

Literature Review

According to the Chang, Young Ku Kang, Dong Hyun Kang and In Joon [2], in the current conventional computerization management of the cadastral system in South Korea is operated with raster map data. However, that data was difficult to use along with the National Geographic Information System in South Korea. Therefore, they decided that, for a more accurate map management, the cadastral map management system must be operated with vector data. Cadastral map computerization was built on related geographic information system. This system was used “Gauss Double Projection” for the length of lands and accurate division of area. Even users decided the length and area, it will be difficult to manage the whole cadastral map due to the discord of map connection. When considering the time before the Cadastral map computerization, the people who provided the land utilization confirmation document to the offices, spent almost over 30 minutes from application to acquirement. Also, cadastral mapping was directly related to private properties and government needed a way to gather necessary information from civilians.

The importance of Cadastral Map Computerization was to reduce the level of inefficiency in the Korean Cadastral Survey Corporation management system. The main affair of the Cadastral Map Management System in South Korea was the acquirement of land utilization confirmation document and merge-divide work of cadastral. The implementation of this project will have been a positive effect as it sought to solve management problems in the Corporation. When comparing with the former cadastral system, it spent more than 40 - 50 minutes for

cadastral map acquirement and after the implementation of the Cadastral Map Computerization, computations processed within 10 minutes and efficiency of affair rose.

According to the Byong-Nam Choe, Mi-Jeong Kim, Kwon-Han Lee and Yoon-Hee Jeong [3], information on various maps and land documents, which are managed by the land administration in South Korea was inaccurate and discordant. Furthermore, people had to travel far to visit a city hall, country office or district office to obtain information on land use regulations. However, the process is taken several months for the information produced by municipalities. Considering the present status of the land data on digital topographical maps have an enormous amount of information and it includes a lot of superfluous information which interferes with the construction and maintenance of a spatial database. One of the other identified drawbacks in managing land information more accurately was a lack of attribute data on topography due to land data was originated and relied on the paper maps.

To solve the identified problems in land administration in South Korea, the Ministry of Construction and Transportation (MOCT) implemented the project of Land Management Information System (LMIS) in 1997. The LMIS has tripartite objectives such as to provide land information to people upon request, to enhance the productivity of public land administration and establish rational land policies.

When considering worldwide similar solutions, a Singaporean company has developed a Cadastral System that supports digital cadaster. According to the Kean Huat Soon, Derick Tan and Victor Khoo [4] who developed the Singaporean Cadastral System, this digital cadaster encodes cadastral information in

digital format which allows for automation and returns high productivity. This System based on the Intergovernmental Committee on Surveying and Mapping's ePlan model, which already has been implemented in Australia and New Zealand. However, registered surveyors can check all the information through the web portal before the authority's inspection and approval. By using this product, engineers expected to reduce turnaround times and speed up the overall approval process. Considering its key features,

- Adding the vertical dimension and time.
- Adopting an open standard for automation and data interoperability.
- Providing a proactive communication platform with registered surveyors.

The current cadastral system was not capable of representing complex and much newer information that involve the developments in Singapore.

By implementing the proposed Cadastral Survey Management System in Land Survey Division of Singapore Land Authority, it helped to achieve automation and data interoperability, 3D and provenance and built a proactive communication platform for registered surveyors.

All the major countries throughout the world since the last decades have been establishing digitalized cadastral systems. Throughout the world, it is recognized as an important facility which helps to make the economic and sustainable development stable. Cadastral Management Systems should be able to adjust for the multi-purposes and meet the modern IT environment.

expected to increase to 1286 million people by the year 2020 and considering the population growth of Malaysia, it is also expected to reach

Current cadastral maps are based on hand-drawn property maps and mostly these maps could be damaged due to the prolonged time of storage. Plans details could be faded or destroyed by several reasons and due to the analog maps and the accuracy of the cadastral maps could be different from few centimetres in some urban and rural areas.

As a solution to the above-identified issues, Prof. Stig Enemark and Prof. Hans Sevattal [5] have published an opinion by researching "Is Land Information System and Planning decentralization is a significant key to sustainable development in Denmark?" Proposed cadastral infrastructure was empowered on land administration and land management systems.

- The proposed cadastral project assisted in valuation, taxation, land management, planning and administration.
- Enabled sustainable development and environmental improvement.
- Professionals in the IT world have already argued that within the next decade, such land information systems will perform an integral part of the model of a man-made environment.
- Provided land information to the financial and business sectors, land administration, environmental management, urban systems, and community information systems.
- Accuracy of the digital cadastral maps, the effectiveness of the sectors will be improving day by day.

According to the Tan Liat Choon, Dr. Khadijah Binti Hussin and Sr. Ernest Khoo Hock Oon [6], the urban population of Asia is

31 million people by 2020. Due to the rapid increases for development processes and technical purposes, the existing Malaysian

Cadastral System is unsuitable for representing the current situations.

The existing Malaysian Cadastral System is insufficient to meet the expected productivity of the high-density developments in urban areas. Due to the legal changes in the land registry has not been made in accordance with the complexity of the developments, some of the buildings have been built illegally or crossing boundary edges. There are difficulties to register the ownership of land and properties and existing legal registration process for 3D property in Malaysia is time-consuming. Experience in land registration and legislation shows there is insufficient property legislation. The utilization of lands in Malaysia has not followed the process of the proper Malaysian Cadastral System.

The land register considered one of the most critical documents in Malaysian Registration System. However, with the implementation of the new Cadastral Management System, the hard copy of the registry replaced by a computerized land registry that enabled the proprietor to transfer, change the land, or grant rights of easements.

Methodology

The success or the failure of the software is influenced by the quality of the requirements. Therefore, identification of the efficient software requirements is one of the key challenges to develop high quality software solutions. Requirement elicitation techniques

can be divided into four categories according to their nature of communication. Such as traditional, contextual, collaborative, and cognitive.

A. Traditional

An Interview is a method of identifying the opinions of clients of the organizations by face-to-face conversations. With the guidance and support of Mr. N.R.L Mendis (Rtd. Superintendent of Surveys) and Mr Wikramarachchi (Rtd. Add. Surveyor General), the interview process was conducted successfully and by selecting one of the three types of interviews such as Closed-Ended, Open-Ended, and Probing Questions, the Business Analyst was able to prepare and generate a report within 48 hours. Most importantly this interview process was intended to discover their expectations of the system, business aspects, critical thinking, and encourage the interviewee to open their personal thoughts on specific topics.

Questionnaires are a technique of eliciting requirements from many people within lesser cost and time. This technique is based on electronics and papers. Therefore, these questionnaires could be a set of written or typed questions on emails and printed sheets. The success of the questionnaire process is depending on how well the questionnaires are design and the skills of the interviewer who conduct the interview session. Considering the environmental facts, it could be suitable for remote locations. Therefore, the Questionnaire was distributed with the assistance of Surveyors and employees of the Divisional and District Survey Offices. Thus, Project objectives were identified in accordance with the suggestions and feedbacks expressed in the questionnaire.

B. Collaborative

Joint Application Development (JAD) is considered as one of the processes that expedite business solutions in the software development environment. After requesting a meetup from the Divisional Survey Office Gampaha, this was followed by a meeting with the Superintendent of Surveys, Assistant Superintendent of Surveys and Surveyors.

When considering the physical involvement of the JAD session, it encourages the teamwork of software architects, software developers, stakeholders, and others who related to the business and software processes to precisely depict the aspects of the business need where they can jointly develop a solution and the success of the session depends on the leadership among the participants who tries achieving group synergy during the JAD session. The JAD session was focused on business problems rather than the technical details. While the JAD offered a team-oriented approach in the software and business environment, it enabled the spirit of the partnership and effective than other traditional business meetups.

C. Cognitive

Document Analysis is a process of analysing the documents related to the problem and gather necessary information. It is considered as one of the best requirement elicitation techniques to gather information and the business analyst of the particular organization should be able to go through all the documents which are related to the software process and analyse the current system architecture as well. Furthermore, this technique helps business analysts to prepare questions for validating the correctness of information.

According to proper procedures and legal permissions obtained from the officers in

charge of the relevant divisions of the Survey Department in Sri Lanka, it was possible to inquire into various official documents related to the proposed artefact such as Cadastral Survey Plans, Tenement Lists, Field Books, Amendments, Department Survey Regulations, Plans and Diagrams, Standing orders, Survey Acts, Temple Lands Registration Ordinance, Registration of Title Acts, Urban Development Authority Regulations for Subdivisions of Lands.

D. Feasibility Study

When it comes to the Feasibility Report, considering the project aspects and the context of the project, research studies were inclined more on Technical Feasibility and Economic Feasibility. According to the research facts, the familiarity with the applications of Survey Department was moderately low and it was impossible to connect Land Reform Commission (LRC), Road Development Authority (RDA), and Private Cadastral Survey Plan Information together. Also, Surveyors record all the survey information manually on field books. However, familiarity with the technology of the Survey Department was moderately high, both employees and senior officers had a good understanding of what the system should do. When considering the compatibility with the existing technology, it was also moderately high due to the advanced survey equipment used, computer labs, and knowledgeable individuals who could operate the proposed artefact.

Although the Survey Department was empowered with knowledgeable individuals and advanced technological equipment, there were still several shortcomings that make it impossible to implement the proposed artefact. Therefore, after a systematic, formal, and transparent Economic Feasibility investigation,

could fulfil the necessary resources and system needs through a properly designed budget plan.

Artefact

It is always debatable the possibility of utilizing innovative technologies on managing cadastral survey plans and mapping in Sri Lanka. Doubt and fear of failure leads to the edge of the bridge where the boundary lays between the 3rd world countries and the rest of the world. Now more than ever, the world needs cutting edge defensive techniques to face challenges, overcome drawbacks and prevent the threats before they occur. Therefore, throughout the application development, the research study aims to minimize the chances of having threats from intruders and secure the application and data responsibly. Thus, to obtain expected outcomes, the proposed artefact was designed and applied following innovative technological features.

1) Desktop Application:

- Microsoft Visual Studio 2019
- Microsoft C# Programming Language
- MySQL Database
- Bunifu Framework
- GMAP.NET
- IronOcr
- LiveCharts
- MessagingToolkit.QRCode
- Spire.Pdf
- Twilio

2) Features:

- Encode and Decode QR
- Encrypt and Decrypt Cadastral Survey Information
- OTP Message Service
- SSL Certification on Email

- Live Mapping – Latitude, Longitude, Routes, Add Points, Area by Polygon, Load Locations, Clear and Remove Points
- Screenshot Facility
- Live Charts and Report Generating – Revenue, Number of Lots, Extent and Topography
- Open and Extract PDF to Word Format | Search and Highlight Texts
- Indicating Error Messages and Password Reset Options
- Backup and Restore Database

Testing/ Results

A. Bimsaviya / LRC / RDA

According to the research facts, information, and alphanumeric data which were gathered from various requirement elicitation techniques, helped designing a platform that could manage imperative and crucial cadastral survey information in Bimsaviya Project, Land Reform Commission, and Road Development Authority.

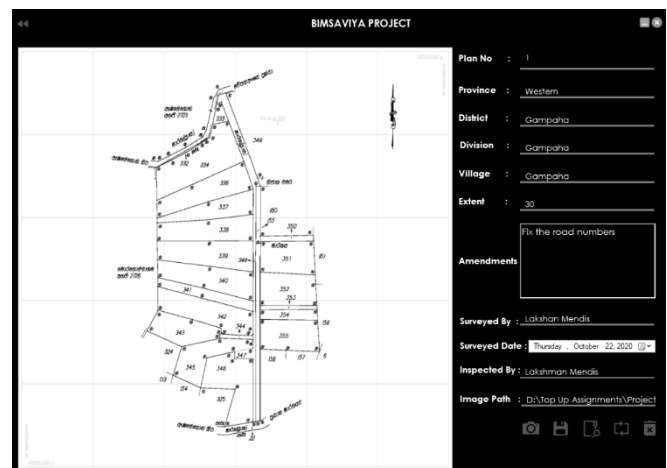


Fig. 1 Managing Bimsaviya Project Survey Information

