Smart facility application: exploiting space technology for smart city solution

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Abstract. Facilities and amenities management is amongst the core functionalities of local government. Considering the vast area that local government has to manage, a smart solution is extremely inevitable to solve issues such as inefficient maintenance of public parks, drainage system and so forth. Therefore, this paper aims to offer a smart city solution which exploits the benefit of space technology. This proposed solution is one of the modules developed in Spatial Smart City Service Delivery Engine (SSC SDE) Project undertaken by Agensi Angkasa Negara (ANGKASA). Various levels of local government have been chosen to understand real issues faced by them. Based on this data, a Smart Facility application has been developed with the aim to enhance the service delivery by the local government hence improving citizens’ satisfaction. Since this project is still in progress, this paper will merely discussing the concept of this application.

1. Introduction
Facility management is not a new discipline altogether but it is a modern concept of maintenance. In the past, and still in practice, maintenance of a facility or a precinct is disintegrated from one to another. A company or a government agency normally has multiple contractors that are doing various maintenance tasks such as cleaning services, landscaping services, mechanical and electrical services, civil services and many others. However, lately, many organisations are moving towards facility management concept where one facility management division is doing all those maintenance work.

Maintaining a facility or a precinct is not an easy task especially if it involve the public at large. In this urbanised society, every little hiccup will cause real damage to the organisation’s image as it became viral in the social media. Thus, organisation such as local government will have to improve the way they manage their facility to provide better services to the public. This is where space technology could be exploited as part of smart city solution to manage massive area under the local government management.
Therefore, the objective of this paper is to explore the idea of utilizing space technology application in smart city initiative to improve facility management in local government. This paper focusses its discussion based upon the Malaysian context and environment although it does not limit its discussion by taking examples from abroad. In addition, data and information in this paper are merely an extrapolation of data obtained from selected local governments. Furthermore, this paper is more interested to share the overall concept of the solution and does not intend to go into details of the proposed solution as it is still under development. However, certain proposed working solution will be shared where necessary.

Space technology as defined by [1], is any technology that is designed, intended, deployed, or put into use in outer space or any celestial body. This includes satellites such as earth observation satellites, navigation satellites, communication satellites and others. These satellites provide avenues for many applications in various fields from government sector to private sector. Both sectors will consequently benefit the public at large. For instance, the application of navigation satellite technology in mobile application such as Waze and Google Maps has tremendously reduce travelling time taken by users. Another good example of the utilization of space technology is in the management of vast areas of forestry. The authority body could use images provided by earth observation satellites to quality of stock, mitigate potential problems and plan for the future of forestry managed. These examples of the utilization of space technology in various sectors shows that such technology could possibly be applied in smart city initiatives.

Smart city initiative or solution is relatively a new idea in Malaysia, although it has been around in many places worldwide. Cities such as Barcelona in Spain, Amsterdam in the Netherland, Toyota City in Japan and Beijing Haidian District in China are famous to be smart although their definition of smart might be different from one to another. Smart city market size is rapidly expanding and it is predicted by ABI Research that it will reach USD 39.5 billion by 2018 and Frost and Sullivan further predicted that it will reach up to total 3.3 trillion by 2025 [2]. In Malaysia, there are also initiatives on smart city development including Cyberjaya and Iskandar Malaysia [3] [4].

2. User requirement study
In this project, facilities is defined to be any facilities and amenities managed by the local government. In Malaysia, local government is the tertiary level government under federal government and state government. There are many facilities and amenities managed by the local government. These include public halls, roads, public parks and many others. In order to understand the real problem faced by local government in managing these facilities and amenities, site surveys and interviews in selected local government has been conducted. Six local governments in various locations were selected in this project. These include urban, suburban and rural areas. This will provide better picture of the problems at various levels.

Interviews and surveys in selected local governments concluded that the main issues or problems encountered by them and based on complaints by the public are waste collection problem, bad condition roads, blocked drainage system and long grass in public parks and places. Somehow, these are common problems in most local government in Malaysia. Therefore, this paper intends to propose applications of space technology to solve part of these problems and issues hence developing smarter city.

3. Smart Facility Management
Facility management is a discipline that involves preventive maintenance and corrective maintenance. In the proposed Smart Facility Management application, both aspects are integrated in the system. This is in line with the best practises of facility management. The preventive aspect of this application is where the supervisors of local government schedule the working plan of each
contractor or local government worker. For instance, contractors or local government workers are schedule on certain date of every month to mow the lawn in the public parks and clean the drains. This is the routine schedule for every specified period of time, however, there are unforeseen events where this routine is not sufficient. This is where the corrective aspects is critical to complement and complete the maintenance activity. Complaints from users or public will provide useful information for the corrective aspect of facility management. For instance, complaint from the public about overgrown lawn or blockages in drains will provide input for supervisors to arrange or if required reschedule the working plan of contractors or local government workers.

In addition, considering the large precinct and various types of facilities managed by local government, locating the exact location of the problem occurred is critical to improve the efficiency of the service. It is always a problem for local government to navigate to the complained area as most of the time location given by the public is ambiguous. It is time-consuming for the officer or maintenance worker to navigate or search for the point of problem. However, with space technology playing a key role, this navigation and searching time could be massively reduced. This Smart Facility application is linked to a Smart Complaint application where the public could pin point the exact location of the problem and attach a photo taken from their smart phone. Therefore, when the manager who receive the complaint could direct the officer or maintenance worker to the closest location if not exact location of the problem hence improving the efficiency of the service.

Hence, Geo-location data from Global Navigation Satellites and images from Remote Sensing Satellites is indeed very useful to manage facilities and related maintenance problems. Space technology will be integrated with spatial technology as well as information technology to provide the proposed smart city solution. The following sub-sections will explain further about some of the concept of the Smart Facility Application.

3.1. Work flow
Work flow of the system is designed in such a way it caters both preventive maintenance and corrective maintenance as explained in the previous paragraph. There are three main actors in the work flow. The first actor is the manager who is responsible to schedule maintenance works, monitor works and manage complaints. The manager could be the top management of local government or the directors of related departments. The second actor is the one who lodges complaints about problems occurred in the facilities and precincts under local government management. This actor includes local citizen or the public at large as well as the officer in-charge within the local government. The final actor is one who executes maintenance tasks. This is normally the contractors and the local government maintenance workers. The following work flow diagram shows the overall work flow between the three main actors.

![Work Flow Diagram of Smart Facility](image)

Figure 1. Work Flow Diagram of Smart Facility.
Firstly, the manager will schedule maintenance workers and contractors daily work over a period of time. For instance, they will be scheduled to do routine condition assessment for every facility, mow the lawn and clean the public hall. This is the preventive procedure of the facility maintenance. This task schedule will be uploaded to the cloud so that relevant access the schedule.

Secondly, complaints from the public and local government officer will be uploaded to the cloud through GSM network. A mobile application is developed to be used by the public to lodge complaints. The mobile application is developed in such a way it could read the GPS coordinate given by the navigation satellite. This is a critical information for the manager in order to give clear direction to the contractors and maintenance workers.

Finally, contractors and maintenance workers will access the cloud daily to get information about the updated daily work schedule which comes with GPS coordinate of the task locations. After task is completed, contractors and maintenance workers will report the task completed including photos of the work done.

The Smart Facility application will provide local government useful information instantly and anywhere there is internet connection. In addition, savings could be made as managers of local government could monitor and supervise contractors and maintenance workers remotely. Apart from that, paperless monthly report could be generated for payment procedure and reporting exercise.

3.2. Web application

The Smart Facility application is developed in both web platform and mobile platform. This application is to be accessed by the manager, the public and the maintenance worker. The access level is differentiated depending on the type of user or actor. In addition, the interface will be customised in accordance to user. The following diagram is an example of the screen capture of the web application developed.

![Figure 2. Viewing available maintained facilities.](image)

Since this project is still in progress, the interface and design is not final yet. The project team is working hard to improve it to make it as user friendly as possible. However, these screen shots provide a good idea how the application will appear finally.
4. **Further enhancement**

In the era of Internet of Things (IoT), almost everything becomes interconnected and automated. The use of sensors in many application is common nowadays. Sensor could reduce human intervention hence could reduce significant amount operating cost using manpower. Thus, the utilisation of sensor to provide autonomous corrective input instead public complaints to notify related authority is a smarter solution to improve the system. This sensor should come with Global Navigation Satellite System (GNSS) module to provide exact location of the problem arising. These notifications and locations can then be viewed on remote sensing satellite maps to give better graphical overview to the relevant officer. The diagram below briefly explains the system.

![Diagram](image)

**Figure 3.** Enhancement by utilising sensors.

5. **Challenges**

There are many challenges in implementing a smart city solution including enormous precinct managed local government, contractual issues and multiple owners involved. The challenges mentioned are not exhaustive but these are some of the key challenges realized along the development of the project and based on local literature available.

Firstly, according to the current demarcation of local government, the geographical area covered by each local government is massive. The size of area managed by local government became a big challenge because many factors have to be considered in each decision making including huge population, geo-politics, infrastructure facilities, socio-economy and physical and many others [5]. In addition, the bigger the size of area the bigger the cost to implement the solution if sensors were to be included.

Secondly, another challenges foreseen in implementing this solution is contractual issues. Local government has many different contracts where each is unique from one to another. This uniqueness makes it difficult to design a generic application that suits all contracts. In addition, certain local government are reluctant to share the extracts of the contract as it is the property of them. This causes more challenges to understand the scope of the contract made that is indeed needed to design a working and realistic application.

Finally, the difficulty foreseen in this project is there are multiple owners or departments in charge of certain facility. For instance, maintenance of the court in a hall is maintained by one department
while another department maintains the lighting system and another department in charge of the drainage system. This causes difficulty in terms of providing maintenance directive as it could involve multiple departments. These challenges require the team project to study thoroughly the local government procedure thus propose the best possible solution.

6. Conclusion

In summary, space technology is indeed a beneficial technology to be exploited to improve local government service delivery. The main improvement would be faster navigation to problem area, user friendly public complaints and efficient reporting of maintenance workers. The utilisation of the space technology enabled application is part of smart city solution proposed by Agensi Angkasa Negara. In addition, further improvement with the integration of sensors could reduce human intervention hence result in higher maintenance efficiency. Furthermore, challenges from procedural and organisational factor provide room for the application to be more dynamics in a sense it can be used in multiple situations.

References
[1] Mineiro M 2011, Space Technology Export Controls and International Cooperation in Outer Space (Springer Science & Business)
[2] Yanrong K Whyte J et al 2014 Comparative Study of Smart Cities in Europe and China, EU-China Smart and Green City Cooperation, EU-China Policy Dialogues Support Facility II
[3] Angelidou M 2015 Smart City Strategy Cyberjaya (Malaysia) retrieved from http://www.urenio.org/2015/02/09/smart-city-strategy-cyberjaya-malaysia/
[4] Jaffar M 2015 Revitalizing and Revamping Overstretched City System And Infrastructure, IRDA
[5] Ngah K 2009 The future challenges of local authorities in Malaysia (Centre for Policy Research and International Studies, CenPRIS, USM) Working paper No. 111/09