

3D Land Administration System for Wilayah Sarawak based on LADM Edition II - Preliminary Works

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3D Land Administration System for Wilayah Sarawak based on LADM Edition II– Preliminary Works

**Ainn ZAMZURI, Alias ABDUL RAHMAN, Muhammad Imzan HASSAN, Malaysia and
Peter VAN OOSTEROM, Netherlands**

Keywords: ISO 19152:2012 LADM, Land Administration, Country Profile, Registration System, 3D LAS

SUMMARY

The numerous country profiles developed in compliance with ISO 19152:2012 Land Administration Domain Model (LADM) in different jurisdictions worldwide reflect the standard's growing significance and acceptance. A country profile may outline the current situation in the land administration (LA) domain and adapt the existing land administration system (LAS) into the LADM concepts, or it may indicate the requirement or desired outcome for a possible future scenario in a specific country. Previous studies show that many countries, such as Brazil, China, Croatia, Netherlands, etc., have developed their country profiles based on LADM. In the meantime, the Malaysian LADM country profile also has been developed. However, it only applied to Peninsular Malaysia (Sabah and Wilayah Sarawak are omitted) since different LA is being practiced. Currently, the Wilayah Sarawak has an integrated organization, Department of Land and Survey Sarawak, applied in the LA domain where all the departments (e.g., Land Registry, Planning, Valuation, Title Registration, Survey and Cadastral Mapping, etc.) contribute the information accordingly in that system. The Sarawak country profile is based on LADM edition II (under development), and is the first country profile reported using all parts (of the new multi-parts LADM edition II), arriving at truly integrated LA. The experience may shall be used on input to the final version of LADM edition II. The new functionality modelled, such in the 3D representation, provide path to Sarawak future. It is the aim of this paper to describe the Wilayah Sarawak country profile development based on LADM Edition II. Relevant 2D and 3D spatial and non-spatial objects of LA, including Native Customary Rights (NCR) data, are the focused of the development of the Wilayah Sarawak LADM Country Profile classes. The country profile model is developed to establish a much broader system related to the land administration of the state.

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1. INTRODUCTION

Malaysia comprises two main land masses, Peninsular and East (Sarawak and Sabah) Malaysia (Hayward, 2021). Land governance in Malaysia is highly pluralistic. In the Peninsular, the majority of the Land Administration (LA) tasks are handled by at least two institutions, namely the Malaysia Department of Survey and Mapping (DSMM) and the Land Office (LO). The DSMM handles the spatial components, whereas LO manages the land registration. The spatial components deal with cadastral information, such as the boundaries of the land parcel. Meanwhile, land registration focuses on cadastral attribute information, such as the legal rights of the properties. However, both are pretty comfortable with 2D-related data but not 3D, as Zulkifli et al. (2015) and Hassan (2017) reported. The Federal Department of Surveying and Mapping (JUPEM) carries out cadastral surveying using eKadastar. In contrast, at the state level, the land office uses eTanah to manage and administrate land (Choon et al., 2015). LASIS is the information system in Sarawak for the land cadastre and administration system. At the same time, Sabah uses LaDess as a land submission system and SALIS as an information system (Abdullah et al., 2017).

During FIG Congress 2010, Hassan M. I. & Rahman A. (2010) proposed for an integrated 3D Cadastre Registration System for Malaysia where some classes (Persons, RegisterObject, RRR) in the initial version of LADM have been adopted, and several 3D components (registration of right-volume and 3D physical object) have been implemented into the data model. 3DParcel has been introduced (to hold 3D objects) as the new class for the data model where it bounds between 2D geometry and 3D information. In 2014, Zulkifli (2014) developed a Malaysia LADM Country Profile for land administration in Malaysia where the model is feasible for Peninsular Malaysia and can be extended for Wilayah Sarawak. Since Wilayah Sarawak has integrated land administration, this paper proposes a 3D LAS for the Sarawak based on LADM Edition II (using all new multi-parts)—more elaborations at the later stage of this paper.

2. MALAYSIA LADM COUNTRY PROFILE

The Malaysian LADM Country Profile is developed using User Requirement Analysis (URA) data from DSMM and the LO. As indicated by Zulkifli et al. (2015), the URA for this country profile is produced through workshops and meetings conducted by the cadastral group and

UTM (in collaboration with TU Delft). Several ideas were gathered and addressed (e.g., 3D lot, BAUnit, strata objects, 2D topology, intermediate points, spatial source, administrative source, level, abstract class, identifier, code list, constraint in share attribute, indexing, clustering, and implicit or explicit encoding of CRS and UoM). This country profile is extended in the form of spatial and administrative parts. The LADM model's inherited classes are indicated by an italicized class name in the upper right corner of the corresponding class.

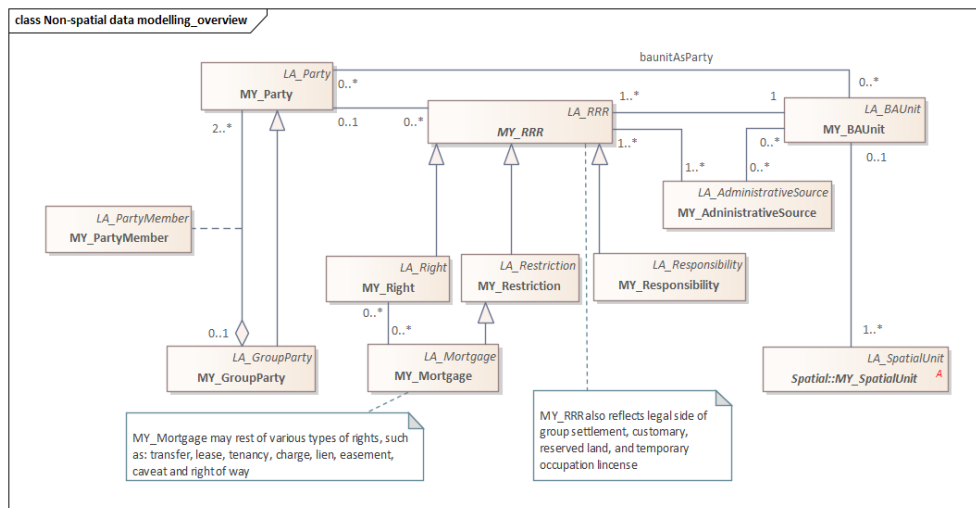


Figure 1: Overview of Malaysia LADM Country Profile (Non-Spatial Part) adopted from Zulkifli et al. (2015)

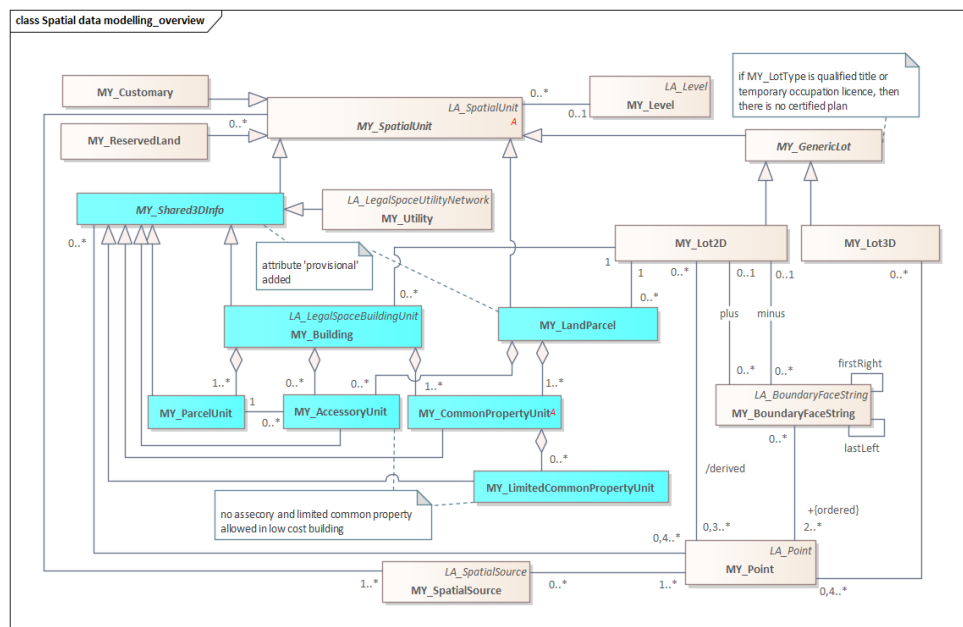


Figure 2: Overview of Malaysia LADM Country Profile (Spatial Part) adopted from Zulkifli et al. (2015)

Spatial units in Malaysia can be in 2D or 3D form. From that case, Zulkifli (2014) is introduced some abstract classes for LADM in Malaysia. The abstract classes, namely, MY_GenericLot, MY_Level, MY_SpatialUnit, MY_SpatialSource, and MY_Shared3DInfo. 'MY_' term is represent for Malaysia and used to define both administrative (see Figure 1) and spatial (see Figure 2) parts of the data model as a prefix. These abstract classes only support the modeling process and represent shared attributes.

Since LADM Country Profile for Peninsular Malaysia has been developed, thus it can be a good reference in developing country profile for Wilayah Sarawak. Any suitable classes and attributes from the Malaysia Country Profile can be adopted into Wilayah Sarawak profile. Moreover, Kalogianni et al. (2021) have presented a methodology for the development of country profiles, and this outline could offer an additional set of guidelines for the development process. Thus, investigation on current land administration in Sarawak is needed to develop a 3D LAS for the Sarawak. Further elaboration on current land administration for Wilayah Sarawak as described in Section 3.

3. PRELIMINARY WORKS ON 3D LAS FOR THE WILAYAH SARAWAK

This section elaborates the structure for Wilayah Sarawak Country Profile based on the suggested outlines from Kalogianni et al., (2021). The development of the data model is designed according to the structured characteristics as follows.

3.1 Profile scope

Sarawak has a land administration and registration system that is well-established and uniform, based on the Torrens principle as discussed by Osman S. & Kueh H. U. (2010). The administration records the fundamental aspects of parcels of land and their boundaries to provide a legal definition of a land parcel. Sarawak Land and Survey Department is responsible for surveying, land administration, planning and evaluation. They have developed an integrated land information system, known as LASIS (<https://elasis.sarawak.gov.my/>), to record land ownerships, land values, land use, and other related data for managing the land information. LASIS is an additional channel for the general public to interact with and provides several services such as land rental, land lease renewal, etc.

Land resource managers have full access to land and property information to understand the interdependencies between multiple services of land professionals. The procedure for formalizing and transferring land rights has been made simple through direct alienation of state land, the methodical adjudication and demarcation of customary rights under the land laws, and the adoption the Torrens Title System. The term "State land" refers to all land that lacks an issued document of title and any land that, following the issuance of a document of title, might have been or could be forfeited, surrendered, or reclaimed by the Government (Sarawak Land Code, 1958). This definition encompasses:

- (a) The bed of any river, stream, lake or watercourse
- (b) The foreshore and beds of the sea within the boundaries of Sarawak as extended by the Sarawak (Alteration of Boundaries) Order in council, 1954 [Vol. VI, p.1025]

Sarawak Land Code (SLC) outlines the rules and procedures for land tenure, land registration, land administration, land acquisition, and related matters. It defines the different types of land ownership, including Native Customary Right (NCR) land, which is of particular significance to indigenous communities in Sarawak. The code also governs the conversion of land for various purposes, such as agriculture, development, and conservation.

Given the diverse cultural and historical context of Sarawak, the land code addresses issues related to both native customary rights and modern land ownership practices. Over time, the land code has undergone amendments and revisions to adapt to changing circumstances and address evolving land-related concerns in the state.

3.2 Stakeholders' involvement

Currently, land administration and registration are managed by a single department namely, Land and Survey Sarawak where all the branches (Land, Survey, Valuation and Spatial Planning) are under one 'roof'. The Land and Survey Department is a leading agency in land management and land administration. Matters under its jurisdiction are land, planning, valuation, survey, and enforcement of the land laws under the land code. Details of responsibilities for each branch as described below.

3.2.1 Land Branch

The main function of this section is to process any application for land for development such as for commercial, industrial, residential, agricultural, recreational, office, institutional or any other purposes.

- (a) Carry out survey works on all land in Sarawak and register them onto the Land Register unit.
- (b) Confirm the boundaries of native's land and register for security of tenure.
- (c) Identify the boundaries of state land.
- (d) Replace Pre-Land Code titles such as various types of Occupation Tickets, Rubber Garden Certificates and Squatter's License

3.2.2 Survey Branch

This branch is responsible for processing, managing, storing, and maintaining spatial data acquired and survey related activities carried out in the state.

- (a) Providing geodetic controls in the state.
- (b) Carrying out aerial photography survey.
- (c) Compiling and producing topographic, thematic and town maps of Sarawak.
- (d) Sale of restricted and unrestricted maps of Sarawak, survey plans, aerial photographs and orthophotos.

- (e) Overseeing cadastral survey works carried out by both Government Surveyors and Licensed Land Surveyors in the state and ensuring the standard of survey work is maintained and that survey practices are in accordance with the Survey Branch technical requirements and the Land Surveyors Ordinance, 2001.
- (f) Storing and maintaining spatial data acquired by the Department.

3.2.3 Planning Branch

Planning branch is responsible for planning and controlling development in accordance with the principles of town and country planning. It also manages and monitors the implementation of Land and Survey Department development projects and give planning advice to the Government and the private sector.

- (a) Monitor and process development applications that involve land conversion, amalgamation, and land subdivision (AVTC) / subdivision / amalgamation of land)
- (b) Processing applications by government agencies
- (c) Processing applications for construction of telecommunication towers
- (d) Provide and produce various types of plans such as structure plans, local plan, service centre, kampung extension scheme, resettlement scheme, landscape plan and roading plans
- (e) Transforming 2D proposed plan into a 3D virtual reality presentation for the State Planning Authority meeting

3.2.4 Valuation Branch

Valuation Branch is responsible for managing land acquisition in accordance with the Government Development Programs. Besides that, it is responsible for assessing promptly all fees due to the Government as well as to provide professional advice to Government Agencies.

- (a) Carry out compulsory Land Acquisition
- (b) Providing Assessment of Premium and Annual Rent
- (c) Miscellaneous Valuation Services

3.3 Status of LAS

The main ethnic divisions in Wilayah Sarawak are comprised of Malay, Chinese and 'Dayaks' - the native peoples of Borneo (King et al., 2017). In Sarawak, *Iban* people represent 30% of the Dayaks (Ichikawa, 2007). The *Iban* communities acknowledge a unique bond with their ancestral lands and territories, as noted by Aiken and Leigh (2011). Nevertheless, conflicts emerge involving the communities, the government, and private market participants. The communities aim to safeguard their lands, while the private entities strive to advance extensive commercial logging and large-scale plantations, as highlighted by Cramb (2007).

The *Iban's* traditional land ownership system relies on *adat* (customary), which encompasses NCR. NCR is the rights and privileges that indigenous communities have over the lands and

resources they have traditionally used and occupied. These rights are often recognized under law or customary practices. In accordance with native beliefs, "clearing and cultivating untouched land bestows permanent rights upon the initial cultivator" (Bulan, 2008). The fundamental unit holding these rights is the household, while the "longhouse community" (see Figure 3 for longhouse in Sarawak) functions as the core land management entity within the community's borders. The *Iban's* system of governance and land tenure is structured around a community-centered approach, wherein individuals seldom exhibit free-riding tendencies. They collaborate to ensure the lasting well-being of the entire community. According to Land and Survey Department of Sarawak, the longhouses are not being mapped and registered because the longhouses can be built and demolished in anytime. Being a part of the longhouse community entitles individual households to possess general access rights to community land and resources, as observed by Aiken and Leigh (2011).

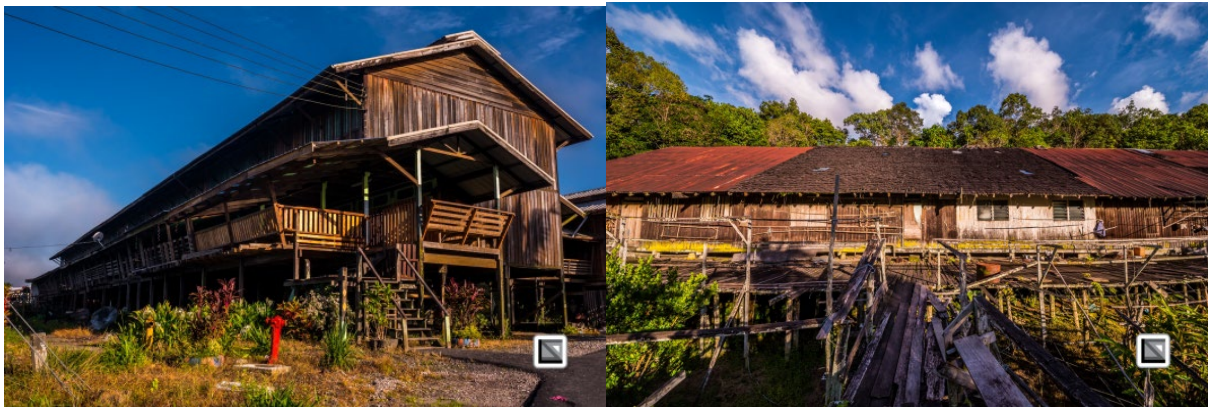


Figure 3: Example of longhouse in Sarawak [source:Malaysia-sarawak-longhouse-19 photography (2017)]

In Sarawak Land Code (SLC), Section 5 (2) appears to be crucial for native people since it integrates their cultural practices in the SLC where different methods through NCR can be acquired (see Figure 4), yet only under Interior Area Land (IAL) after obtaining a permit from a district officer.

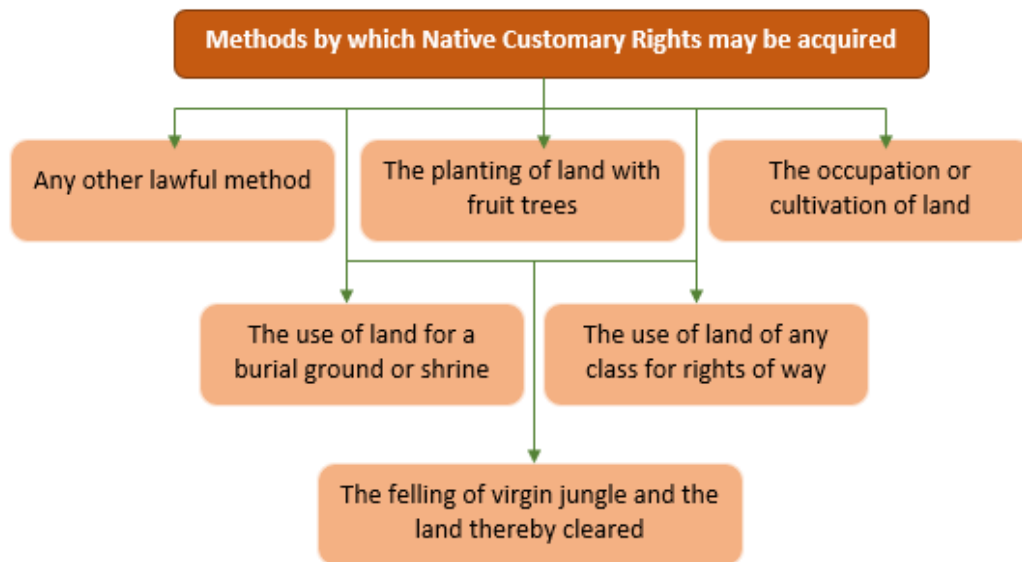


Figure 4: Methods acquired by NCR

The SLC does not fully acknowledge NCR. While the state only acknowledges farmland that was cultivated prior to January 1, 1958 as Native Customary Land (NCL). *Iban* people perceive their communal territories, village forest reserves (pulau galau), and farmland as part of their SCL territorial domain. "Pulau Galau" refers to "communal forest reserves" in the context of the indigenous communities, particularly the *Iban* people, in Sarawak, Malaysia. These are areas of land traditionally designated and preserved by these communities for various purposes, including cultural practices, resource management, and spiritual significance. "Pulau Galau" translates to "sacred forest" in the Iban language. These forest reserves are often considered crucial components of the traditional land management systems of indigenous groups. They are set aside to protect the environment, preserve biodiversity, and sustain the cultural practices and beliefs of the community. The concept of "Pulau Galau" reflects the deep connection between indigenous communities and their ancestral lands, highlighting their efforts to maintain a harmonious relationship with nature while preserving their cultural heritage.

In the light of this, the government regards any uncultivated land or virgin forests as state land, thus considering land under traditional forest-fallow practices as abandoned or undeveloped in the SLC, thereby belonging to the State.

3.4 Profile development stage

Sarawak Country Profile is developed by adopting ISO 19152 Land Administration Domain Model (LADM) edition II reflecting the current cadastral system in Sarawak Land Registry/Survey (only), not valuation and spatial planning (in detail). The current cadastral system was integrated into four departments: survey, land registry, valuation, and planning.

Hence, we attempt to develop a country profile that adaptable to all the departments. UML diagrams were created, where three core packages were applied with adaptation to local (Sarawak) needs. The modelling process is at conceptual level. In this data model, several code list values were introduced in WS_PartyType, WS_PartyRoleType, WS_TypeOfNativePeople, WS_TypeOfReservedLand, WS_TypeOfCustomaryLand, WS_TypeOfSpatialSource and etc. suit to the Sarawak cadastral system. The prefix 'WS_' is used to represents Wilayah Sarawak. All the classes were associated to suitable classes. Code lists were included in the data model.

3.4.1 Non-spatial Part (Party and Administrative Packages)

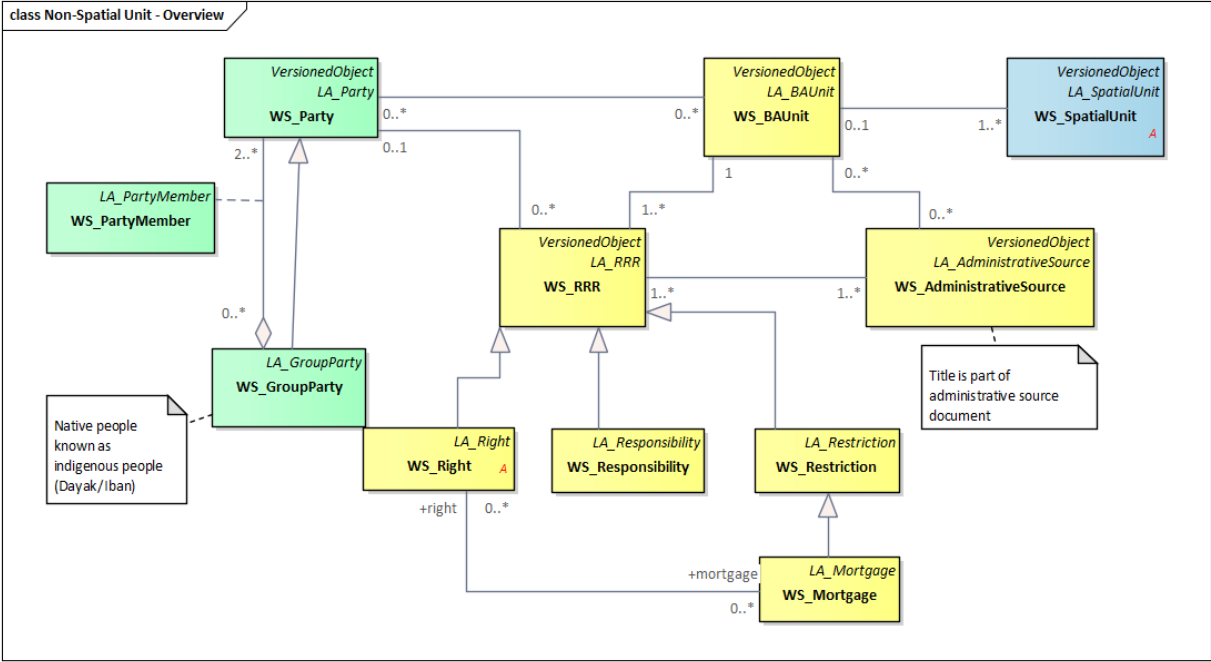


Figure 5: Overview of Non-Spatial Part of Wilayah Sarawak LADM Country Profile

Figure 5 illustrates the classes pertaining to the non-spatial unit of the Sarawak LADM Country Profile. The relationships between these classes were meticulously crafted based on their interconnections. Specifically, the WS_Party and WS_GroupParty classes were incorporated from the LADM framework. The WS_TypeOfNativePeople class is employed to denote the indigenous populations in Sarawak, including groups like *Dayak* and *Iban*. Meanwhile, WS_LandCategory is used to represent various land types found in Sarawak, and WS_TypeOfTitle is integrated as part of the administrative source documents.

WS_AdministrativeSource is associated with both WS_RRR and WS_BAUnit. In the LADM Malaysian country profile, the spatial unit is denoted by suID, whereas sID is employed for

both spatial and administrative sources. Specifically, in the Malaysian country profile, suID is derived from the Unique Parcel Identifier (UPI). The sID for spatial sources corresponds to the certified plan number, while the sID for administrative sources represents the title number. This same convention is followed in Sarawak administration, where suID is utilized, also based on the UPI, but it does not include 'mukim' information. More detailed information regarding the non-spatial aspect can be found in Appendix A.

3.4.2 Spatial Part (Spatial Unit Package)

Figure 6 shows the spatial part of the country profile. WS_SarawakLandUseType, WS_TypeOfSpatialSource, WS_TypeOfParcelUnit and WS_TypeOfValuationUnit were added into the spatial unit package. WS_SpatialUnit is generalized by WS_LegalSpaceParcel to identify the type of land use of the spatial unit is. Then, WS_GenericLot was adopted from Malaysia Country Profile where this class only supporting the modelling process, representing shared attributes and structures.

One of the important foundations of LADM is the fact that all information in the system should originate from source documents and that the association to the source document is explicitly included. In case of spatial source documents (usually certified plans) there are links with spatial unit and point tables: WS_SpatialSource has association with WS_SpatialUnit and WS_Point. Details on the spatial part can be seen in Appendix B.

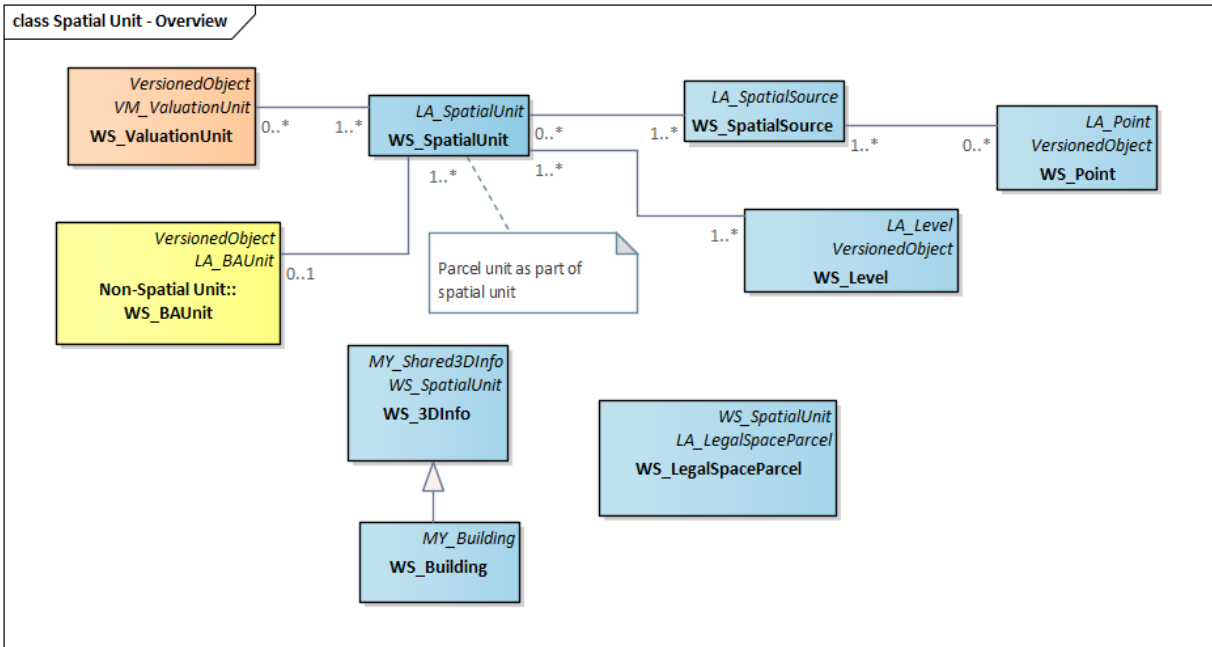


Figure 6: Overview of Spatial Unit for Wilayah Sarawak LADM Country Profile

3.4.3 Code Lists

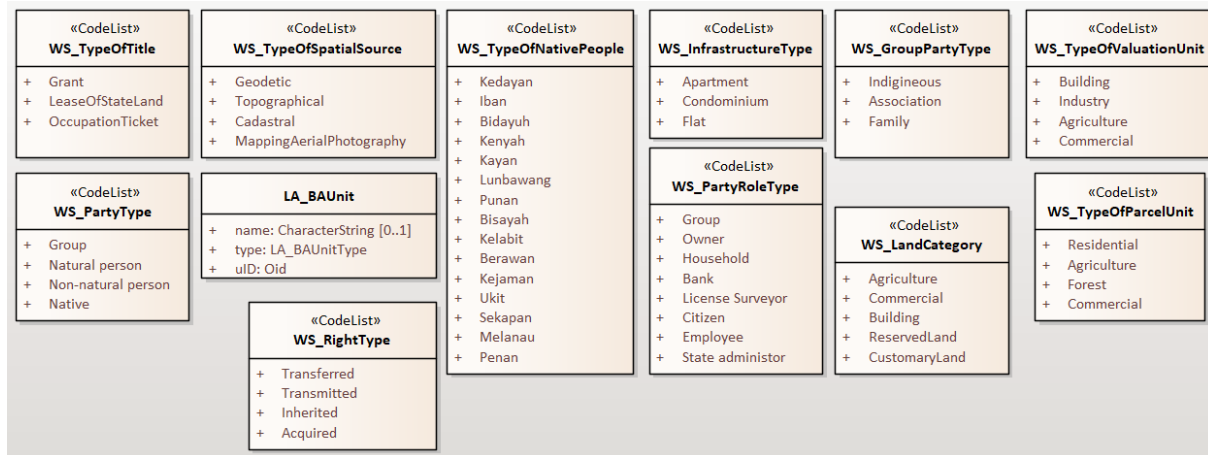


Figure 7: Code Lists of Wilayah Sarawak LADM Country Profile

Figure 7 represents some of the code lists for the Sarawak profile. Several values in these code lists have been incorporated from both the LADM and Malaysia Country Profile. Majority of the code list values were adopted, while some were introduced to align with Sarawak's administrative requirements. Notably, WS_PartyType has been expanded to include the 'native' value, which signifies the indigenous population in Sarawak. Additionally, WS_TypeOfNativePeople has been introduced to specify the various types of indigenous groups present in Sarawak.

4. CONCLUSIONS AND FUTURE WORK

The proposed Sarawak country profile is partly based on the existing spatial and administrative registration systems, and partly based on new developments inspired by the LADM standard. Based on the previous literature and the preliminary result, we believe there are good potentials to adopt LADM Edition II into Sarawak 3D LAS. Many countries have developed their country profiles, including Malaysia. Even though Malaysia has proposed and developed a country profile based on LADM, the developed data model can be extended for Sarawak LA. NCR is an official terminology utilized by the Sarawak legal systems. There is a difference in legal standing between Sarawak with Peninsular Malaysia where all the related branches (Land, Survey, Planning and Valuation) located under 'one roof' department – quite unique situation to be investigated for the LADM Edition II.

Hence, in this paper, we developed a country profile based on LADM Edition II for the Wilayah Sarawak. To be noted, the country profile still needs improvements especially in the aspect of 3D LAS with the relevant parts (part 4 – valuation and part 5 – spatial planning). It

is part of this project to get more relevant information and data from the stakeholders. This is also can be example to the other states or countries with the similar situations.

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BIOGRAPHICAL NOTES

Ainn Zamzuri is a researcher at the Department of Geoinformation, Faculty of Built and Environment, Universiti Teknologi Malaysia (UTM), Skudai, Johor, Malaysia. She received a degree in Geoinformatics from UTM in 2019 and finished her MsC in Geoinformatics in 2022 also in UTM. She is currently working on her PhD research concerning The Malaysian LADM Country Profile with Building Information Model (BIM) and Valuation Information for 3D Strata Building.

Alias Abdul Rahman is a professor at the Department of Geoinformation, Faculty of Geoinformation and Real Estate, Universiti Teknologi Malaysia (UTM), Skudai, Johor in Malaysia. He received a degree in Surveying and Mapping Sciences from North East London Polytechnic, England, UK in 1987, Postgrad Diploma in GIS from ITC, Netherlands, and MSc in GIS also from ITC, Netherlands. In 2000, he received his PhD degree from University of Glasgow, Scotland, U.K. He currently leads the 3D GIS research group in the faculty.

Muhammad Imzan Hassan obtained an MSc degree from ITC, Netherlands and a BSc degree in Geoinformatics from Universiti Teknologi Malaysia (UTM). He received his PhD in UTM in 2017. Currently a staff and member of 3D GIS group of the Faculty of Built Environment and Surveying at the UTM, Malaysia. His profession are 3D cadastre, data modeling, spatial database and etc.

Peter van Oosterom received the M.Sc. degree in technical computer science from the Delft University of Technology, The Netherlands, in 1985, and the Ph.D. degree from Leiden University, in 1990. From 1985 to 1995, he worked with the TNO-FEL Laboratory, The Hague. From 1995 to 2000, he was a Senior Information Manager with the Dutch Cadastre, where he was involved in the renewal of the Cadastral (Geographic) database. Since 2000, he has been a Professor with the Delft University of Technology and the Head of the Section 'GIS Technology.'

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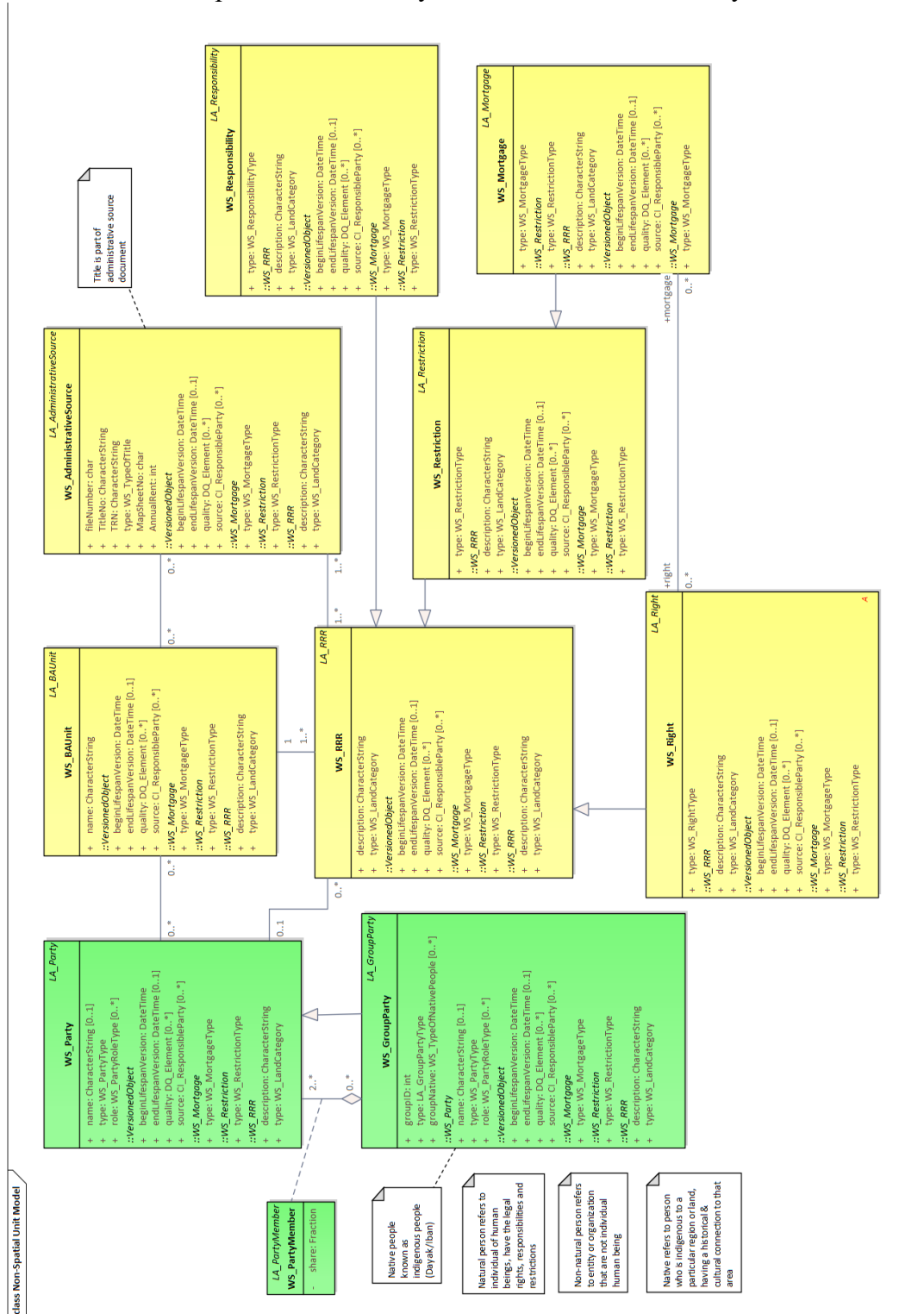
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APPENDIX A – Non-Spatial Part of Wilayah Sarawak LADM Country Profile



APPENDIX B – Spatial Part of Wilayah Sarawak LADM Country Profile

