Expanding the Sarawak LADM Country Profile with Valuation Information – Towards a Unified Land Administration Model

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Key words: Sarawak Country Profile, Land Administration Domain Model (LADM), LADM Part 4 – Valuation Information

SUMMARY

In striving to modernize Sarawak's land administration system, this paper aims to bridge persistent gaps between legal, spatial, and valuation information by expanding the state's LADM Country Profile to include comprehensive valuation data. Current fragmented systems lead to inefficiencies including outdated property assessments, especially for complex, mixed-use developments such as strata properties in rapidly urbanizing cities like Kuching. By leveraging the updated LADM Edition II standard alongside Building Information Modelling (BIM), this study proposes a unified data model which aligns legal rights, spatial units, and valuation attributes within a single digital framework. Through data collection, conceptual modeling, and stakeholder validation with Sarawak's land administration authorities, the paper demonstrates how this integrated approach could enhance transparency and improve sustainable urban development.

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1. INTRODUCTION

Effective land administration (LA) is crucial for sustainable development, urban planning, and fair property taxation. However, fragmented systems and inconsistent integration of legal, spatial, and valuation data often reduce the efficiency and transparency of land governance, as reported by Williamson et al. (2010). For instance, the absence of a unified framework often results in data redundancy, inconsistent data standards, and missed opportunities to leverage spatial technologies for effective decision-making. Fragmented and inefficient LA systems might lead to delays and inconsistent property valuations. For example, outdated property assessments in the Philippines have constrained urban planning and governance effectiveness. Multiple and overlapping valuation systems resulted in inconsistent property values for the same asset depending on the purposes (e.g., taxation and housing) as reported by Alvina et al. (2023). Meanwhile in Turkiye, Kara et al., (2021) and Şimşek et al., (2021) address difficulties in assigning share values in strata context. The process of recording input and output valuation data needs to be implemented for assessing changes in values transaction and exchanging information.

Those challenges highlight the urgency of integrating spatial, legal, and valuation data into unified frameworks to ensure transparency and efficiency in property taxation and land governance. Valuation information plays a critical role in LA by providing the basis for property taxation, enabling market transparency, and supporting urban planning initiatives. However, the complexity of modern properties, such as mixed-use developments including strata units, poses challenges in ensuring accurate and fair assessments. Without a framework that effectively integrates valuation attributes with spatial and legal data, these challenges can lead to inefficiencies and inequities in property governance (Kara et al. 2023).

In order to integrate valuation information with spatial and legal datasets, leveraging international standards like the Land Administration Domain Model (LADM) is inevitable. The recently updated LADM Edition II provides a comprehensive framework for such integration, offering a pathway toward unified, digital LA systems (Oosterom et al. 2019). Kara et al., (2020) also mentioned that three-dimensional (3D) information can be used to better estimate and explain values of property units. Valuable information can be extracted from the 3D models and 3D datasets such as property characteristics (e.g., space area and type of zones). 3D BIM data also suggested to be applied to determine the purpose of valuation and properties' quality (Radulović et al., 2023). A comprehensive conceptual model enables better organization of the available and updated data in the databases (Sladić, D. et al., 2023). Thus, by considering all those recommendations for Sarawak aligns with its aspirations for transparent governance, equitable taxation, and sustainable development. Establishing a unified framework presents a valuable opportunity to enhance the integration of legal, spatial,

and valuation data. It could improve the state's ability to manage property valuations more efficiently, especially for mixed-use developments including strata properties in growing urban areas like Kuching city in Sarawak which is part of the Malaysia country. This would help ensure fairer valuations, consistent tax assessments, and stronger support for revenue collection and urban planning initiatives.

Thus, this study attempts to integrate valuation information into Sarawak LADM country profile. By leveraging Building Information Modelling (BIM) and spatial technologies, this approach aims to align legal, spatial, and valuation datasets, facilitating accurate property valuations and streamlined governance processes. This research involves exploring the status of valuation information in Sarawak's land and property administration, developing a unified framework that integrates valuation information with legal and spatial datasets, and validating the framework by engaging with stakeholders (e.g., Department of Land and Survey Sarawak) to facilitate their needs and expectations as illustrated in **Erro! Fonte de referência não encontrada.**. The integration of these components within a unified framework offers a pathway to enhance property taxation fairness and support sustainable urban development in the state. Section 2 elaborates the status of valuation in Sarawak and other countries (e.g., Turkiye, Croatia, and Cyprus). Section 3 discusses on research methodology such as framework used to expand the country profile, the integrated classes and relevant code lists. Lastly, Section 4 concludes the research and suggests some future works.

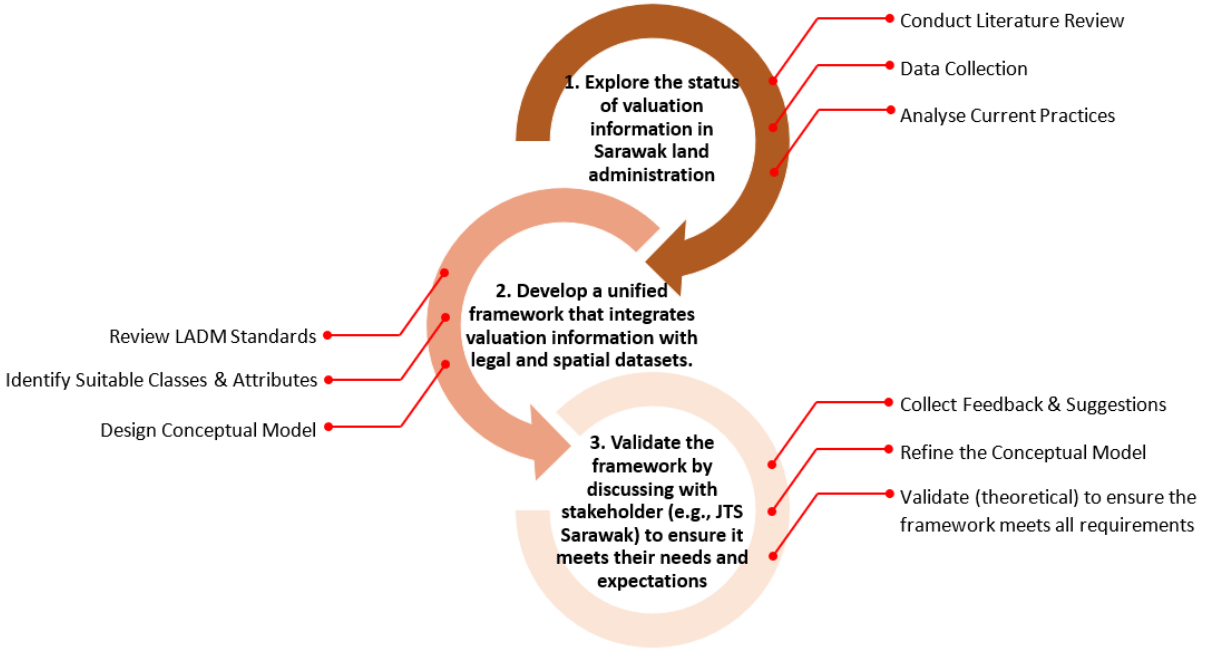

Figure 1. The flowchart

2. STATUS OF VALUATION IN SARAWAK AND OTHER COUNTRIES

This section describes the status of valuation in Sarawak and other countries including Peninsular Malaysia. Sarawak also part of Malaysia (seeFigure 2), however, they follow their own regulations and guidelines for LA. The regulations and guidelines will be discussed further in the sub-sections.

2.1 Peninsular Malaysia

Valuation plays a crucial role in Malaysia's LA system as it supports various aspects such as property taxation, land acquisition, stamp duty assessments including estate administration. In Peninsular Malaysia, valuation activities are handled by the Valuation and Property Services Department (*Jabatan Penilaian dan Perkhidmatan Harta, JPPH*), which operates under the Ministry of Finance Malaysia. JPPH is responsible for managing valuations for federal and state governments, local authorities, and statutory bodies (e.g., Securities Commission Malaysia, Malaysian Industrial Development Authority) (Valuation and Property Services Department, accessed July 2025). Statutory bodies in Malaysia are government-created entities established by Parliament, which outlines their powers, functions, and responsibilities. They are considered as public authorities or agencies of the Malaysian government by providing service like managing investments. However, they are not part of the core structure of government ministries or departments, though they may be supervised by a relevant ministry. One of the JPPH's responsibilities is providing technical advice on valuation of strata properties for assessment rates which is carried out by local authorities. Strata properties such as apartments, condominiums, and office towers present valuation challenges due to their multi-level structure, shared common areas, and layered ownership. Each parcel within a strata scheme is valued based on factors such as floor area, floor level, location, market condition, and building facilities. The Strata Titles Act 1985 (Act 318) and the Strata Management Act 2013 (Act 757) provide the legal basis for strata title registration and management, which includes maintaining updated records of individual units for taxation and management corporation purposes.

2.2 Sarawak State

Meanwhile, in Sarawak, the valuation of strata properties falls under the *Jabatan Perkhidmatan Penilaian dan Harta Sarawak* (JPPHS) in collaboration with local councils and the Sarawak Land and Survey Department (JTS). Even though Sarawak is part of Malaysia, it has own regulation namely, Strata (Subsidiary Titles) Ordinance 2019 for the sub-divided building(s) or land(s). Sarawak located at Borneo Island (see Figure 2) bordered by Sabah to the northeast and Kalimantan (Indonesia) to the south with area covered approximately 124,450 km² similar in size to Peninsular Malaysia (Liang et al., 2019).

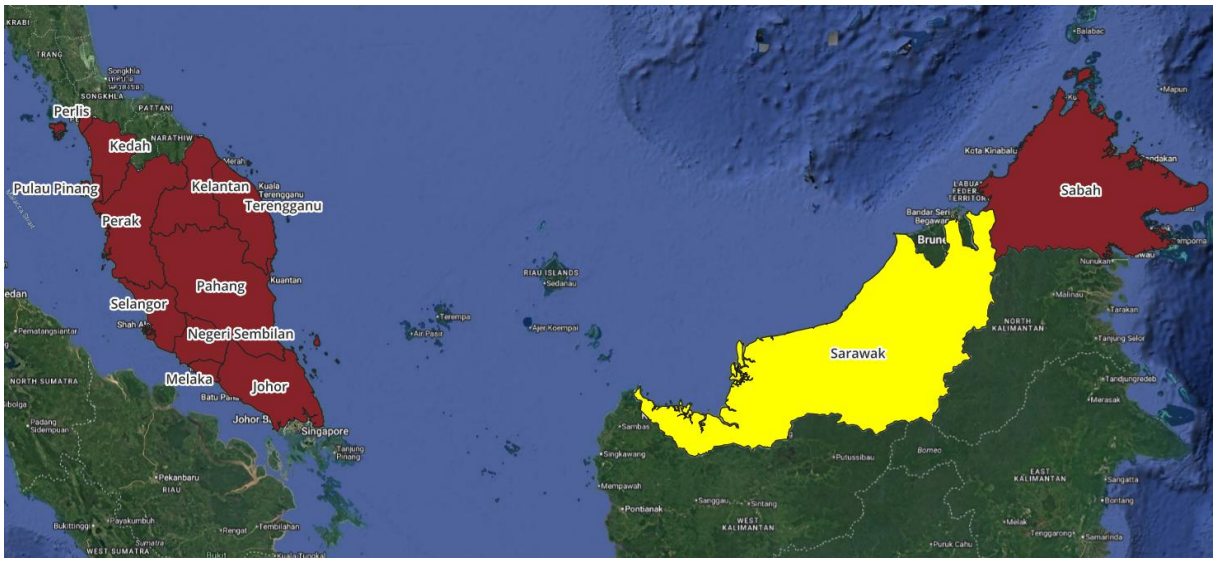

Figure 2. Sarawak's location (highlighted in yellow) (retrieved from Google Earth Pro)

According to Department of Statistics Malaysia, total population of Sarawak is approximately 2.5 million as updated on 17 October 2024. The population density remains parse – reflecting broad tracts of rural and forest areas. There were 770, 885 land title deeds registered across Sarawak – covering approximately 2,470,381ha (6.1 million acres) across all districts as updated on December 31, 2024, by Land and Survey Department Sarawak. Around 66,818 residential units including 376 apartment buildings, 12,274 shophouse units and 307 commercial mall units approved in subdivision and building plan applications, and the state has recorded over 950,000 land parcels within its cadastral system, managed by LASIS – Sarawak's integrated Land and Survey Information System (Land and Survey Department Sarawak). Sarawak uses a Torrens title system, ensuring land title security, and integrates land survey, registration, planning, valuation, and zoning under the Sarawak Land Code (1958) and state legislation, administered solely by the Sarawak Land and Survey Department (Zamzuri et al., 2023). The LASIS, initiated in 1984 and fully operational by 2010, supporting - surveying data (electronic field book, cadastral mapping), title and strata title registration and valuation, including revenue collection, and aerial photograph integration. This system was implemented in two (2) phases where the components of LASIS Phase 1 are Survey Computation System, Cadastral Mapping System, Title Registration System and Revenue System. Meanwhile, LASIS Phase 2 accommodates Valuation Information System, Planning Information System, Land Administration & Adjudication System and Aerial Photograph Information System. In this case, valuation information system provides facilities to process land acquisition and valuation of landed properties. It also maintains a database for land acquired for public purposes and property market transactions (Chong, 2025). LASIS is divided into mLASIS (LASIS interface with public on mobile platform) and eLASIS (LASIS interface with public on web platform). eLASIS is provided by JTS Sarawak as an additional channel for the public to interact with and go through its services. Almost all the services in eLASIS are provided for free, for instance land rent and premium enquiry; however, some

services have nominal fees. People can easily sign up for experiences of the services as shown in Figure 3 (eLASIS) and Figure 4 (mLASIS).

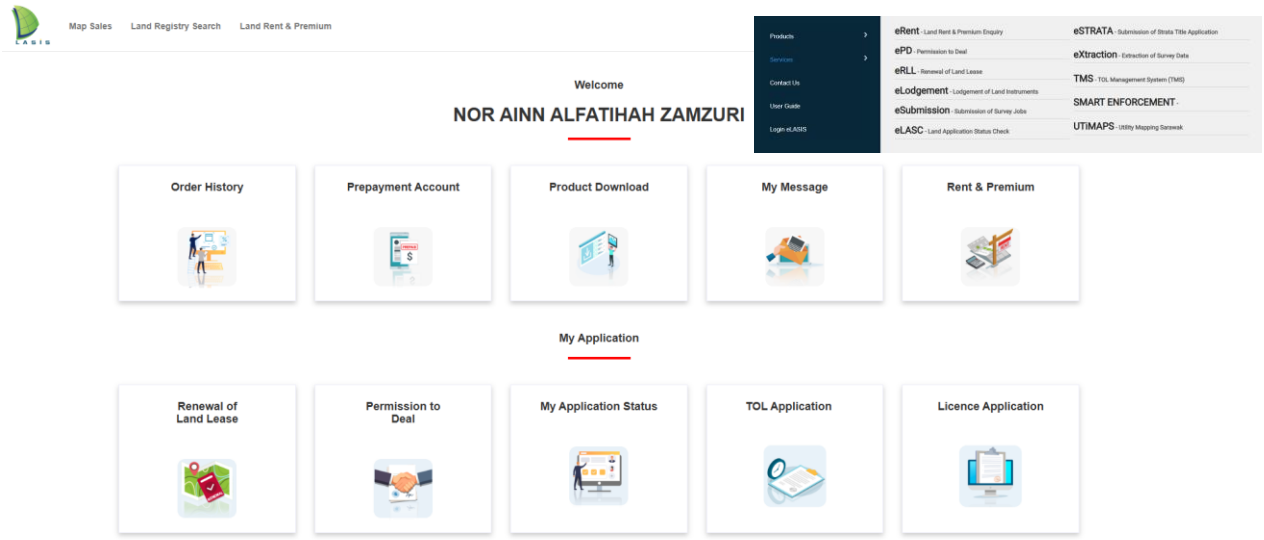

Figure 3. Available services within eLASIS environment

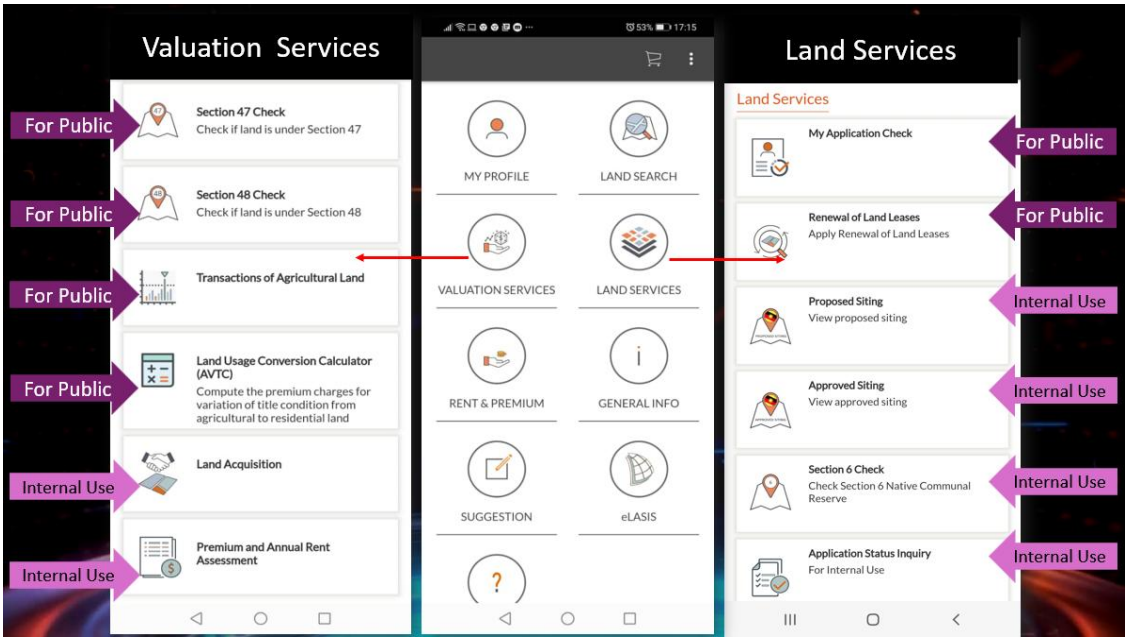

Figure 4. Part of available services within mLASIS environment

JTS Sarawak is a Government Agency under the Ministry of Urban Development and Natural Resoures where the only agency that has four (4) major diciplines of LA and management under one roof in line with the global LA persperctives (Zamzuri, et al. 2023). Figure 5 represents the connection between the LA's perspectives based on Williamson et al. (2010) with Sarawak's LA. All the branches (Land, Survey, Planning including Valuation) are

administered by four (4) Assistant Directors. For the Valuation Branch, they are responsible in ensuring land required for implementation of government development projects are made available timely. They also responsible in providing Assesment of Premium and Annual Rent for;

- Application for Variation of Title Condition (AVTC)
- Direct Alienation
- Renewal of Land Leases (RLL)
- Annual Rent

Meanwhile, mischellaneous valuation services as follow;

- Rental Assesment
- Assessment for Student Loan Purposes
- Assessment of Fee Payable for Temporary Occupation License (TOL)
- Auction by the High Court

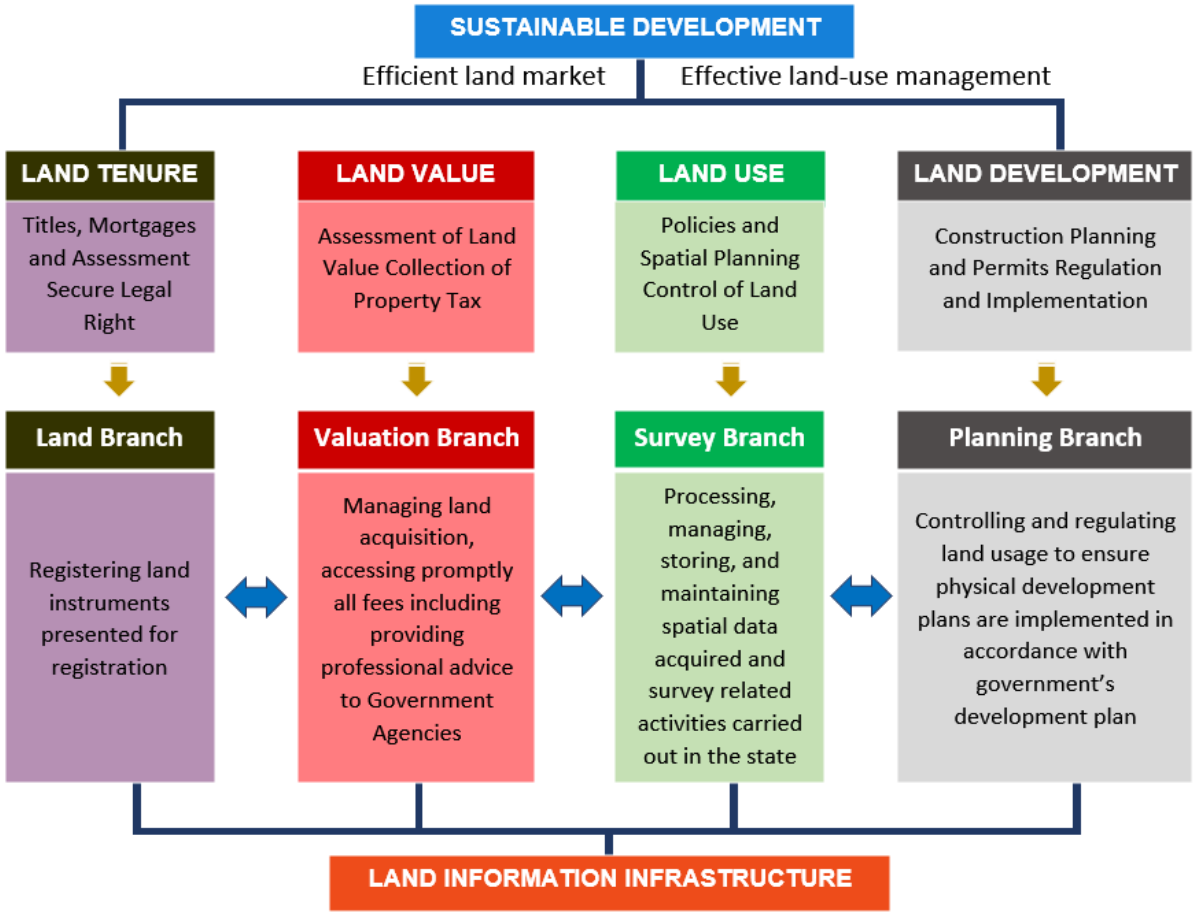

Figure 5. Four major disciplines of land administration and management under one roof in line with the global land administration perspective (adapted from Williamson et al., 2010; Department of Land and Survey Sarawak, accessed and revised July 2025)

LASIS is already a unified and centralized system where this established framework provides a solid foundation for the development of the new data model. It offers:

- property valuation services (for stamp duty, land acquisition, government housing loans, rental and taxation assessments)
- valuation requests and submissions (applicants can request valuations online)
- transaction data recording (market prices of properties are captured and stored)
- valuation reports (report are issued by government valuers and stored in the system as official records)
- integration with land ownership data (each valuation case is tied to a land title or building unit)

However, the current system could be enhanced via aligning LADM and Valuation Information Model. Currently, valuation is often tied directly to titles or parcels. Through this improvement, valuation unit (VM_ValuationUnit) can be introduced to represent not only land parcels but also strata units, condominium units or building parts. Next, the current valuation reports include details like building age, floor area, use type – but these information stored mostly as text or PDF, not structured attributes. This unified data model would offer a standardized form in storing the attributes (e.g., buildingUseType, floorCount) linked to the code lists (aligned with Sarawak Land Code and local valuation practices). The current system also has persistent gaps between legal, spatial and valuation information in 3D view. This leads to inconsistencies and efficiencies, particularly for complex properties like strata units. The current system, which integrates land, survey, planning and valuation under one department serves as a starting point for the proposed unified model. Therefore, a more advanced data model is required to fully bridge the data gaps and modernize the valuation process. The data model development also referring to the previous related studies (see Section 2.3) for better mapping.

2.3 LADM based valuation information in other countries

Nowadays, many countries are moving towards 3D land administration for better administration by linking three essential components – People, Space and Rights/Restrictions/Responsibilities (RRRs) such as countries like Argentina – developing 3D parcel and property concept and adopting LADM in academia; Australia Queensland – 3D ePlan submission; Czech Republic – data source for 3D data (use of BIM for cadastral purposes); Hungary – surveying guidelines and standards from 3D legal spaces, issues and visualization; Netherlands – future 3D system with fully compliant with LADM ISO standard; Poland – legal definition of 3D cadastral objects; Singapore – legislations related to the vertical dimension; Sweden – 3D ownership apartment in existing tenancy apartments issue including Turkiye – towards 3D data availability and cadastral data quality (Shnaidman, et al., 2019). Despite 3D approach, some countries (e.g., Turkiye, Croatia, Serbia, Cyprus and Mongolia) are adopting valuation information for their land administration. Valuation information is introduced as ISO 19152-4:2025 standard (Part 4: Valuation Information), published in July 2025, establishing a unified conceptual schema for valuation, transaction

prices, mass valuation, and valuation units including buildings and parcels (International Organization for Standardization, 2025).

2.3.1 Turkiye

In Turkiye, a working group under FIG Commissions 7 & 9 developed a Turkish LADM Valuation Information Model country profile, covering admin or legal parties, valuation units (with two different valuation objects – improved property (land and condominium) and unimproved property (rural and urban parcel)), procedures, tax categories (land and building taxes that are levied according to the tax value of properties) and code-lists using UML diagrams based on LADM Part IV concepts (Kara et al., 2018b). They implemented Enterprise Architect (EA) and INTERLIS as tools to translate the conceptual to technical model. All the classes, code lists, attributes, relations, as well as, constraints were implemented in ORACLE 11g via SQL DLLs (Kara et al., 2018a). The developed data model encompasses several components namely;

- Valuation Units – defined as parcels, building, or combined units with valuation linkage
- Property Attributes – permanent characteristics, legal status, usage and valuation parameters
- Administrative Actors – parties involved in valuation (e.g., curators, owners, assessors)
- Process Entities – valuation requests, procedures, values, and mass appraisal workflows

The data model as illustrated in the report of Kara et al., (2021) links cadastral parcel and legal property objects with valuation data. This enables transactional data, price histories, valuation outcomes, and mass appraisal metrics to be integrated into existing land administration systems.

2.3.2 Croatia

In Croatia, the LADM Valuation Information is modeled together with Spatial Planning Information package to validate if the existing national datasets could support a prototype valuation system. In this country, property data is spread across several key registers, such as cadastre, land book, tax administration and physical planning system. Tomic et al., (2021) confirmed that the most valuation attributes, such as land use, location, and building details already exist in official registers, though some important indicators especially for building were missing. By using UML diagram, they modelled how valuation classes can connect with cadastral and fiscal information, confirming that the LADM extensions are suitable for implementation. Drawing from this, the Sarawak LADM profile can adopt a similar approach by linking valuation classes to cadastral, building, and fiscal registers, while addressing local gaps through extensions and tailored code lists.

2.3.3 Cyprus

A case study in Cyprus is one of the useful references for the Sarawak profile where the authors, Demetriades et al., (2023) investigated on how to integrate BIM and LADM specifically within the property valuation context. The study uses two-step approaches where the current general valuation model in Cyprus been analyzed and extended for more advanced model based on Part 4 – Valuation Information. The model retains the essential features based on the existing system and added new attributes to better serve the country's needs. It shows how BIM can be integrated to create precise 3D property registrations, leading to a more realistic assessment of a property's value. By refering Ozughan et al., (2022), the integration of valuation information based on LADM into the IFC is accomplished by storing the relevant information within the IFC elements (IfcSpaces, IfcZones and IfcSite). IfcZone adopted CY_VM_CondominiumUnit and CY_VM_ValuationUnit; IfcSite adopted CY_VM_SpatialUnit and CY_VM_ValuationUnit; IfcSite adopted CY_VM_Building. Prefix 'CY_' indicates Cyprus. The full data model can be referred through the publication, Demetriades et al., (2023).

3. DEVELOPMENT OF A UNIFIED FRAMEWORK – LEGAL, SPATIAL AND VALUATION

Development of the unified Sarawak LADM country profile required on valuation information integration into the existing core land administration structure. The conceptual schema being designed and developed by accommodating the requirements of Sarawak property valuation practices together with others pertinent LADM-based classes.

3.1 Valuation Package Development

The valuation package (see Figure 6) was designed as the foundation of integrating valuation information into the Sarawak LADM country profile. WS_VM_Valuation class records valuation events, capturing attributes such as date and type of valuation, purpose, assessed value including status. This class is connecting to other classes such as WS_VM_ValuationUnit, WS_VM_Building, WS_VM_SpatialUnit, WS_VM_ValuationSource, and WS_VM_TransactionPrice, providing a comprehensive framework that aligns both legal and physical of property valuation. The WS_VM_ValuationUnit is associated to zero or more [0..*] instances of spatial unit. A valuation unit may be;

- only land parcel
- only building
- land parcel(s) with or without building(s) together as land property
- condominium unit consisting of building part(s) (e.g., condominium main part, accessory part, joint access facility) and share in land parcel(s)

Meanwhile, WS_VM_SpatialUnit represents land parcel(s) such as cadastral parcel and sub-parcel that are subject to valuation. Spatial unit may have a building as a complementary part of parcel where its characteristics (e.g., date of construction and use type) been represented by WS_VM_Building. A spatial unit may have zero or more [0..*] buildings. A building may represent a condominium building which consists of;

- condominium units (e.g. apartments, shops)
- accessory parts assigned for exclusive use (e.g. garages, storage areas, staircases)
- joint facilities covering parcel, structural components (e.g. foundations, roofs)
- accession areas (e.g. entrance halls, spaces)

These attributes are represented by WS_VM_CondominiumUnit to indicate the individuals use or shares. This class associated to the WS_VM_ValuationUnit where it serves as the medium for linking valuation activities to real-world. Meanwhile, VM_ValuationSource records the origin of valuation data – such as valuation reports or declarations – while VM_TransactionPrice captures transactional information including type of transaction, date of contract, and agreed price. Together, these elements bridge valuation records with administrative and market-based evidence.

The valuation package also incorporates set of code lists (Figure 7**Erro! Fonte de referência não encontrada.**). Examples include VM_BuildingAndCondominiumUseType (residential, agricultural, industrial, office, etc.), VM_ConstructionMaterialType (concrete, steel, timber, etc.), VM_ValuationApproach (cost, income, sales comparison), and VM_StatusOfAppeal (accepted, rejected, in decision). Locally relevant extensions such as WS_ValuationPurposeType reflect Sarawak-specific requirements, covering purposes like stamp duty, government housing loans, land acquisition, rental, and taxation. The use of standardized code lists facilitates interoperability across jurisdictions while also ensuring compliance with local valuation practices.

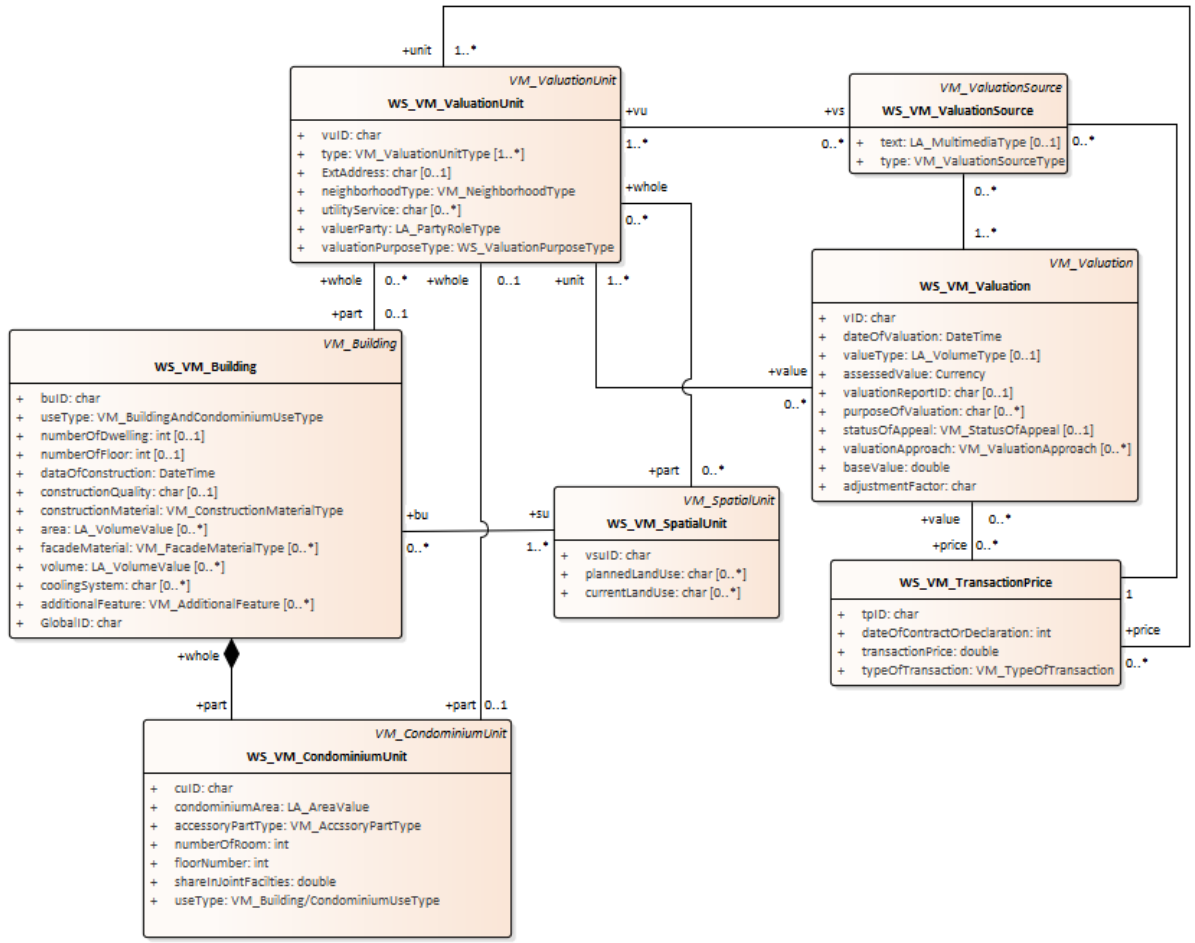

Figure 6. Conceptual data model of valuation information for Sarawak

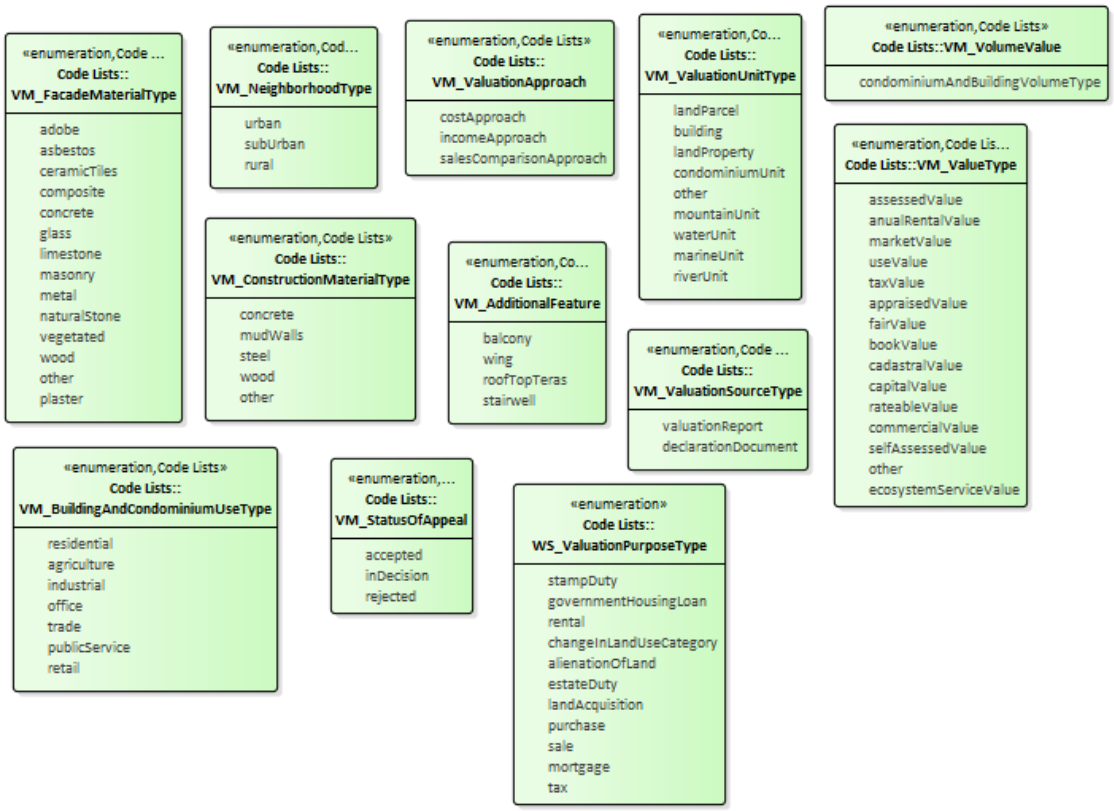

Figure 7. Code Lists for Sarawak Valuation Package

3.2 Integration with Sarawak LADM Profile

The development of the Sarawak LADM Country Profile towards a unified model required the incorporation of valuation information into the existing core land administration structure. The conceptual schema (Appendix A) illustrates the integration of valuation classes with the Sarawak-specific LADM extensions, ensuring consistency with LADM Edition II while accommodating the requirements of property valuation processes mandated under Sarawak's land administration and valuation practices.

The mapping concept between the Sarawak profile and the valuation domain was realized through the use of linked classes and shared attributes. For example, WS_BAUnit and WS_LegalSpaceBuildingUnit were connected to VM_ValuationUnit, allowing each legal or physical building unit in Sarawak's strata and cadastral system to be uniquely associated with its corresponding valuation record. Likewise, VM_Building was linked with WS_BuildingElement, enabling construction characteristics (e.g., number of floors, construction material, gross floor area) to be embedded directly into valuation workflows. The model also introduces Sarawak-specific extensions in line with jurisdictional requirements. These include classes such as WS_BuildingElement, WS_LegalSpaceBuildingUnit, and WS_AdministrativeSource, which contextualize LADM concepts to Sarawak's cadastral and building registration practices. Through these extensions, valuation information can be anchored to authoritative sources (e.g., title documents, administrative extracts) while

maintaining alignment with BIM-derived data such as IfcBuildingStorey, IfcSpace, and IfcPropertySet. This package thus forms the valuation core of the Sarawak Country Profile. It provides a structured framework for capturing the physical, legal, transactional, and administrative aspects of valuation. Importantly, its design enables seamless mapping with other LADM classes (e.g., LA_Party, LA_BAUnit, LA_SpatialUnit) and with BIM-derived building attributes.

Bringing these components together, the final integrated model (Appendix A) demonstrates how valuation classes interoperate with Sarawak's legal and spatial core profile. Rights, restrictions, and responsibilities – reflected through WS_RightType, WS_RestrictionType, and WS_ResponsibilityType – are preserved within the model while valuation extensions broaden the profile to include economic and market dimensions. This unification ensures that cadastral, physical, and valuation information coexist within a single schema. Overall, the integration of valuation information into the Sarawak LADM Country Profile strengthens the model's ability to support both land administration functions and property valuation workflows in a unified environment. By bridging BIM-derived physical attributes, legal cadastral entities, and valuation records, the extended profile provides a comprehensive representation of land and building assets in Sarawak. This integrated approach not only ensures compliance with ISO 19152:2012 Edition II but also lays the foundation for advanced applications such as 3D strata valuation, automated data exchange with valuation authorities, and visualization in 3D geospatial platforms.

4. CONCLUSION AND FUTURE WORK

To conclude, the development of a unified data model strengthens the system's ability to support both land administration functions and property valuation workflows. By bridging BIM-derived physical attributes, legal cadastral entities, and valuation records, the extended profile provides a comprehensive representation of land and building assets in Sarawak. The study successfully demonstrates how valuation classes can be interoperated into Sarawak's legal and spatial core profile. This unification ensures that cadastral, physical, and valuation information can coexist within a single schema. The previous discussions on LASIS shows that, the proposed model clearly aligned the gaps between legal, spatial, and valuation information which are not fully addressed by the current system. The new data model introduces specific classes and attributes, such as WS_VM_Valuation and WS_VM_ValuationUnit, to formally capture and organize valuation data. This systematic approach ensures that valuation information is integrated with the legal and spatial datasets as managed by LASIS. The unified data model also aligns with the international standards LADM Edition II and improves efficiency and transparency in property valuation assessments. The leverage updated LADM Edition II and BIM (validated), presents a use case for Sarawak situation. For future work, the BIM/IFC aspect to be incorporated into the developed model with the 3D visualization platform (Cesium web) with proper queries. This integrated approach warrants for sustainable urban development – accurate property valuations and streamlined governance processes. Furthermore, the unified framework lays the foundation for advanced applications like 3D strata valuation, automated data exchange,

and visualization on 3D geospatial platforms, for near future Sarawak's land administration initiatives.

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APPENDIX A - Conceptual data model of the integration between valuation classes with other classes