Real Property Tax Mapping and Records Management System: An Application for Butuan City Government

Maria L. Rodriguez[*1], Juan C. Perez[2], Carlos A. Sanchez[3]

[1]Department of Mechanical Engineering, University of Buenos Aires, Argentina
[2]Faculty of Engineering, University of Mexico, Mexico City, Mexico
[3]School of Applied Sciences, University of Barcelona, Spain

ABSTRACT

This paper describes Visual Basic Application for customization of GIS software in order to develop sets of tools and utilities that are tailored-fit to the tax mapping and management of records of the real property units of Butuan City that could be utilized also in other developing countries. Visual Basic Application was employed to perform subdivision and consolidation of real property units (RPUs) within the GIS platform. These functionalities will enable users to automatically update the map and the database dynamically whenever an RPU owner declares conveyance of property either by subdivision or consolidation. VBA was further applied to automatically update the lot numbering of RPUs in an inverted "S" pattern whenever there is a need to re-section the tax map. On the other hand, an enhancement and customization was employed to automatically generate a tax map book for Butuan City. All developed applications were then integrated to give ease to the end-users. Upon simulations and testings conducted to the customized functionalities for the tax mappers of the City Assessor's Office of Butuan City, it was therefore observed that an efficient, accurate, and effective tax mapping can change the paradigm as well as the quality of service of the City Government of Butuan, Philippines and any other local government units.

KEYWORDS: VBA**,** ArcGIS, tax mapping, real property units, real properties management

I. INTRODUCTION

This paper presents an Visual Basic Application for customization of GIS software in order to develop sets of tools and utilities which can be used for the mapping, storage and management of records for the real property units of Butuan City. The extension has been prepared based on the legal and administrative concepts defined in Philippine law.

Real property taxes, according to OECD (2010) refer to those taxes levied regularly in respect of the use or ownership of real property. They are levied on land and buildings, in the form of a percentage of the assessed value of a property or in terms of other characteristics of real property, such as size, location, and so on, from which are derived a presumed rent or capital value (OECD, 2010). Generally, the following three main stages are involved in the administration of property taxation: identification of the property being taxed, assessment of the property; and tax collection and dealing with arrears (Bird and Slack, 2002).

Dillinger (1991) define identification as finding all the properties subject to taxation and obtain the proper information needed. Based on the data from 1st step (identification), assessment of the properties are applied . Aside from these, subdivision and consolidation will can be done if the technical details of the real properties has been made. The last stage covers collecting the taxes, ensuring payments, and dealing with appeals which thoroughly discussed by Bird and Slack (2002).

With the local government relying heavily on real property tax, efficient real property tax mapping and records management procedures needs well-functioning tools and procedures in the attainment of their target collections and services. For instance, Dillinger (1991) points out that a property tax system requires a complete and accurate inventory which enables the discovery of all the properties subject to taxation. Similarly, Tang et al. (2011) state that an integrated property database is the fundamental element underpinning the taxation of real property. UNECE (1996) list down the minimum of output of an inventories namely: the identification and mapping of all properties, the classification and reclassification of each property in accordance with an agreed set of datasets, implementation of relevant market value based on the latest datasets and identification of the ownerships.

Many countries real property databases or inventories exist in terms of cadastral systems consisting of cadastre and land registers. Cadastral description includes the text records about the attributes of each parcel. A well functioning cadastral system provides the basis for the property tax inventories. However, the property tax administration also needs the following information which is not generally provided by the traditional cadastral

systems like physical, economic, environmental data regarding property units with their buildings which is particularly needed for appraisal processes and a spatial representation of 3D property units which allows the tax administration to verify that all taxable objects have been included in the tax inventories including new or upgrade of property. Others have applied parcelization like the work of Germain et al. (2006) in one county in central New York using digital tax map sheets.

In the past few years, these requirements were fulfilled by two paradigms within the geo-spatial domain, namely; the land administration and Spatial Data Infrastructures (SDIs). The notion of land administration refers to the "management of information about the ownership, value and use of land and its associated resources" (UNECE, 2004). Nowadays, ownership maps are being created in a GIS by digitizing plat books and paper maps and utilizing legal descriptions from tax assessment rolls in which changes in ownership will be tracked through time using GIS analysis

Software nowadays becomes a necessity for real property mapping and records management , as it provide and end users to make transactions fast and easy (Algizawy, 2017). Furthermore, some of the software offers and enables customization which allows developers to create program using Visual Basic Application (VBA) language to develop more enriched tools that are specific to the needs of a particular organization (Beaumont, 1987). And ArcGIS 10.1 is one of the famous and powerful GIS software today. ArcGIS is geared with complete tools for geospatial data processing. It provides a tool for the developer to further expand its functionalities through its capabilities to handle VBA and python scripting for a plug-in development http://www.esri.com/news/arcnews/spring12articles/introducing-arcgis-101.html. The City of Butuan Assessor's Office is still performing the management of RPUs manually. But considering the increasing number of RPUs of the city, inefficiency, inconsistency and low reliability of the processing is inevitable with manual processing and transactions. Performing map revision manually of one section usually takes three to seven days. In doing so, inconsistencies and redundant records may be incurred as the city is dealing an increasing number of RPUs without an integrated data management platform. The inconsistency and inefficiency will further lead to unreliable data that can affect the clear monitoring of the tax collection of the city as it is the basis for the computation of real property taxes.

To address this problem, this study employs VBA programming in order to develop customized tools under the ArcGIS 10.1 environment. The study aims to develop tools that can automate RPU transactions and aid in real property management of the City Government of Butuan.

II. MATERIALS AND METHODS

This study used QuickBird Image of Butuan City with 2.56 meter resolution. RPU attributes like Starting Point, Bearing and Distance from Land Title are the reference data used for plotting and other land information that will be inputted in the Land Registry System.

Figure 1 Butuan City Quickbird Image

The study use ArcGIS 10.1 incorporated with Visual Basic Application. The PostgreSQL is the back-end or the database of the program.The ArcGIS provides a tools for the developer to create a customize program inside the ArcMap environment.VBA that was just installed solely before can now be integrated to the ArcMAp environment that allows the developer to perform customizations inside the application.

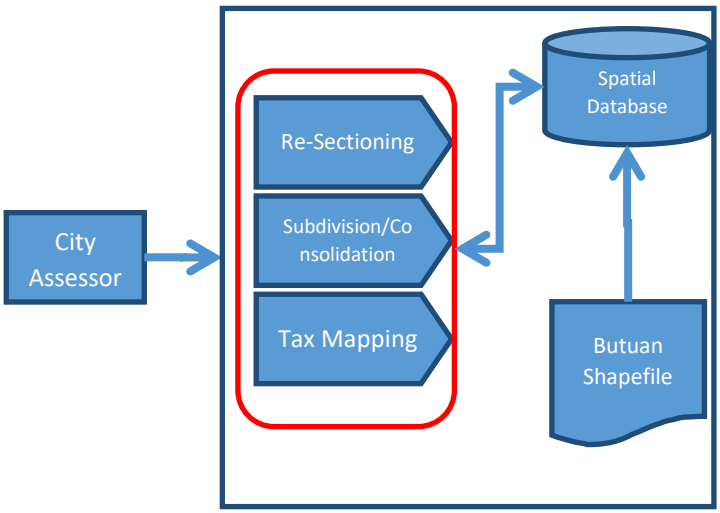

Figure 1. Conceptual Framework

Figure **1** shows the flow of the data and the connection of the program. The database will be the center of the communications between the programs. As the other program provides and update, another will display it. All of the programs will be used by the City Assessor's Office.

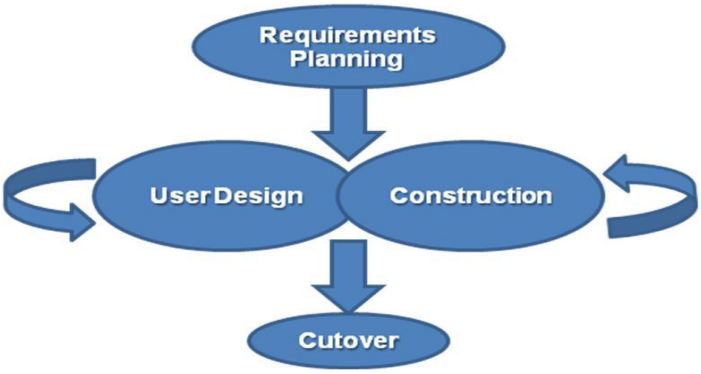

Figure 2. Methodology

Figure **2** shows the methodology of the study. A Rapid Application Development (RAD) was employed to develop a customized application for the City Assessor's office. This is to consider constant checking and changes while implementing the system. And considering the duration of the project RAD will be the best method to cope with the short duration. Requirement specification and planning was implemented first. User Design and construction then followed that involves creating prototype and presentation to the user and implementation, in this process also where geospatial data processing will take place. Here, user design and construction created a loop to achieve the desired customized program for city assessors. When the desired model will be achieved testing and training will be conducted.

III. RESULTS AND DISCUSSION

The Butuan Parcel Map is digitized using the ArcGIS 10.1 software. To digitize the tax map, the RPU descriptions are gathered in every land title and inputted it into the application using its Coordinate Geometry (COGO) plug-in.

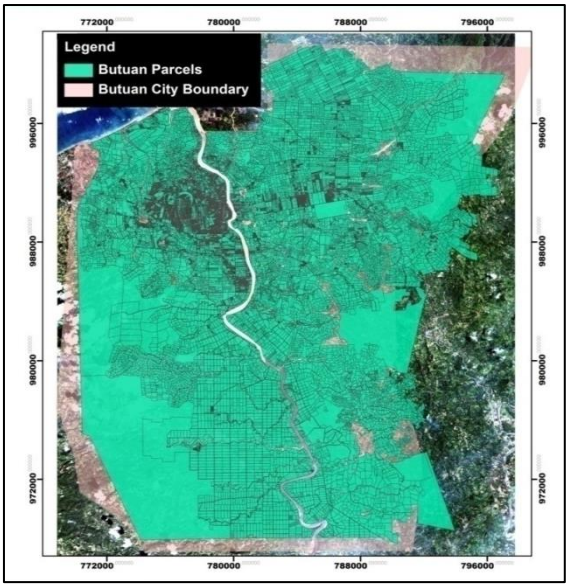

Figure 3. Butuan City Land Parcels

Figure 3 is the digitized parcels of the Butuan City Map, conformed to the projection of the QuickBird image.The map is then stored in the PostgreSQL database and was used by the customized programs.

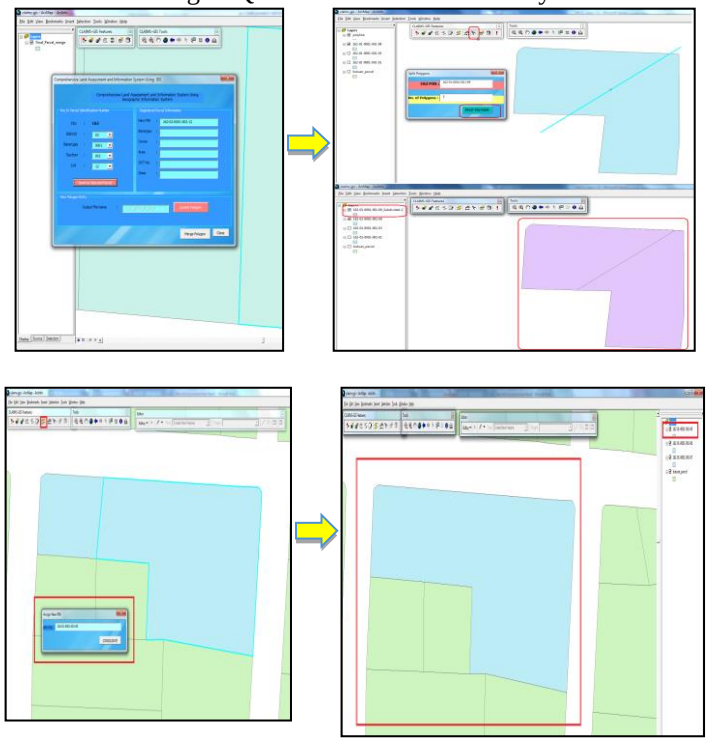

Figure 4. Subdivision/Consolidation Program

Figure 4 is the Subdivision/Consolidation module interface. The program performs the subdivision of the land parcel whenever there was an event of splitting the land and merging or consolidating the land. It will be more convenient for the tax mapper to perform such process using the automated program. As the subdivision performs, interface will be provided to user for the inputting of new data with the subdivided /consolidated parcel and stored in the database.

Figure 5. Re-Sectioning Program

Re-sectioning program GUI is shown in Figure 5. The module developed to address the possible event of a certain section to reach the maximum number of parcels set in one section, which in the study area a maximum of 99 parcels is set based on the standard protocol followed by the assessor's office Tax Mapper. If the set lot number limit was reached, the program will provide two ways to perform. The first method is by giving the end-user the control to manually select the areas with parcels to be re-sectioned and second method is by giving the end-user a system-recommended re-sectioning of maps. As the parcels to be re-sectioned were identified, the program will then perform an Inverted "S" numbering to assign new lot number of the parcels with the newly created sections, and dynamically update the database.

Figure 7. System Recommended Re-Sectioning

System Recommended Re-Sectioning as shown in Figure 7 program performs re-sectioning without user intervention. The program performs re-sectioning based on the rules and parameters set/provided.

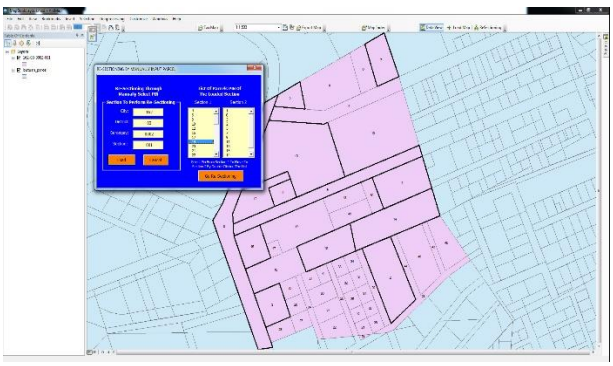

Figure 8. Manual Select Parcel Re-sectioning

Figure 8 is the interface for Manual Select Parcel numbering where user is given capability to divide the section accordingly. List of parcels will be provided for user to divide the section by grouping parcels into two by selection. When the selection is performed, parcels will be highlighted to guide the user. After the clustering, user can now perform re-sectioning.

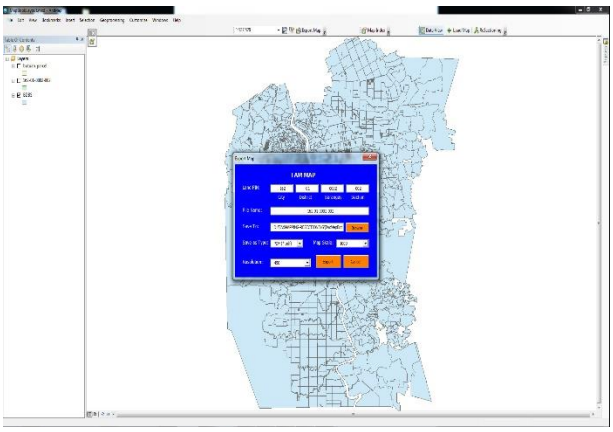

Figure 9. Tax Map Book Module

The tax map book interface module shown in 9developed to assisted user in querying section based on the information provided. Inputted information will then be used by the program to search the specific section, highlight the section and zoom to extent. The search section will be imported to PDF, JPG, PNG and TIFF format as indicated by the user on the interface.

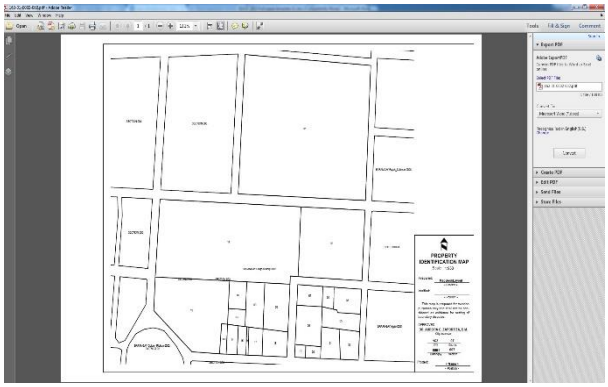

Figure 10. PDF Tax Map Output

Figure 10 shows the sample output of the tax map book in PDF format. The template was based on the standard provided by the assessor's office of Butuan City.

IV. CONCLUSION

The ArcGIS customization capability has a bigger contribution in GIS data analysis and making the map processing faster with an organized GUI that will be friendlier to the users. The programs developed contribute the spatial data and text data processing faster and will make the City Assessor's Office be able to perform its function efficiently. The revision of section which will be done within 3 days or more are now accomplished within a couple of seconds or minutes based on the area of the section to be revised. Inconsistency are minimized and/or eliminated because all transactions are being done by the developed system. The lot PIN numbering, which is a very tedious work, was provided with an automated system is still requiring intervention from the user. As the ArcGIS equipped with powerful tools and plug-ins, such processing of the map is more reliable and fast that will assist the City Government of Butuan in collecting real property taxes with the additional provision of visual representations of RPUs, and somehow an exact data handling and representation that will be monitored based from the data that comes in and out of the database. Thus, customization of ArcGIS

with its VBA extension environment indeed played significant roles in creating application that will be suitable and aligned to the needs of the users.

V. ACKNOWLEDGEMENTS

The authors of this study would like express their gratitude to the City Government of Butuan for the trust and support given by providing all the necessary data and funding to finish this endeavor.

VI. REFERENCES

[1] OECD, 2010. Revenue Statistics 1965–2010: 2010 Edition.
[2] Bird, R.M., Slack, E., 2002. Land and Property Taxation: A Review. World Bank, Washington, DC.
[3] Dillinger, W., 1991. Urban Property Tax Reform, Guidelines and Recommendations. Working Paper. World Bank, Washington, DC.
[4] Germain, R.H., Brazill, K., Stehman, S.V., 2006. Forestland parcelization in Upstate New York despite economic stagnation and a declining population. Natl. J. Am. Foresters 23, 280–287.
[5] Tang, B., Wong, S., Liu, S., 2011. Institutions, property taxation and local government finance in China. Urban Studies 48 (5), 847–875.
[6] Essam Algizawy, Tetsuji Ogawa, and Ahmed El-Mahdy. 2017. Real-time large-scale map matching using mobile phone data. ACM Trans. Knowl. Discov. 11(4), Article 52
[7] Beaumont J R 1987 Location Allocation Models and Central Place Theory. Spatial Analysis and Location Allocation Models 21-54. New York, Van Nostrand Reinhold
[8] http://www.esri.com/news/arcnews/spring12articles/introducing-arcgis-101.html