities, no substantial contribution from this activities as the earlier phased of development in this city were emphasis on the community and social development while commercial activities only will be started at the last phased of the city development.

Finally, availability of advance technology from around the world especially in developed countries give the local authority ample choices to select the best ICT elements such as hardware, software, system, program and operations to be adopted that can give maximum benefits at a reasonable cost.

VI. LIMITATION AND FUTURE RESEARCH

This study is only limited to one smart city that is managed by one local authority. Therefore, the generalization of the findings should be taken with precautions.

It is recommended that future research can be undertaken for more than one smart city. A comparison can be made in terms of strength, weaknesses, opportunity and threats of these cities in term of all three factors – policy, economy technological factors.

More interviews should be conducted to compare and gather more meaningful findings on the ICT application in the city. Various staff in the different levels of local authority departments can be selected as samples to study the level of commitment and effectiveness of the local authority to integrate ICT in their operation and also management of city.

This survey can be used to understand the level of acceptance, usefulness and utilization of ICT by the residents of the city. This is important as key performance indicators of the local authority should be based on the community acceptance towards the effort made by the local authority.

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