

## **Proposal for Taking the Current Cadastre to a 3D, LADM Based Cadastre in Trinidad and Tobago**

**Charisse GRIFFITH-CHARLES and Earl EDWARDS, Trinidad and Tobago**

**Key words:** 3D Cadastre, LADM, Trinidad and Tobago.

### **SUMMARY**

The current cadastre in Trinidad and Tobago is 2D, only partially digital, and does not conform to the requirements of the LADM. A web accessible application, that has been recently developed, applies only to a subset of state land that has been leased to private individuals. A clear proposal for taking the current 2D system to a 3D, LADM-based system can be developed and tested so that the land registry and land survey institutions can have a clear prescription for upgrading the current systems. The benefit of introducing this 3D cadastre in high-value, transaction-heavy areas of Trinidad and Tobago can be faster transactions in the more affluent condominium sector, which will help to invigorate the economy and redound to the benefit of the entire country.

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## **1. INTRODUCTION**

In Trinidad and Tobago, the current Conveyance and Law of Property Act Chapter 56:01, which pertains to land transacted on by deeds, does not define the term ‘parcel’ nor refer to the entity at all, but recognises only ‘land’. This definition of land includes all buildings, mines, and fixtures attached to the land as the definition states:

“land” includes land of any tenure, houses and other buildings, mines and minerals, and other corporeal hereditaments; also a rent and other incorporeal hereditaments, and an easement, right, privilege, or benefit in, over, or derived from land, and also an undivided share in land;

The Real Property Act Chapter 56:02, which provides for the registration of title to land, also does not define the term ‘parcel’ but makes several references to the entity. This legislation defines ‘land’ as:

“land” means land, messuages, tenements, and hereditaments, corporeal and incorporeal, of every kind and description, or any estate or interest therein, together with all paths, passages, ways, watercourses, liberties, privileges, easements, plantations, gardens, mines, minerals, and quarries, and all trees and timber thereon or thereunder lying or being, unless any such are specially excepted;

Both items of legislation therefore do not limit the property held to that with tangible or physical expression only. Since Trinidad and Tobago is a former British colony, the legislation is based on the law of England and is very similar to previous English law and the law in place in many post-colonial territories.

The construction of the graphical description of land, for the purpose of transactions, is the responsibility of the registered land surveyor as the Real Property Act Chapter 56:02 states:

Every map, plan or diagram required for the purposes of this Act shall be prepared and furnished in the manner specially provided for the purpose by the Land Surveyors Act and by Rules made thereunder.

The preparation of the rules for graphically visualising the land or parcel is the responsibility of the Land Survey Board of Trinidad and Tobago (LSBTT), which makes prescriptions for how the parcel is graphically described. These prescriptions must be consistent with the Land Surveyors Act, the Land Surveyors Regulations, and the Land Surveyors Rules and currently refer only to 2D paper based descriptions of surface parcels. The rules make some concession to describing 3D parcels by requiring for condominiums and townhouses a location plan, strata plans for each floor, and elevation plans for each façade. Other legislation related to rights, restrictions and responsibilities include the Planning Act and Property Tax Act which describe how restrictions can be applied to development in spatial zones and tax responsibilities can be attached to property parcels.

This paper examines the current land registration and cadastral mapping legislation, regulations, policies and technical processes for gaps that would need to be filled for construction of a new 3D, LADM-compliant system. A model is developed that would fill these gaps and a proposal is described for implementing the model. The proposal takes into consideration the desirability of conforming to the LADM structures, the potential practicality of precisions and coverage of the 3D cadastre, and the efforts required by, and the opportunities offered to institutions as a result of this development. The status of current initiatives in other countries is examined for applicability to the Trinidad and Tobago legislative, technical and institutional environment.

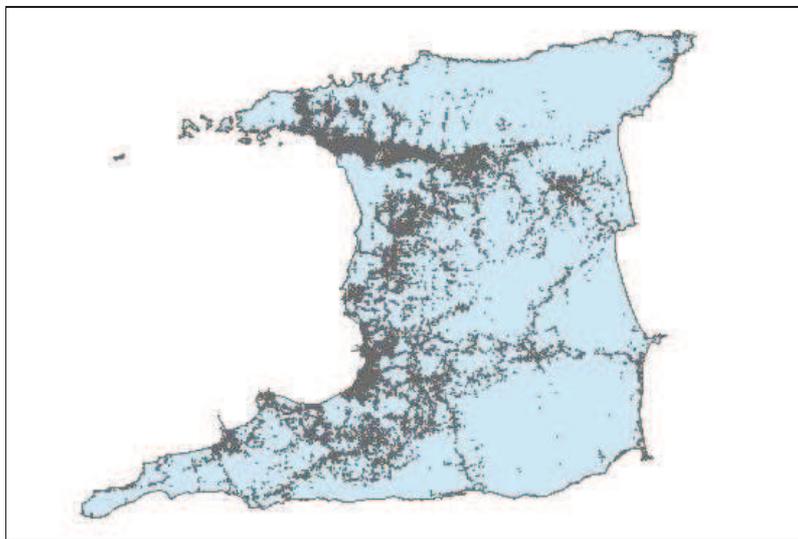
A fully developed prototype, constructed to demonstrate the applicability of the proposal, is then described. The prototype takes a small representative area including typical buildings with strata ownership and demonstrates how this 3D cadastre can be achieved using available LIS software while ensuring that the structure of the database conforms to the LADM required information regarding person, spatial unit, and rights, restrictions and responsibilities that apply in the particular jurisdiction. Legislative changes would include: a clear definition of a spatial unit as opposed to the currently accepted definition of a parcel, and determinations of precisions to which vertical directions are to be described.

The findings are that, building on the recent initiatives to construct a digital land information system for state land, legislative changes are required along with procedural changes at institutional and professional levels. The graphical description of some utility easements may be too complex to be practical for visualisation and should remain in verbal description in some instances. The digital model adopted for the state land system is one step further along the way from the paper based cadastral system but requires amendments to the legislation and institutional procedures to support practical implementation for more widespread use on private land and in 3D space.

## **2. PROJECT JUSTIFICATION**

The World Bank Group annually acquires data, calculates the ‘ease of doing business’ indicators from those data, and ranks the countries of the world in terms of these indicators. Data are acquired on the number of steps required to check the status of the property in order to be assured of its ownership status, the number of days required to complete the sale transaction, and the cost of the sale transaction as a percentage of its value. The average of the ranks on these three indicators leads to one of the rankings in the ease of a transfer of property from one seller to a buyer. According to the arguments for land registration and titling, the assumption is that if this time and cost is reduced and the process is simplified by comprehensive and current data on land tenure, entrepreneurs will be encouraged to purchase property and set up business leading to an invigorated economy and taxes accrued to the state (Feder and Nishio 1998; Feder and Noronha 1987; Feder et al 1988; Gould et al 2006; Griffith-Charles 2004; Barnes and Griffith-Charles 2007; Griffith-Charles and Opadeyi 2009). Activity in the business sector leads to employment of lower income groups and therefore reduces poverty and unemployment. In the ranking for 2013, Trinidad and Tobago ranks 67 in the overall ease of doing business but 178 out of 189 countries in the registration of property

(World Bank Group 2014). This is quite an unacceptable standing. This means that the registration process accounts significantly in reducing the efficiency of the transaction but that the land market is active. Given that these transactions are more prevalent among the more affluent urban areas, improving the land administration in the urban areas would benefit the land market and help to fuel the economy. Figure 1 indicates the location of buildings over all of Trinidad. The buildings are concentrated in the western half of Trinidad and along the main highways. This is an indicator that these areas can be targeted for the implementation of a 3D cadastre with the express aim of facilitating the real estate sector of the economy. Further analysis can be done to refine this calculation of the area to aim for the establishment of the 3D cadastre in order to reduce the area to be focused on if the intention is to increase transactions in the land market. Low income densely populated areas may be removed from this process and targeted for introducing the Social Tenure Domain Model (STDM) instead (Griffith-Charles 2011). The different datasets for the LADM areas and the STDM areas can eventually be merged into one seamless dataset as allowed by the LADM standard.

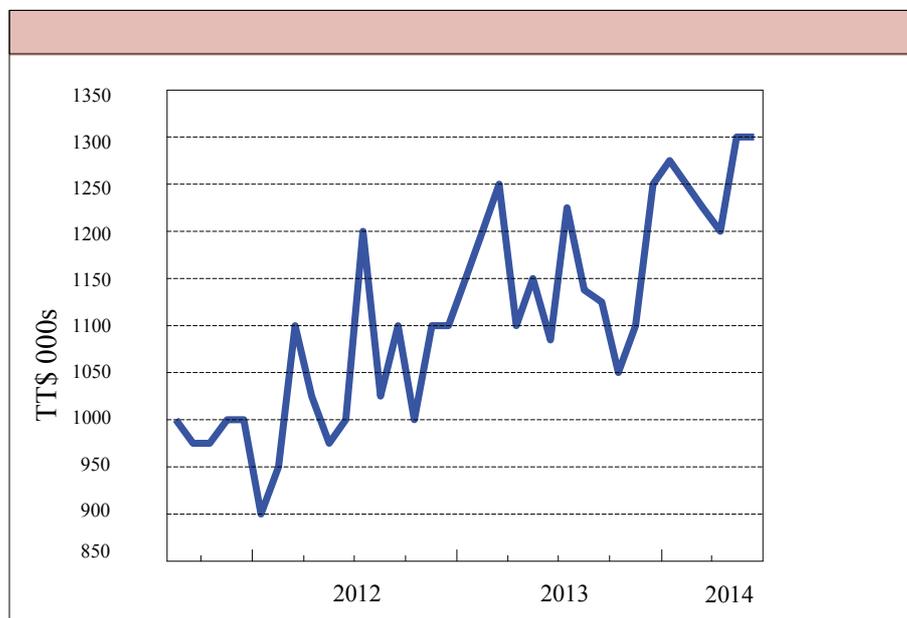


**Figure 1. Building density in Trinidad**

Supportive information for this thrust to target the land market can be obtained from the Central Bank published statistics (Central Bank of Trinidad and Tobago 2014). Figure 2 shows the median property prices in the real estate market over the last few years. This indicates growth in the sector, despite the low ranking of the country in registration efficiency, which can translate into an energised economy. The state can benefit from the taxes earned on this activity. The justification for this approach also follows on previous work to use cost benefit analyses to determine where best to develop a 3D cadastre in Trinidad and Tobago (Griffith-Charles and Sutherland 2011; 2013)

It is anticipated therefore, that the areas selected for establishment of the 3D LADM based cadastre will be those where high-valued, transaction-heavy properties predominate. Since there is no fiscal cadastre with a graphical component, the textual files of the Valuation Division can be used along with the knowledge of the areas held by valuation surveyor and

real estate agents. The transaction records at the Land Registry at the Registrar General's Office can also be a source of this information.



**Figure 2. Median property price increases 2012 to 2014 in Trinidad and Tobago (Central Bank of Trinidad and Tobago 2014)**

### 3. LEGISLATION

The existing legislation describes the legal entities corresponding to the LADM's basic administrative unit and the attendant spatial unit, the spatial source and the party. The legislation that describes the form of the administrative source or evidence of rights, restrictions and responsibilities include the Conveyance and Law of Property Act Chapter 56:01, the Registration of Deeds Act Chapter 19:06, and the Real Property Act Chapter 56:02 since land can be transferred both by the deed system under the former Acts and by the title system under the latter Act. The spatial source can therefore refer to a deed describing the transfer between vendor and purchaser or a Certificate of Title where the transaction is recorded related to the parcel.

#### 3.1 Existing

Currently, for condominium schemes, a management company is formed, which becomes the owner of the property. The individual apartment owner must hold shares in the company which must be relinquished when the apartment is sold to facilitate the new owner acquiring both the interest in the apartment and the share interest in the common property areas such as parking areas, lobbies, gardens, and walkways. Figure 3 shows a typical survey plan for a condominium scheme including the cross-sectional and strata views.

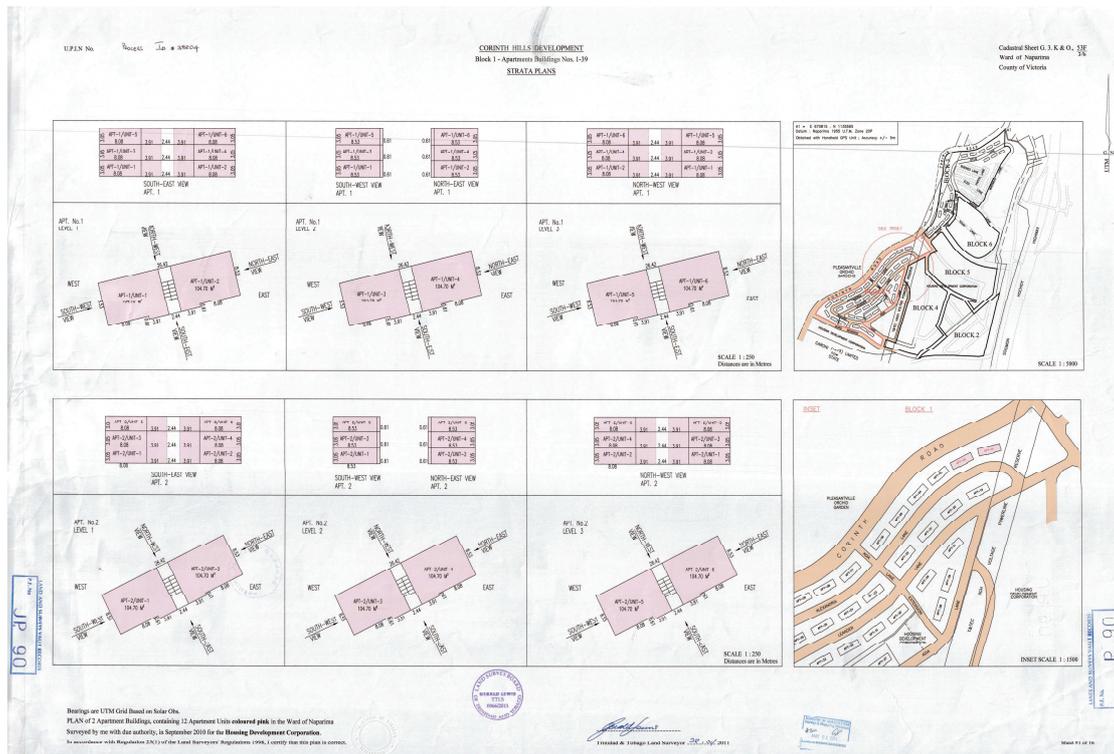


Figure 3. Typical cadastral plan of condominium scheme showing sections

### 3.2 Proposed

To make the current system compliant to the LADM, the spatial source, deed or title, would be identified by a unique number. The party, which can be an individual or a company, or other group would have to be registered as well.

Attributes include:

- Availability status – whether document exists
- External archive ID – since there is a separated cadastre and register, the cadastre will have the external ID of the land registry
- Maintype – the type of document, whether deed or title

## 4. VISUALISATION

The visualisation of the parcels would assist the state in land administration provision of services and maintenance of data. The potential use of the visualisation is dictated by the precisions possible in the visualisation.

### 4.1 Existing

The cadastral plan is authoritative for defining the limits of the parcel or basic administrative unit in the LADM. For 3D ownership in condominiums, the 3D aspect is visualised by incorporating several different views on the 2D paper plan. This is not able to be replicated in

the cadastral index as the index is a plan view in 2D of the relationship between all parcels. A typical view of a section of a condominium is shown in the excerpt of a cadastral plan shown in Figure 4. The current paper index is shown at Figure 5.

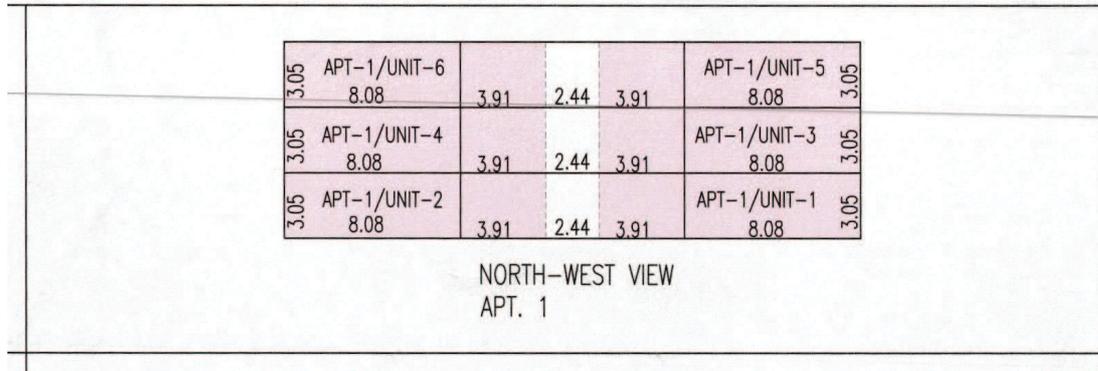


Figure 4. View of a detail of a cadastral plan showing a vertical section of a condominium

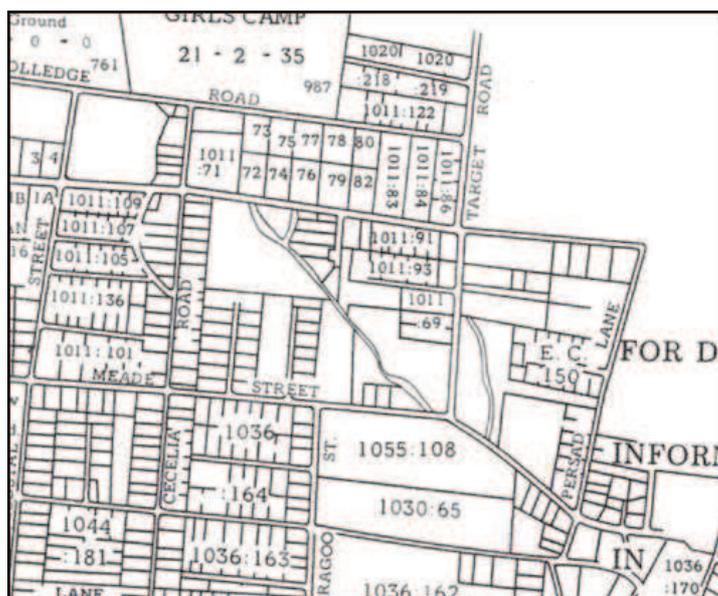


Figure 5. Excerpt of cadastral index, paper version

Some of the cadastral data has been digitised as shown in Figure 6, overlaid on topographic data, but this dataset is incomplete and there is difficulty in keeping it current as a result of a ponderous system that only allows individual changes to be performed at a time, and also because of a lack of sufficient human and financial resources in the responsible state institution. This cadastral management system is proposed to be updated in an externally funded project over the coming year and a half (Inter-American Development Bank 2013).

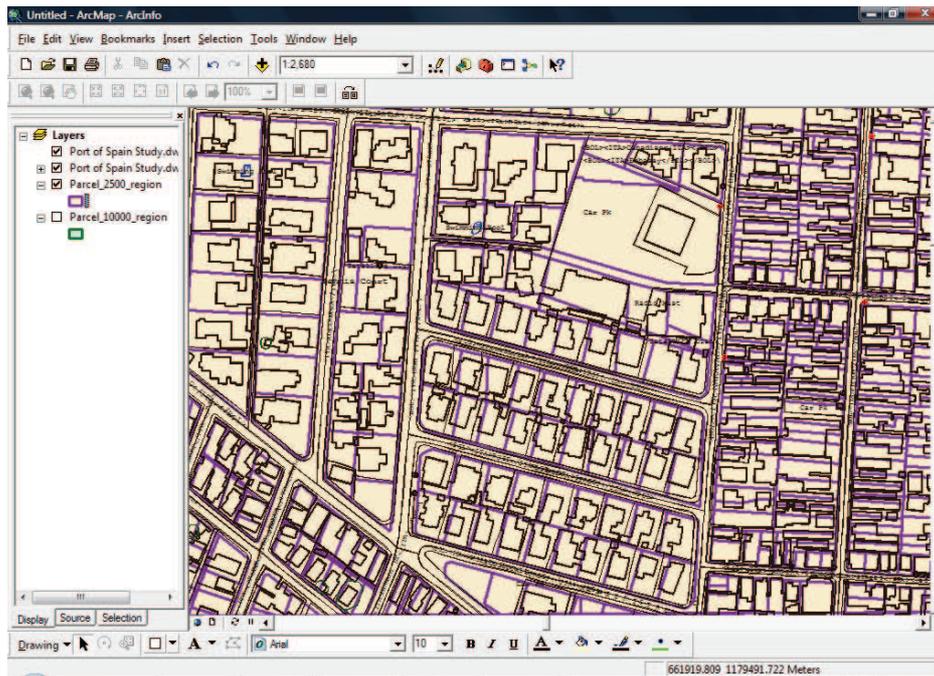


Figure 6. Digital cadastral index in Trinidad and Tobago

#### 4.2 Proposed

In the LADM, the basic administrative unit would be defined by the external limits of the parcel that is registered to the company comprising all owners in the condominium scheme. These boundaries in 3D have no visual, tangible expression but can be visualised if necessary using virtual lines. It is proposed that this would only be necessary for the urban environment where condominiums, apartments and commercial buildings are closely juxtaposed. Figure 7 shows a parcel in 3D view which has no 3D visualisation. The rural parcels can be rendered this way.

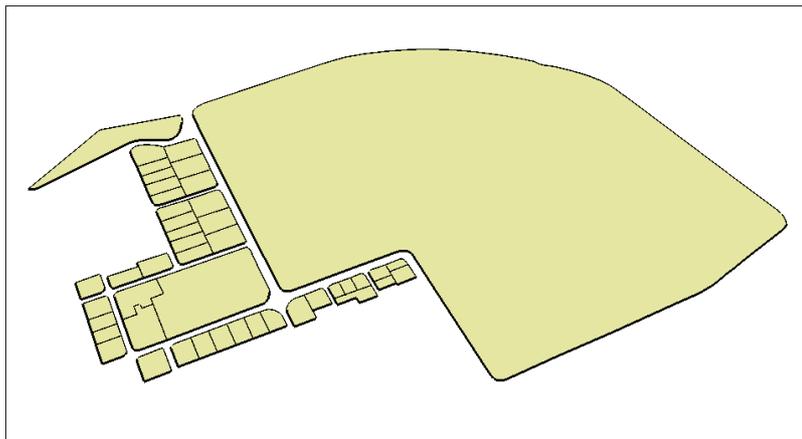
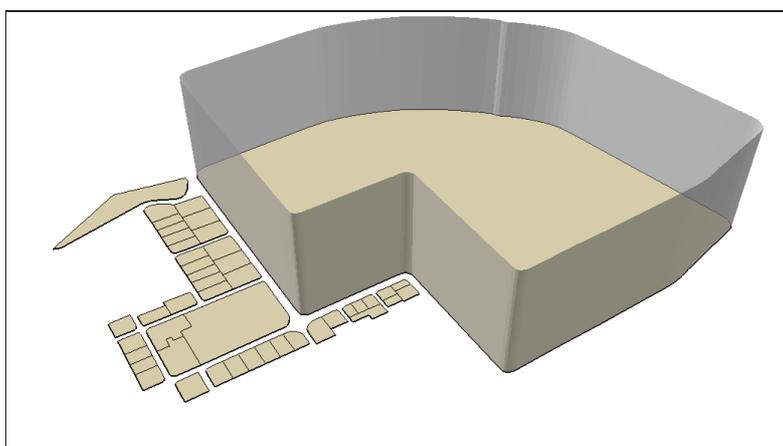
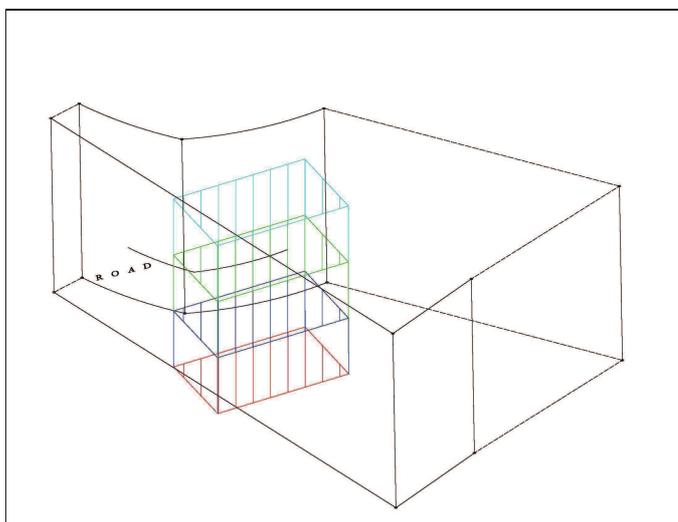


Figure 7. Parcel with 2D boundaries visualised in perspective view

Parcels with a single owner or single residence on it can be rendered in 3D with only the boundaries extruded to some fixed height and open ended at the top as shown in Figure 8. The benefit of visualising external boundaries is that encroachments can be readily observed as shown in Figure 9. This would require, though, that the precision of the cadastral index be improved to that of a cadastral map. This would be a costly exercise as land parcels are currently surveyed relative to each other with no requirement to provide absolute coordinates that would place the parcel accurately into the cadastral fabric. As it is, and as the proposed system is constructed, an apparent encroachment cannot be taken as observed but will have to be surveyed in the field to confirm whether it actually exists. The use of the 3D cadastre is still supportive to the authoritative position of the survey plan. This is similar to many countries in the world (Falzon and Williamson 2001; Van Oosterom et al, 2011; Karki et al, 2013).

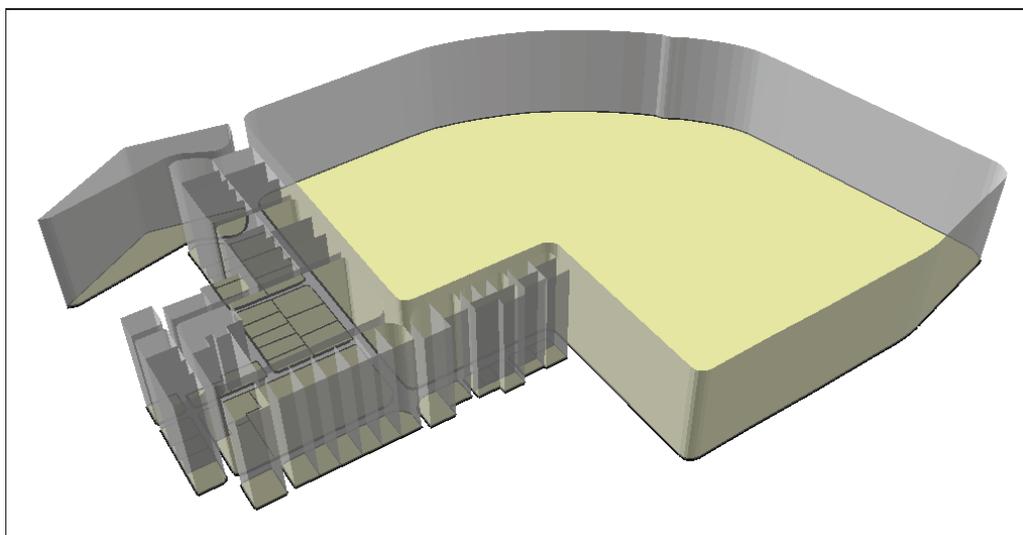


**Figure 8. Parcel with only boundaries shown in 3D**



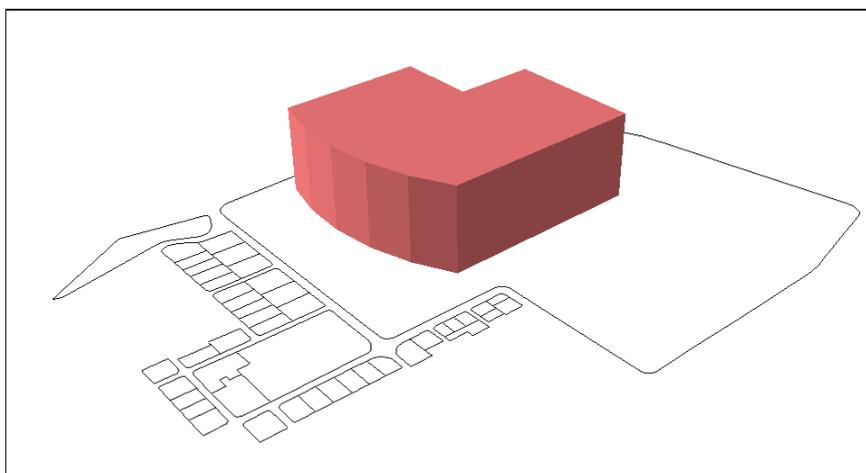
**Figure 9. Encroachment of building over boundary**

Figure 10 shows the extrusion of all contiguous parcels within a localised area.

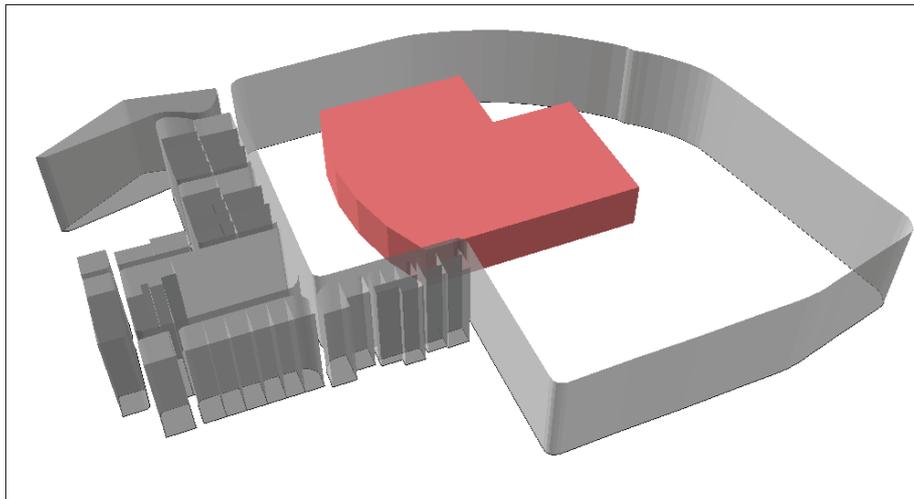


**Figure 10. Parcels shown open at the top with buildings shown for visual reference**

The building unit can be registered as an entity in cases where the interests in the building are separate to the interests in the land and where the physical structures coincide with the legal boundaries. The visualisation can be as shown in Figure 10 and Figure 11. The visualisation of the boundaries may not necessarily look the way the physical structure looks with its particular embellishments and therefore may not be recognisable by users of the database. These refinements such as windows and doors for example have no bearing on the boundaries and do not define the boundaries so should not form part of the visualisation.

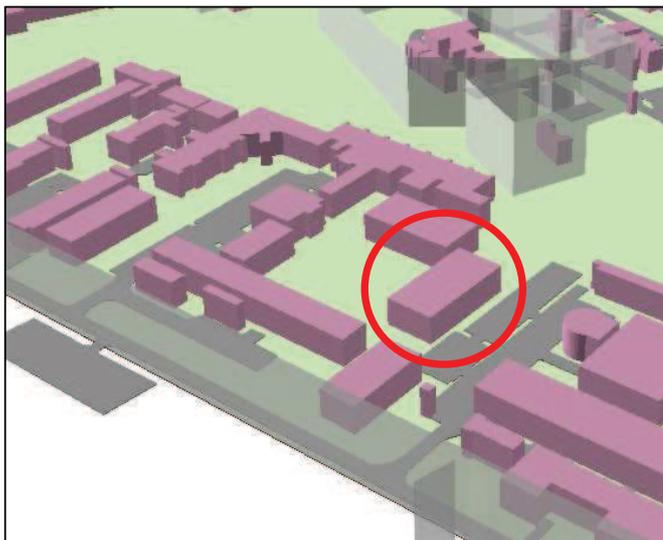


**Figure 11. Interests in the building not the same as interests in the land**



**Figure 12. Boundaries of buildings reflected by physical structures**

Figure 13 is an excerpt of the prototype that shows the individual buildings owned and occupied separately. One building is highlighted for examination in Figure 14.



**Figure 13. Excerpt showing buildings in one area**

Figure 14 shows details of the prototype system that includes the attributes to the data in the system. It is to be noted that intricate details of communal easements for utilities are not identified for display as these are thought to be too complex for survey and visualisation. In the interest of reduced cost of inclusion and maintenance in the database, these issues will remain outside of the system for the moment.

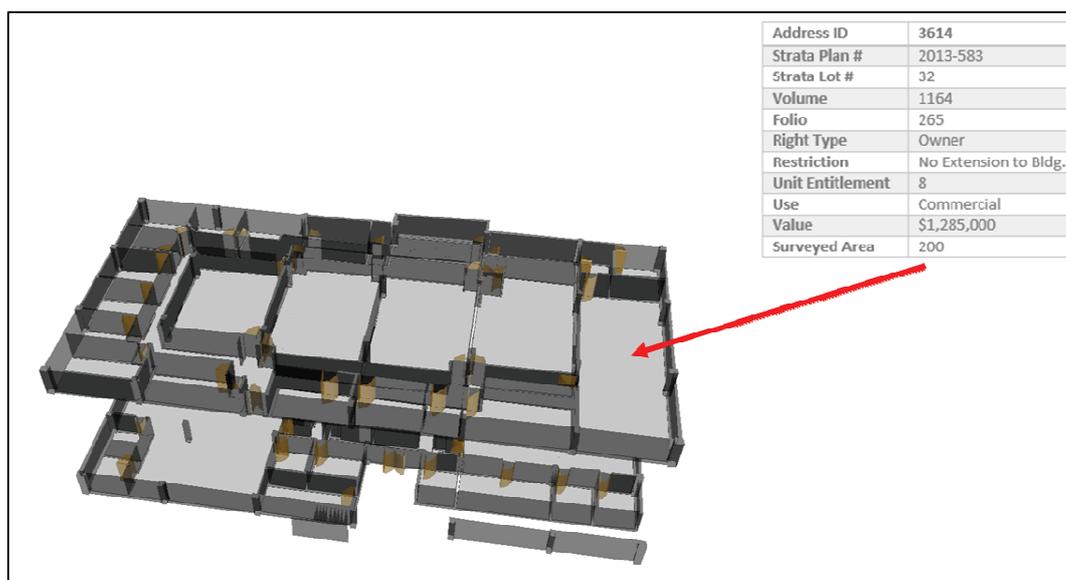


Figure 14. Prototype details of 3D cadastre

Table 1 shows the partial attribute listing and the specifications for these attributes.

Table 1. Attribute specifications for the LA\_

Attribute Name	Field Type	Width	Example	Remarks
Address ID	Integer	50	5631	Link to external address table
Strata Plan #	Text	100	2014-48	Number assigned by recording agency
Strata Lot #	Text	15	F116	Unique ID for Lot
Volume	Short Integer	5	1164	Book recording title information
Folio	Short Integer	5	465	Entry number in that book
Right Type	Text	100	Owner	Type of possession
Restriction	Text	255	No extension of apartment allowed	Restrictive covenants
Unit Entitlement	Short Integer	25	4	Undivided shares in common area
Use	Text	100	Residential	Permitted use of strata lot
Value	Double		100000.00	Valuation at time of transaction in TT\$
Surveyed Area	float		85.3	Floor Area recorded on survey plan in sq. m

## **5. ANTICIPATED CHALLENGES**

### **5.1 Resources**

It is anticipated that both financial and human resources would be very limited in the development of this 3D cadastre for an identified area of the overall cadastre in Trinidad and Tobago. Since the townhouse and condominium plans already have cross-sections included, these data can be used to populate the databases. This would minimise the new data that land surveyors would be asked to supply. Eventually, land survey rules can be adjusted to allow for submission of digital information to the specifications required such as are being developed elsewhere (Karki et al, 2013). This would reduce the amount of manipulation required and the amount of human resources required at the cadastral system.

### **5.2 Capacities**

New systems can be hampered by lack of capacities to develop and maintain the technology but also by lack of capacity to engage with the system effectively. Training of staff and the public has to be ongoing until both stakeholder groups are comfortable with adoption.

### **5.3 Legislation**

Very minor legislative changes will be required to accommodate the changes to the preparation of the cadastral plans if they are required to be submitted in digital form to provide for easier updating, and if all plans are required to give vertical measurements as well as horizontal. The cadastral index itself has no legal standing at the moment and functions as a database to collect plans and display them in relative location to each other. If it is decided to raise the index to the status of a survey plan and to have it be authoritative and definitive as to the extent of interests then this needs to be spelt out in the legislation and would necessitate adaptation by the land surveyors, and land owners. The Land Survey Board of Trinidad and Tobago has autonomy to make changes to the rules for describing boundaries on plan and the methods of acquisition of data by land surveyors. This would make it relatively simple to make amendments to the rules unless the professionals themselves protest at the increased requirements for submission of data. If the rules infringe substantially on the Land Surveyors Act or Land Surveyors Regulations, then parliamentary approval would be required for any amendments to the legislation. It is therefore suggested, because of the delays and bureaucracy that would affect adoption of the system that new rules be only small variations on what already exists.

## **6. CONCLUSION**

Despite the challenges of human and financial resources, and institutional capacities, there is justification for placing at least some of the parcels in the cadastral system in Trinidad and Tobago into a 3D LADM system. The areas to be placed into the system can be determined by the intensity of real estate activity as it is anticipated that the activity in the land market can help to fund the establishment and maintenance of the cadastral system leading to self-sustainability. Decisions must be made on the level of compliance to the LADM that is being sought. The prototype system discussed here examines some of the issues and suggests some of the solutions for the development of the system.

## REFERENCES

- Barnes, G., and C. Griffith-Charles. 2007. Assessing the Formal Land Market and Deformalization of Property in St. Lucia. *Land Use Policy*. Vol. 24:2. Pp494-501.
- Central Bank of Trinidad and Tobago. 2014. Summary Economic Indicators. Central Bank of Trinidad and Tobago.
- Falzon, K. and Williamson, I. 2001. Digital Lodgement of Cadastral Survey Data in Australia – Issues and Options. *The Australian Surveyor*. 46 (1). 62-71.
- Feder, G., Nishio, A., 1998. The benefits of land registration and titling: economic and social perspectives. *Land Use Policy* 15 (1), 25–43.
- Feder, G., Noronha, R., 1987. Land rights systems and agricultural development in Sub-Saharan Africa. *World Bank Research Observer* 2 (2), 143–169.
- Feder, G., Onchan, T., Chalamwong, Y., Hongladaron, C., 1988. Land Policies and Farm Productivity in Thailand. The Johns Hopkins University Press, Baltimore, MD.
- Gould, K., Carter, D., Shrestha, R., 2006. Extra-legal land market dynamics on a Guatemalan agricultural frontier: implications for neoliberal land policies. *Land Use Policy Journal* 23, 408–420.
- Griffith-Charles, C., 2004. The impact of land titling on land transaction activity and registration system sustainability: a case study of St. Lucia. Ph.D. Dissertation, Geomatics Program, University of Florida.
- Griffith-Charles, C. and J. Opadeyi. 2009. Anticipating the Impacts of Land Registration Programmes. *Survey Review*. Vol. 41:314. 10 pages.
- Griffith-Charles, C. 2011. The Application of the Social Tenure Domain Model (SDTM) to Family Land in Trinidad and Tobago. *Land Use Policy*. Vol. 28:3. 514-522.
- Griffith-Charles, C. and M. Sutherland. 2013. Analysing the Costs and Benefits of 3D Cadastres with Reference to Trinidad and Tobago. *Computers, Environment and Urban Systems*. Vol. 40: July 2013. 24-33, <http://dx.doi.org/10.1016/j.compenvurbsys.2012.07.002>.
- Griffith-Charles, C. and M. Sutherland. 2011. An Analysis of the Necessity for 3D Cadastres with Reference to Trinidad and Tobago. In *Proceedings of the 2<sup>nd</sup> International Workshop on 3D Cadastres*. P. Van Oosterom, E. Fendel, J. Stoter, A. Streilein (eds). The Netherlands: International Federation of Surveyors (FIG).
- Inter-American Development Bank. 2013. Request for Proposals for Upgrade of the Cadastral Management System (CMIS) of the Lands and Surveys Division, Ministry of Housing, Land and Marine Affairs, <http://idbdocs.iadb.org/wsdocs/getdocument.aspx?docnum=38017844>.

Karki, Sudarshan, Rod Thompson, and Kevin McDougall. 2013. Development of Validation Rules to Support Digital Lodgement of 3D Cadastral Plans. *Computers, Environment and Urban Systems*. Vol. 40: July 2013. 34-45

Van Oosterom, P., J. Stoter, H. Ploeger, and S Karki. 2011. World-wide inventory of the status of 3D cadastral systems in 2010 and Expectations for 2014. FIG Working Week 2011. 18-22 May 2011. Marrakech, Morocco.

World Bank. 2014. Economy Rankings. World Bank, <http://www.doingbusiness.org/rankings>.

## **BIOGRAPHICAL NOTES**

**Charisse Griffith-Charles** Cert. Ed. (UBC), MPhil. (UWI), PhD (UF), FRICS is currently lecturer in Cadastral Systems, Land Administration and Surveying in the Department of Geomatics Engineering and Land Management at the University of the West Indies, St. Augustine, where her research interests are in land registration systems, land administration, and communal tenure especially 'family land'. Dr Griffith-Charles has served as consultant and conducted research on, inter alia, projects to revise land survey legislation in Trinidad and Tobago, assess the impact and sustainability of land titling in St. Lucia, address tenure issues in regularizing informal occupants of land, and to assess the socio-economic impact of land adjudication and registration in Trinidad and Tobago, apply the STDM to the eastern Caribbean countries, and document land policy in the Caribbean. Her publications focus on land registration systems, land administration, cadastral systems, and land tenure and these have been published in *Surveying and Land Information Science*, *Computers, Environment and Urban Systems*, *Journal of Land Use Policy* and *Survey Review* amongst others.

**Earl Edwards** is a certified project management professional with both the ASAPM and IMPA and also a member of the Institute of Surveyors of Trinidad and Tobago. He obtained his BSc with first class honours from The University of the West Indies; an MPhil in GIS and Remote Sensing from the University of Cambridge; and a PhD in Geospatial Information Sciences from the University of Nottingham. Dr Edwards is currently a lecturer in Geospatial Information Sciences at UWI, with responsibility for the MSc in Geoinformatics programme, and one of the leading Enterprise GIS consultants in the Caribbean Region

## CONTACTS

Charisse Griffith-Charles  
Department of Geomatics Engineering and Land Management  
Faculty of Engineering  
The University of the West Indies, St. Augustine  
St. Augustine  
TRINIDAD AND TOBAGO  
Tel.: +868 662 2002 ext 82520  
Fax: + 868 662 2002 ext 83700  
E-mail: Charisse.Griffith-Charles@sta.uwi.edu

Earl Edwards  
Department of Geomatics Engineering and Land Management  
Faculty of Engineering  
The University of the West Indies, St. Augustine  
St. Augustine  
TRINIDAD AND TOBAGO  
Tel.: +868 662 2002 ext 83634  
Fax: + 868 662 2002 ext 83700  
E-mail: Earl.Edwards @sta.uwi.edu