# Towards the Netherlands LADM Valuation Information Model Country Profile

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**Key words**: LADM Valuation Information Model; ISO 19152:2012 Land Administration Domain Model (LADM); Immovable property valuation

## SUMMARY

In this paper, an overview of property valuation system and practices in the Netherlands are described within the context of LADM Valuation Information Model. The paper also includes the development of the Netherlands Country Profile of LADM Valuation Information Model.

A collaborative research initiative has proposed an international valuation information model that extends the ISO 19152:2012 Land Administration Domain Model (LADM) for specifying semantics of valuation registries maintained by public authorities. The proposed model was created based on the specifications of international standards; literature survey and data acquired from questionnaires responded by the national delegates of FIG Commission 9 and FIG Commission 7. Recently, the model has been updated according to the outputs of the seventh LADM Workshop, information gained from personal communications, and the results of previous tests and assessments. It has been decided that the model should be evaluated with new country profiles and prototype systems.

This paper firstly examines the public property valuation system and practices in the Netherlands in terms of property valuation legislation, WOZ-value (the official assessed value), the usage areas of the WOZ-value, valuation approaches, revaluation, indexing and dissemination of the WOZ-values. Secondly, the required data sets for property valuation and their data sources are identified considering the related legislation and the System of Key Registers in the Netherlands. The obtained information is used to develop the Netherlands Country Profile of the LADM Valuation Information Model. It is noted that the country profile covers transaction prices used in valuation procedures, parties involved in valuation practices, and market analysis information. It is proved that LADM Valuation Information Model provides a decent basis to represent property valuation system in the Netherlands. The results of the study will be used to evaluate LADM Valuation Information Model and input will be provided to LADM v2.0 revision within ISO TC 211 and OGC.

# Towards the Netherlands LADM Valuation Information Model Country Profile

**Abdullah KARA, Turkey; Ruud KATHMANN, Peter van OOSTEROM and Christiaan LEMMEN the Netherlands; Volkan ÇAĞDAŞ and Ümit IŞIKDAĞ, Turkey**

## 1. INTRODUCTION

Valuation is a process of developing an opinion of value of a specific purpose as of a given date (IAAO, 2014). It is required by the public and by the private sector for a wide variety of reasons, often forming and informing the basis of transactions, taxation, compensation and accounting (FAO, 2017). In immovable property valuation activities conducted for public purposes, the estimated value (e.g. market value, tax value) of property units (i.e. land and immovable property) is calculated based on their legal, geometric, physical, geographical, economic and environmental characteristics. Therefore, appropriate systems are needed for fair and timely valuation of tenure rights of land and immovable property. It is expected from property valuation registries or databases to record the characteristics of property units that are subject to valuation. Furthermore, the relationships between property valuation registries and other land administration registries (e.g. cadastre, land registry, building and dwelling registries) should be specified by means of spatial data infrastructures (SDI). One of the main components of the SDI is domain-specific standards that specify the semantics of a domain (e.g. ISO 19152:2012 Land Administration Domain Model) (Lemmen et al., 2011).

There are several regional and international associations of professional bodies who set valuation standards. Some of these standards are as follows: the European Valuation Standards (EVS – The Blue Book) (TEGoVA, 2016), International Valuation Standards (IVSC, 2016), and a set of standards published by International Association of Assessing Officers (IAAO) including Mass Appraisal of Real Property (IAAO, 2013a), Ratio Studies (IAAO, 2013b). These standards focus more on procedural aspects of immovable property valuation. For example, the International Valuation Standards (IVS) outline the broad principles of valuation. They do this by regulating the valuation process rather than defining detailed methods employed and by promoting the use of consistent definitions, bases of valuation and reporting standards (FAO, 2017, p. 88). Despite of the existence of such valuation standards, there is no internationally accepted data standard that defines semantics of property valuation registries and the links between valuation registries and the other land administration registries (e.g. cadastre, land registry, and building and dwelling registries).

The ISO 19152:2012 Land Administration Domain Model (LADM), an international standard for the domain of land administration, is related to management of information concerning the ownership, value and use of land. The first version of LADM focuses on legal and administrative aspects of land administration and considers the value component out of scope. Moreover, LADM only provides information on legal aspects of properties (parcels or building parts/apartments), however physical characteristics of building parts are also utilized

in property valuation activities. On the other hand, the LADM provides a framework that allows for an extension that responds to property valuation requirements.

A collaborative research initiative has proposed an international valuation information model that extends the LADM for specifying semantics of valuation registries maintained by public authorities. The proposed model was created based on the specifications of international standards; literature survey and data acquired from questionnaires responded by the national delegates of FIG Commission 9 and FIG Commission 7. Recently, the model has been updated according to the outputs of the seventh LADM Workshop, information gained from personal communications, and the results of previous tests and assessments.

Figure 1 shows the classes and relations between LADM and LADM Valuation Information Model. The white and vanilla colored classes present the LADM and proposed LADM Valuation Information Model, respectively.

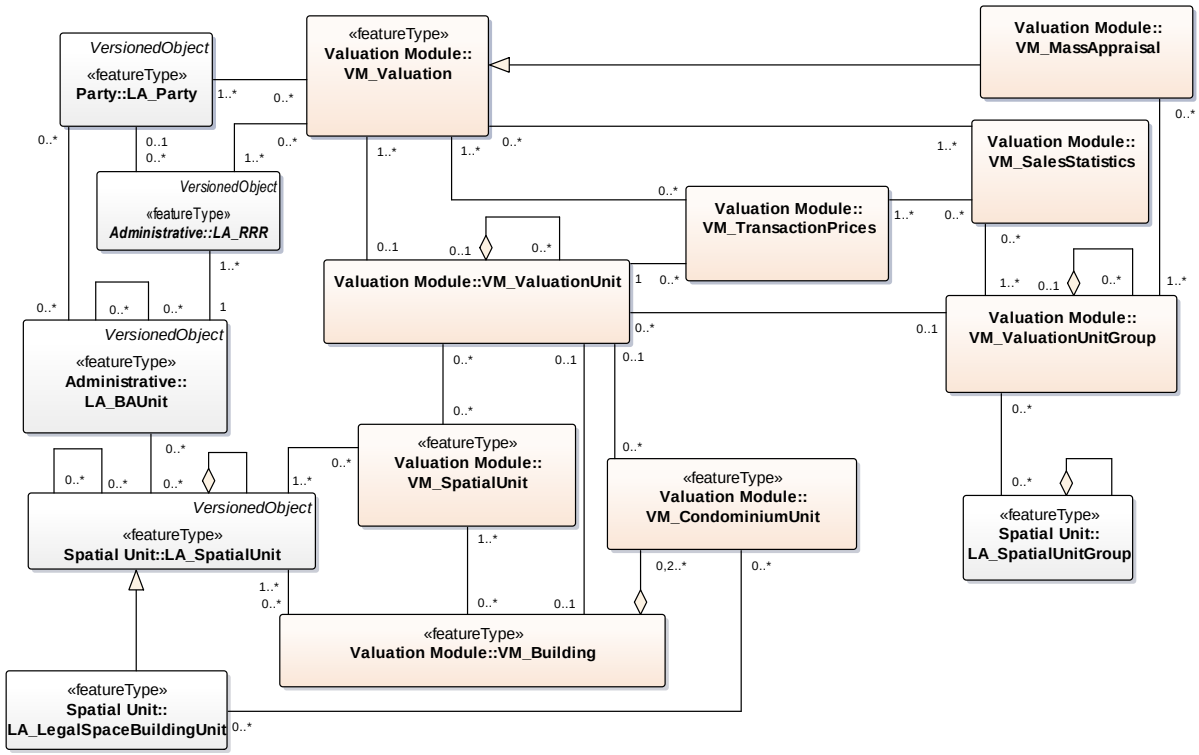


Figure 1. LADM and LADM Valuation Information Model

The purpose of the LADM Valuation Information Model is to specify semantics of registries used in immovable property valuation activities and relations between these registries. It has been designed to provide a data management framework in relation to public property valuation activities. It enables the recording of data concerning the parties that are involved in valuation practices, property objects that are subject of valuation, as well as their geometric, legal, physical, economic, and environmental characteristics. While extending the scope of LADM for public valuation purposes, the international valuation standards mentioned, the

immovable property measurement standards (e.g. ISO 9836:2017, IPMSs) and the 2D/3D geographical data standards (e.g. OGC LandInfra, INSPIRE) that are related to immovable properties are maximally used especially for determining the code list values. It is aimed that LADM Valuation Information Model will provide public bodies a common basis for the development of local or national databases, enable integration of valuation databases with other land administration databases, and can act as a guide for the private sector to develop information technology products.

The conceptual structure of the proposed LADM Valuation Information Model was presented in detail in Çağdaş et al. (2016); Kara et al. (2017) and Kara et al. (2018a). A Turkish Country Profile of LADM Valuation Information Model was developed in Kara et al. (2018b) and the profile was implemented and tested in Kara et al. (2018c). Moreover, Tomić et al. (2018) analysed data in Croatian official registers to test for compliance with the LADM Valuation Information Model. In the seventh Land Administration Domain Model Workshop, it has been decided that LADM Valuation Information Model should be evaluated with new country profiles and prototype systems.

This paper presents the Netherlands Country Profile of ISO 19152 LADM Valuation Information Model. In order to design a comprehensive country profile, an overview of property valuation system and practices in the Netherlands is firstly described. General information on public property valuation practices in the Netherlands is given in Section 2. More specifically, property valuation legislation, WOZ-value (the official assessed value), revaluation, valuation methods, valuation reports and dissemination of property values and usage areas of WOZ-value are investigated in this section. Section 3 details required data sets for property valuation and their data sources. This section also gives information about the System of Key Registers in the Netherlands since this system is one of the important data sources for property valuation. Section 4 introduces the Netherlands Country Profile of ISO 19152 LADM Valuation Information Model, which was developed using the information obtained from previous sections. The last section suggests further researches and concludes the paper.

## 2. PROPERTY VALUATION IN THE NETHERLANDS

This section gives information about property valuation conducted for governmental (public) purposes in the Netherlands. The private sector valuation activities are not included in the context of this paper.

In the Netherlands, approximately nine million properties are valued annually for levying taxes and other government purposes (Kathmann and Kuijper, 2018). The estimated market value, namely WOZ-value (WOZ-waarde), is formally assessed for all types of properties (e.g. residential and commercial). The property valuation for public purposes is regulated by the Special Act for Real Estate Assessment (Wet Waardering Onroerende Zaken – Wet WOZ) that was established on January 1st, 1995 defining determination and provision of real estate property values for various property taxes (Wet WOZ, 1995). The act authorizes all municipalities to assess the value of immovable properties and it is mandatory for public

organizations to use these assessed values for various purposes. The Council for Real Estate Assessment (Waarderingskamer), is an independent governmental organization, supervises the municipalities on the implementation of the act and monitors the quality of real estate property assessment (Kathmann and Kuijper, 2018).

The WOZ-value is primarily the real market value of a real estate property on a given date. The market value definition of the European Valuation Standards (EVS) of the European Group of Valuers' Associations (TEGoVA) is used as basis for the definition of the WOZ-value: "The estimated amount for which the property should exchange on the date of valuation between a willing buyer and a willing seller in an arm's length transaction after proper marketing wherein the parties had each acted knowledgeably, prudently and without being under compulsion." (TEGoVA EVS, 2016). The WOZ-value equals the market value that is based on the "highest and best use", which is the formal allowed use as described in the zoning plan (Bervoets et al., 2016).

The WOZ-values of valuation units (WOZ-object) have been assessed annually since 2007. For the annual property valuation, a valuation date that lays one year prior to the current year is being used; therefore, the assessed value for the year 2018 is based on the real estate market on 1 January 2017 (Bervoets et al., 2016; Kathmann and Kuijper, 2018). By doing so, the assessed value is up-to-date and enough market data can be analyzed in order carefully to perform the valuation (Bervoets et al., 2016).

Different techniques of mass appraisal are used with computerized valuation models for determining WOZ-values of properties in the Netherlands (Kathmann and Kuijper, 2018). In general, three approaches within the systems of mass appraisal are used in the valuation processes, namely sales comparison, income and cost approaches. The sales comparison approach is being mandatorily used for the assessment of residential properties (Bervoets et al., 2016). The WOZ-value for a non-residential property can be assessed in three different ways depending on the market data available. These methods are the sales comparison approach, the income approach (capitalization of the rental value, based on rent prices) or the discounted-cash-flow method (mostly for commercial real estate) (Bervoets et al., 2016). The valuation of non-commercial and non-residential properties that have no market, the Special Act for Real Estate Assessment (Wet WOZ) determines that the depreciated replacement costs must be issued as WOZ-value (Bervoets et al., 2016). The depreciated replacement costs reflect the value for the current owner in a situation where there is no potential buyer who is willing to purchase this object on the market (Bervoets et al., 2016; TEGoVA EVS, 2016). Moreover, for the valuation of agricultural real estate a special form of sales comparison method is used based on a national market analysis of all sales transactions of agricultural property. When there is a lack of sales data for certain types of agricultural properties, the market analysis is partly based on investments in new or existing properties. The results of this national market analysis are given to the municipalities in the form of a valuation model for the actual valuation.

Municipalities, private firms and universities collaborate for designing the mass appraisal models using Computer Assisted Mass Appraisal (CAMA). In the mass valuation models, not

only multiple regression analysis (MRA) types of models are used, but also statistical clusters, case-based reasoning and other types using sales comparison more directly (Kathmann and Kuijper, 2018).

In the Netherlands, all owners and users of immovable properties are annually informed of the new assessed value. This is done by the official tax bill for the local taxes. This tax bill is sent out in a paper form to the official mailbox of the taxpayer. Alternatively, a taxpayer can find the tax bill within his personal web page provided by government (MijnOverheid). Taxpayer can also get a valuation report that explains the assessed value. These valuation reports are also available on the web. An example of the valuation report for a residential property is given in the Figure 2. The report mainly consists of the data on the property characteristics and on comparable sales prices and the characteristics of these properties sold. Municipalities also present pictures of all properties that were used for comparison in the valuation report, so the taxpayer can understand the comparison made. In the former years, these valuation reports were very important for the taxpayer to understand the valuation and to check whether the valuation was correct. However, since October 2016, the WOZ-values for residential properties are publicly available on the web for all sorts of private use in the context of a fair and transparent government. A web-based WOZ-viewer was introduced, not only showing the value of a single residential property, but also the values of all residential properties (WOZwaardeloket, 2019). Figure 3 shows a screenshot from the WOZ-viewer for a residential property and its characteristics including WOZ-value, valuation date, address, surface area and date of construction. Now this WOZ-viewer is becoming more important to understand the valuation and to check whether the assessed WOZ-value is consistent with market prices and the assessed values of comparable properties. It is expected that the usage of WOZ-values will increase as the assessed values for residential properties have become publicly available (Bervoets et al., 2016).

The WOZ-value of valuation units (WOZ-objects) is used for various purposes. The main purpose of the annual property valuation in the Netherlands is the property taxation. The WOZ-value is used by both central and local governments for levying taxes. According to Kathmann and Kuijper (2018), approximately 16.5 billion Euro is being levied on annual basis of which 14.5 billion Euro must be considered as annual taxes that are being levied on both owners and users of real estate properties while the other 2 billion Euro is being levied sporadically when triggered by a particular event, as seen in the

Table *1*. On national level, the central revenue office uses the WOZ-value for levying income tax, tax for large-scale owners of rented houses, gift and inheritance tax (Kathmann, 2014).

Real estate tax is levied by the municipalities. For residential property, the owner pays around 0.1% to 0.2% of the assessed value as a yearly tax to the municipality. The rates for this tax may vary in different municipalities. The rates for non-residential properties are mostly higher than the residential ones and the average tax rates for non-residential property is between 0.2% and 0.4% of WOZ-value. For non-residential properties, both owner and user of the property pays tax. Polderboards which are a type of local government in the Netherlands that

take care for ‘dry feet’ since a large part of the country is below sea level, also levy a property tax from the owner of the property, as a percentage of the assessed value.

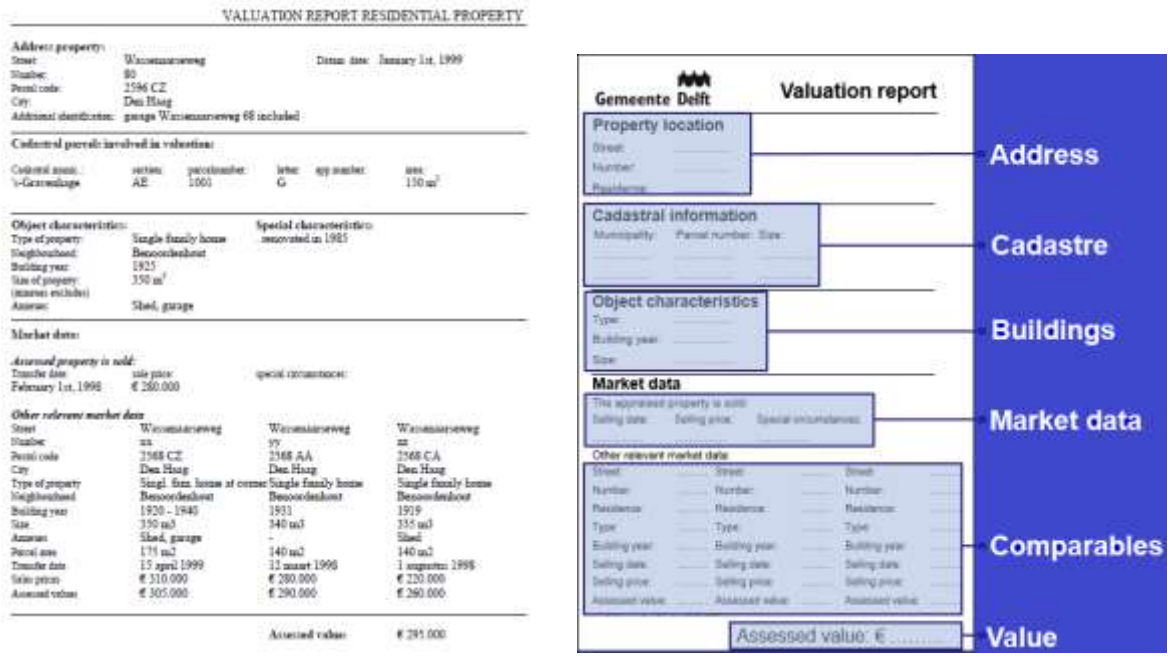


Figure 2. An example valuation report of a residential property (Kathmann, 2005)

In general, WOZ-value are accepted by the taxpayer. In other words, taxpayer can appeal against the WOZ-value, but only a small number (2%) of taxpayer do appeal. If a WOZ-value is considered incorrect, taxpayers can object to municipalities for reconsideration and revaluation of the property. The Council for Real Estate Assessment encourages informal contact instead of formal objections. There are three layers of court for the formal appeals: the Court, Court of Appeal and Supreme Court.

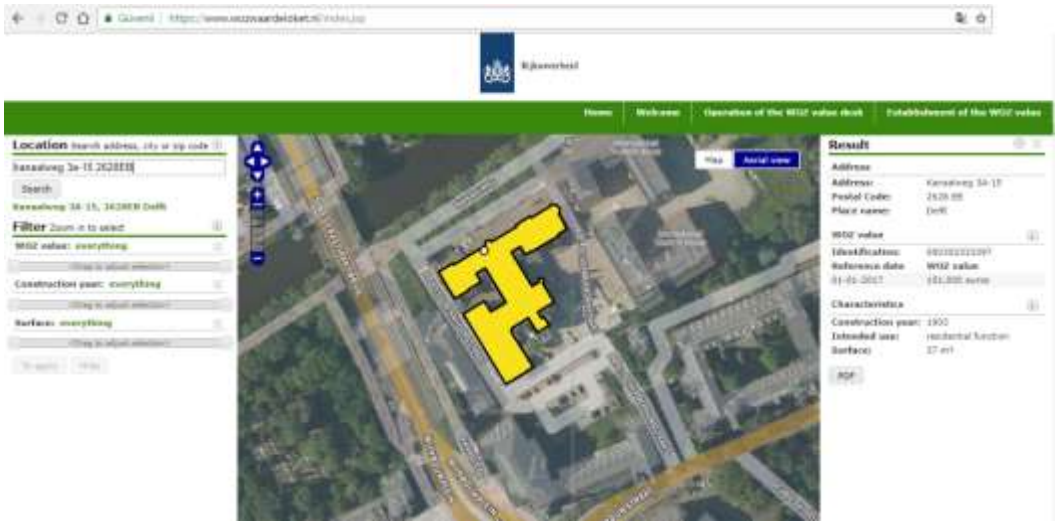

Figure 3. A screenshot from the WOZ-viewer for a residential property

Since the up-to-date assessed values of the immovable properties are of high quality and are accepted by the public, legislators in the Netherlands have decided to use the assessed values for other purposes such as mortgage lending, social housing and fighting fraud (Bervoets et al., 2016). These purposes are partly defined by law, for instance the use of the assessed value by Ministry of the Interior and Kingdom Relations (also responsible for Housing), to set a maximum rent price for social housing. The WOZ-value is also used by notaries, mortgage banks and insurance companies for preventing real estate fraud. Moreover, the Central Bureau of Statistics in the Netherlands (CBS) uses the WOZ-value to calculate the price index for residential properties by analyzing the ratio between a sales price and the WOZ-value of the property sold.

Table 1. Tax types and their annual revenue in the Netherlands (Kathmann and Kuijper, 2018)

| | Periodic (billion euro's per year) | Sporadic (billion euro's per year) |
|---|---|---|
| **Central government** | **€ 4.5 (total)**<br>*€ 2.5 (home owners forfeit)*<br>*€ 1.0 (capital return tax)*<br>*€ 1.0 (landlord charge)* | **€ 2.0 (total)**<br>*€ 1.0 (transfer tax)*<br>*€ 1.0 (estate/inheritance tax)* |
| **Local governments** | **€ 10.0 (total)**<br>*€ 3.5 (real estate tax)*<br>*€ 4.5 (other municipal taxes/ fees)*<br>*€ 0.8 (water system charges built)*<br>*€ 1.2 (water treatment tax)* | Not applicable |
| **Total** | **€ 14.5** | **€ 2.0** |

The next section gives information on which data is needed in property valuation and which data sources are utilized for valuation purposes in the Netherlands.

## 3. DATA REQUIREMENT IN PROPERTY VALUATION IN THE NETHERLANDS

Principally, three types of data sources are used by the 355 municipalities that are responsible for property valuation processes in the Netherlands. These data sources are as follows: (1) Information from the System of Key Registers (e.g. Cadastre, Register of Persons (Inhabitants) and Register of Addresses and Building), (2) Information from the system for advertising the supply of the real estate properties on the market, (3) Information that municipality specifically collects for mass valuation (Kathmann and Kuijper, 2018).

The information derived from the System of Key Registers is substantial for the assessment of real estate. The next subsection investigates the characteristics of the System of Key Registers and its utilization in property valuation activities.

### 3.1 The System of Key Registers

In the Netherlands, a number of registers have been formally designated as key registers and these registers constitute the System of Key Registers, which currently consists of 13 base

registries that are related with each other. These registers are primarily intended for official use by public agencies on central and local level. This system should deliver authentic data of such a high quality that the government can use this information for its work without any further investigation (Kathmann and Kuijper, 2018).

In 2006, it was decided to design a property value register as a part of the System of Key Registers. Therefore, the Key Register for Assessed Values (Basisregistratie WOZ – Basisregistratie Waarde Onroerende Zaken) was designed in accordance with the Special Act for Real Estate Assessment (Kathmann and Kuijper, 2018). It mainly contains information on WOZ-value, valuation date, valuation object (WOZ-object) and legal person designated by the municipality as interested party (WOZ-Belang) such as owner, user or co-beneficiary. The Key Register for Assessed Values has relations with the objects in the Key Register of Cadastre (Basisregistratie Kadaster – BRK) and the Key Register of Addresses and Buildings (Basisregistratie Adressen en Gebouwen – BAG).

One of the base registers that is essential for property valuation is the Key Register of Cadastre (BRK). The Cadastre, Land Registry and Mapping Agency of the Netherlands (the Kadaster) collects and registers administrative and spatial data on property and the rights attached to it. The ownership rights of all parcels are recorded in the BRK, therefore, it is the most important source of information to set up the list of properties to be assessed for taxation (Kathmann and Kuijper, 2018). The size of cadastral parcels are also recorded at this register and this data are utilized in property valuation activities. Moreover, this register contains complete and accurate information on sale prices, in case of a transaction, for both residential and non-residential properties.

The Ministry of the Interior and Kingdom Relations is the responsible institution for maintaining the Key Register of Addresses and Building (BAG). The BAG includes information on building, occupancy units in the building and addresses of them. A building (Pand) in the BAG, refers to the smallest unit that is functionally and constructively independent, durably connected to the earth, and that is accessible and lockable. The recorded building characteristics in this register are the 2D geometry, date of construction, status of building (e.g. finished, demolished, under construction) and more. A building can include zero (e.g. garages or warehouses), one (e.g. detached house) or many occupancy units (e.g. apartments). An occupancy unit (verblijfsobject) is the smallest useable unit within one or more building. It should be accessible from a public road or a communal thoroughfare, lockable, functionally independent and can be the subject of legal acts of property law (Goorman, 2010). It can be designed for different purposes such as residential, commercial, or recreational. A number of characteristics of occupancy units are included in the BAG register such as designation of address, geometry (point), surface area, construction date, status, and usage type. All source documents (e.g. building permits) pertaining to administrative or geometric changes to a building and an occupancy unit, must also be stored in the BAG register (Goorman, 2010).

It should be noted that the surface area of building units plays a critical role in property valuation. The commonly used basis for measuring immovable property is specified in the

NEN 2580:2007 standard. This standard gives definitions and procedures for measuring floor areas and volumes of properties. For market and valuation purposes, the usable floor area (gebruiksoppervlakte) of residential properties is measured using this standard (Boeters, 2013; TEGoVA EVS, 2016). It can be defined as "an area (or areas) within the outer/separating walls, including supporting and non-supporting partition walls." (NEN 2580:2007; Kathmann and Kuijper, 2018). This area then is broken down into usable floor areas of dwellings. The government has registered the usable floor area to the BAG register. For valuation of non-residential properties, the rentable floor area of offices and retail buildings (verhuurbaar vloeroppervlakte) is also measured according to the NEN2580:2007 (TEGoVA EVS, 2016).

Other Key Registers that are used in the property valuation activities are the Key Register of Large-Scale Topography (Basisregistratie Grootschalige Topografie – BGT), the Personal Records Database (Basisregistratie Personen – BRP) and the Business Register (Handelsregister). The BGT is a large-scale topographical registration for the Netherlands. It contains a diverse set of data (e.g. building, road and water bodies) and large-scale maps from 1:500 to 1:5000. The construction year of buildings and size of property units in the BGT may be utilized in property valuation activities (Işıkdağ et al., 2014). Moreover, it can be utilized to make geographical analysis affecting value of immovable properties. The BRP contains the personal data of people who live in the Netherlands (residents) and of people who live abroad (non-residents). This register is used to determine taxpayers. In the same way, the Business Register is used as a source of data for taxpayers that are legal persons (companies, government agencies, etc.)

The municipalities are responsible for data collection and property valuation (Waardering Onroerende Zaken - WOZ). Because of the specialized kind of work, municipalities often create shared service centers for all WOZ related activities. The WOZ-objects (valuation objects) can be different from the BAG-objects. A WOZ-object can contain multiple BAG-objects and cadastral parcels. For that reason, the WOZ-subobject (WOZ-deelobjecten) was constituted. A WOZ-object contains one or more WOZ-subobjects. Such a subobject consists of either a (part of a) parcel, a (part of a) BAG building, or a (part of a) BAG occupancy unit, and can be linked to the BAG or BRK (Goorman, 2010). Moreover, a WOZ-object may or may not overlap partially or completely with a building in BAG. The primary difference between BAG and WOZ in this regard is that BAG defines buildings physically: 'what are the boundaries of a structure?', while WOZ defines them functionally: 'who uses and owns what space for which purpose?' (Goorman, 2010). If adjacent buildings or parcels of land are owned and used by the same person, then these parcels and buildings will together form a single WOZ-object. On the municipal level, however, WOZ-subobject is used to solve lack of compatibility between BAG and WOZ objects. Additionally, the address information for WOZ-objects and WOZ-subobjects are derived from the Key Register of BAG.

The data collected for valuation purposes supplies data to the BAG (and vice versa) about the characteristics of buildings and occupancy units, such as surface area, status, and construction and demolition dates. Note that the surface area of occupancy unit that WOZ supplies to BAG is often the sum of the different WOZ-subobjects. In other words, WOZ does not store the total surface area itself, only subtotals of the different functional parts of an occupancy unit.

Figure 4 shows a general overview of characteristics and interrelation of the System of Key Registers from the perspective of property valuation in the Netherlands.

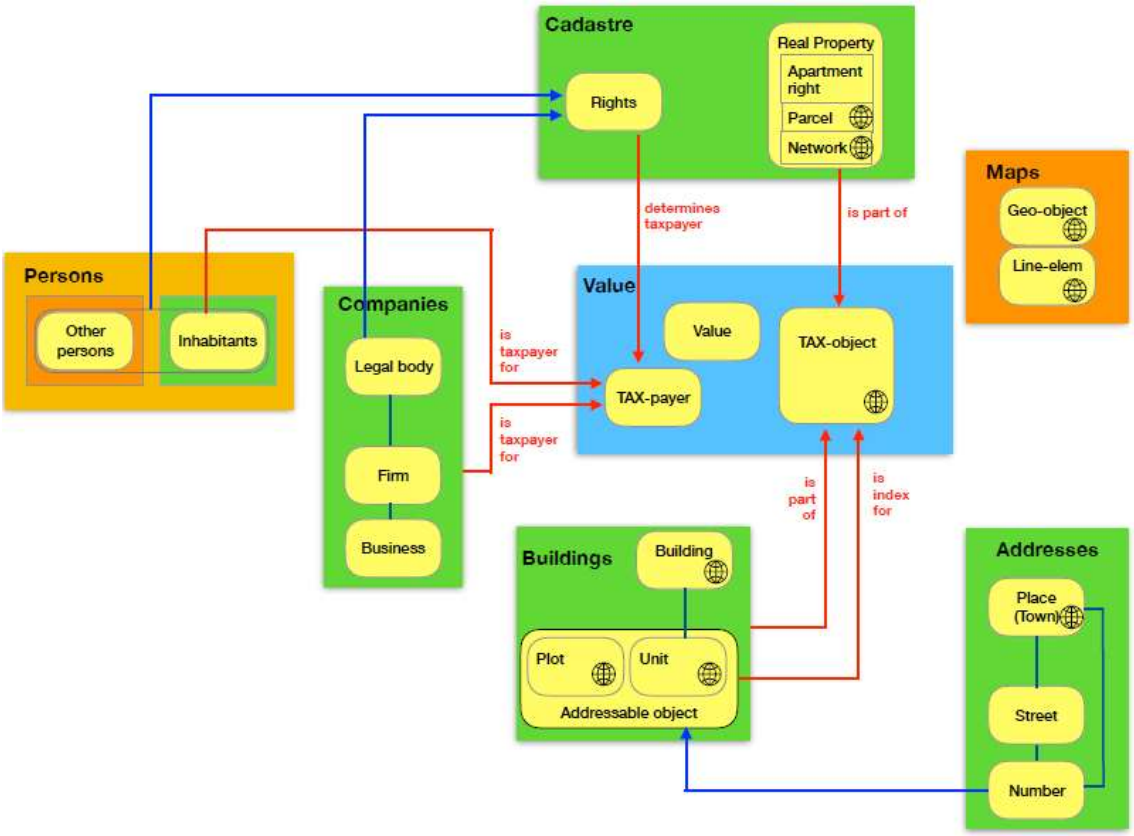


Figure 4. A general overview of the Key Registers in terms of Property Valuation (adopted from Kathmann and Kuijper, 2018)

### 3.2 Data Requirement in Property Valuation

The main data source for property valuation in the Netherlands is the System of Key Registers. However, it does not meet all the requirements for property valuation. This section investigates these data requirements.

The BRK does not provide a complete list for properties to be valued since the demarcation of property units to be appraised have not only been determined by ownership, but also by use. In other perspective, the real estate tax is paid not only by the owner of a property, but also by the user of the property. For making a correct demarcation of properties and a complete list of properties, municipalities have to make inventories of the self-contained units with separate users (Kathmann and Kuijper, 2018).

The BRK records successful sale prices (transaction prices) but does not present all market data available that are required in the property valuation. Therefore, market data is collected

and analyzed by the municipalities themselves. For instance, rental prices of commercial real estate (e.g. office space and shops) are required since the rental transactions are not registered, in contrast to the sales of real property (Kathmann and Kuijper, 2018). Not only information on the successful transfers is needed for property valuation, but also information on properties on the market that have not been sold yet. Additionally, the asking prices for properties that are on the market, duration on the market, first advertisement date and the actual date of sale are required for a correct and complete market analysis (Kathmann and Kuijper, 2018). The building cost data should also be collected by municipalities for specific properties like schools, hospitals and industrial sites since they are appraised using cost approach (Işikdağ et al., 2014).

The BAG registers the construction year and the size (usable floor area) of the main building. The rest of the information required for property valuation activities are collected by the municipalities. These includes, for example, the type of the building (e.g. detached houses, semi-detached houses, terraced/town houses, apartments, single family dwelling, multi family dwelling, shared apartments), the size of different parts of the building (e.g. shopping space versus storage space or an old part of the building versus a newly built enlargement), annexes of the building (e.g. garage, shed), information that provides insight into the maintenance condition and the quality of a building or building parts (Kathmann and Kuijper, 2018). Note that the planning information is also important for the property valuation. The spatial planning information (e.g. future use, zoning restrictions) are derived from the municipal zoning maps for property valuation in the Netherlands (Işikdağ et al., 2014).

Municipalities, who are responsible for the property valuation, often use the services of companies to perform the actual valuation or cooperate to be able to have highly specialized staff. The valuation is checked at national level by the Council for Real Estate Assessment. A large part of the work for property valuation is collecting and updating the data for the valuation models (Kathmann and Kuijper, 2018). Collecting and updating information is mostly done in the office using real estate advertising websites, recent aerial photographs and street view type of images (cyclorama's) (Işikdağ et al., 2014; Kathmann and Kuijper, 2018). For collecting market analysis information, all advertisements for residential and non-residential properties are automatically collected from the different webpages and combined in one central database.

The property characteristics used in the valuation range from location, size of properties, type of property, year of construction, maintenance condition, quality of materials and facilities (Kathmann and Kuijper, 2018). These characteristics are also checked and updated by using advertisement sites on the web, aerial photographs and street view images. For change detection, automated techniques are being used for comparing aerial photographs for consecutive years or comparing aerial photographs with existing digital maps (Işikdağ et al., 2014). Moreover, 3D data models are also being used for collecting and updating data. For instance, location of a building, type of a building, roof structure, floor area of a building and facilities in a building (e.g. elevator) can be collected and updated using 3D data models in the Netherlands (Işikdağ et al., 2015). The municipalities increasingly make use of the knowledge of stakeholders for collecting, checking and updating information for property

valuation, for example by sending out information forms or by asking stakeholders to provide information through interactive websites. It turns out that asking stakeholders to help updating object characteristics is an efficient way to improve not only the data quality, but also the trust of these stakeholders and the assessed values (Kathmann and Kuijper, 2018).

For the collecting, updating and quality control of object characteristics, a distinction is made between primary characteristics and secondary characteristics (Kathmann and Kuijper, 2018). While primary object characteristics are only changed by building activities, secondary object characteristics may change without building activities, for instance because of time (Kathmann and Kuijper, 2018). Table 2 presents the data utilized from the System of Key Registers for property valuation, while **Fejl! Henvisningskilde ikke fundet.** shows the data collected or updated by the municipalities for property valuation, including the primary and secondary object characteristics.

Table 2. Data utilized from the System of Key Registers for property valuation

| **BRK** | **BAG** | **BGT** | **BRP** |
|---|---|---|---|
| Parcel number<br>2D geometry (polygon)<br>Size of land plot<br>Municipality of property<br>Ownership (RRR)<br>Selling price (transaction price)<br>Selling date (transaction date) | *Building*<br>Date of construction<br>Size of building<br>Status (finished, demolished, under-construction)<br>2D geometry (polygon) | Date of construction<br>Size of building (surface area) | Taxpayer |
| | *Occupancy units*<br>Address<br>Geometry (point)<br>Size of occupancy unit<br>Date of construction<br>Status<br>Use type (residential, commercial, recreational) | | |

Table 3. Data collected or updated by the municipalities for property valuation

| **Primary object characteristics** | **Secondary object characteristics** | **Market data** |
|---|---|---|
| Type of building (detached houses, semi-detached houses, apartments, single family dwelling, multi family dwelling)<br>Type of annex (shed, garage, warehouse)<br>Date of construction<br>Date of construction of annexes<br>Number of annex<br>Size of building<br>Size of annex<br>Size of different part of buildings<br>Special circumstances (e.g. renovated in 1985) | Maintenance condition (interior and exterior of the building)<br>Quality of property (construction material quality, interior quality)<br>Neighborhood<br>Infrastructure<br>Potential nuisances (surroundings, view) | Rent prices<br>Asking price<br>Duration on market |

The municipalities check the correctness of the registered object characteristics before the valuation models are used, as part of the quality checks on the results of the valuation. Therefore, a protocol has been developed for measuring the quality of the registered object characteristics. Municipalities are obliged to use this protocol at least once a year to gain insight in the quality of the data available. The protocol gives, for instance, guidelines for the

size of samples to be taken for comparing the registered data with the real world. The results of these samples are then extrapolated to all properties in municipalities. If the percentage of errors in the registered data is too high, the municipality has to perform extra checks and an optimization of the data registered. In some cases a re-inventory of one or more characteristics of all properties can be necessary (Kathmann and Kuijper, 2018).

In the next section, the Netherlands Country Profile of ISO LADM 19152 LADM Valuation Information Model is described, which is developed using the obtained information about the public property valuation activities and the data requirement for these activities in the Netherlands.

## 4. THE NETHERLANDS COUNTRY PROFILE OF THE LADM VALUATION INFORMATION MODEL

This section describes the Netherlands ISO 19152 LADM Valuation Information Model Country Profile. To do this, LADM Valuation Information Model is extended with new classes, characteristics and relations to cover country specific information in property valuation. Figure 5 shows the main classes and relationships of the country profile. 'NL_' prefix is used for newly added classes for developing the country profile. The orange, vanilla and white colored classes present the Netherlands Country Profile, LADM Valuation Information Model, and ISO LADM 19152, respectively. Note that the information given about LADM Valuation Information Model was taken from Çağdaş et al. (2016) and Kara et al. (2018a).

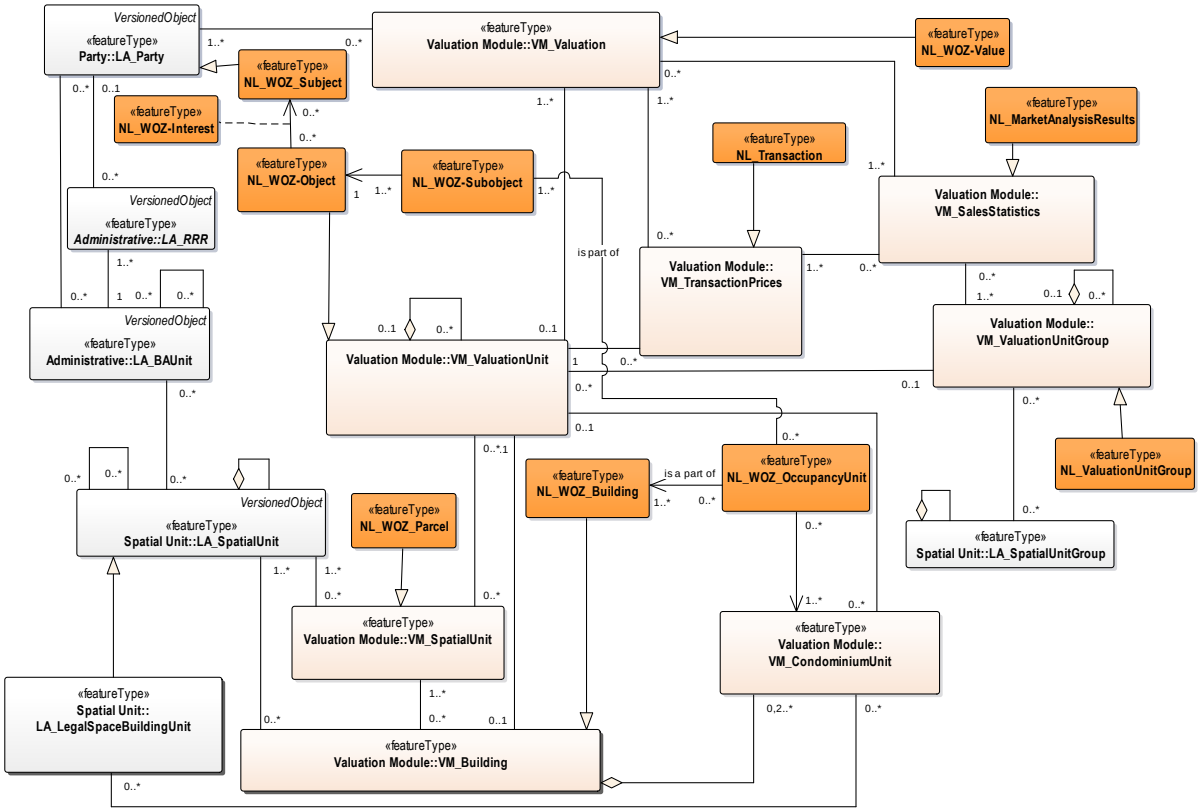


Figure 5. An overview of the Netherlands LADM Valuation Information Model Country Profile

The municipal register for Real Estate Valuation (the municipal WOZ databases) contains WOZ-value, WOZ-object, WOZ-subobject and WOZ-interest classes. These classes of the WOZ register have relations with the classes of other registers, for example, building and occupancy unit in the BAG, cadastral parcel and transaction price in the BRK, people and companies in the BRP, and Business Register. Since not only information recorded in the BAG, BRK, BRP and Business Register is utilized in property valuation processes when calculating the WOZ-value of WOZ-object and WOZ-subobject, some super classes were created in the country profile to represent the other object characteristics utilized in the property valuation. These classes are NL_WOZ_Building, NL_WOZ_OccupancyUnit, NL_WOZ_Parcel and NL_WOZ_Subject. It is noted that these classes do not really exist in the Key Registers but they are only created for developing the Netherlands LADM Valuation Information Model Country Profile. Moreover, the municipal WOZ databases have relations with transaction prices (NL_Transaction) and market analysis (NL_MarketAnalysisResults). From this point forward, the design process of Netherlands Country Profile of LADM Valuation Information Model is examined in detail.

VM_ValuationUnit represents the basic recording unit of valuation registries. The VM_ValuationUnit class defines common characteristics for the valuation objects such as parcel, building, building unit and property. VM_ValuationUnit class has relations with

VM_SpatialUnit, VM_Building and VM_CondominiumUnit classes that specify characteristics of the valuation objects. These classes were related with the NL_ValuationUnit, NL_SpatialUnit, NL_WOZ_Building, NL_WOZ_OccupancyUnit, NL_WOZ-object, NL_WOZ-subobject classes to develop the Netherlands LADM Valuation Information Model Country Profile as seen in the Figure 6. Furthermore, the code list classes of the valuation objects for the Netherlands Country Profile are depicted in the Figure 7.

In the WOZ register, there are two object types related to property valuation, WOZ-object and WOZ-subobject. These objects are associated with parcel, building, occupancy unit. A WOZ-object can contain multiple (parts of) BAG objects (i.e. building and occupancy unit) and (parts of) cadastral parcels, while a WOZ-subobject consists of either a (part of a) parcel, a (part of a) BAG building, or a (part of a) BAG occupancy unit. A WOZ-object can contain one or more WOZ-subobjects. It is noted that the WOZ-object is the formal valuation unit, which is defined in the article 16 of the Special Act for Real Estate Assessment. Therefore, NL_WOZ-object class is specified as child classes of VM_ValuationUnit (see Figure 6). The code list values of NL_StatusOfWOZ(Sub)Object and NL_TypeOfUse classes, which are related with NL_WOZ-object and NL_WOZ-subobject classes, can be seen in the Figure 7.

LA_SpatialUnit class of core LADM is related with VM_SpatialUnit, VM_Building and VM_CondominiumUnit classes of LADM Valuation Information Model. These classes represent characteristics of parcels, buildings and building units used in valuation activities. For the Netherlands Country Profile, these classes of LADM Valuation Information Model were related with NL_WOZ_Parcel, NL_WOZ_Building, NL_WOZ_OccupancyUnit classes.

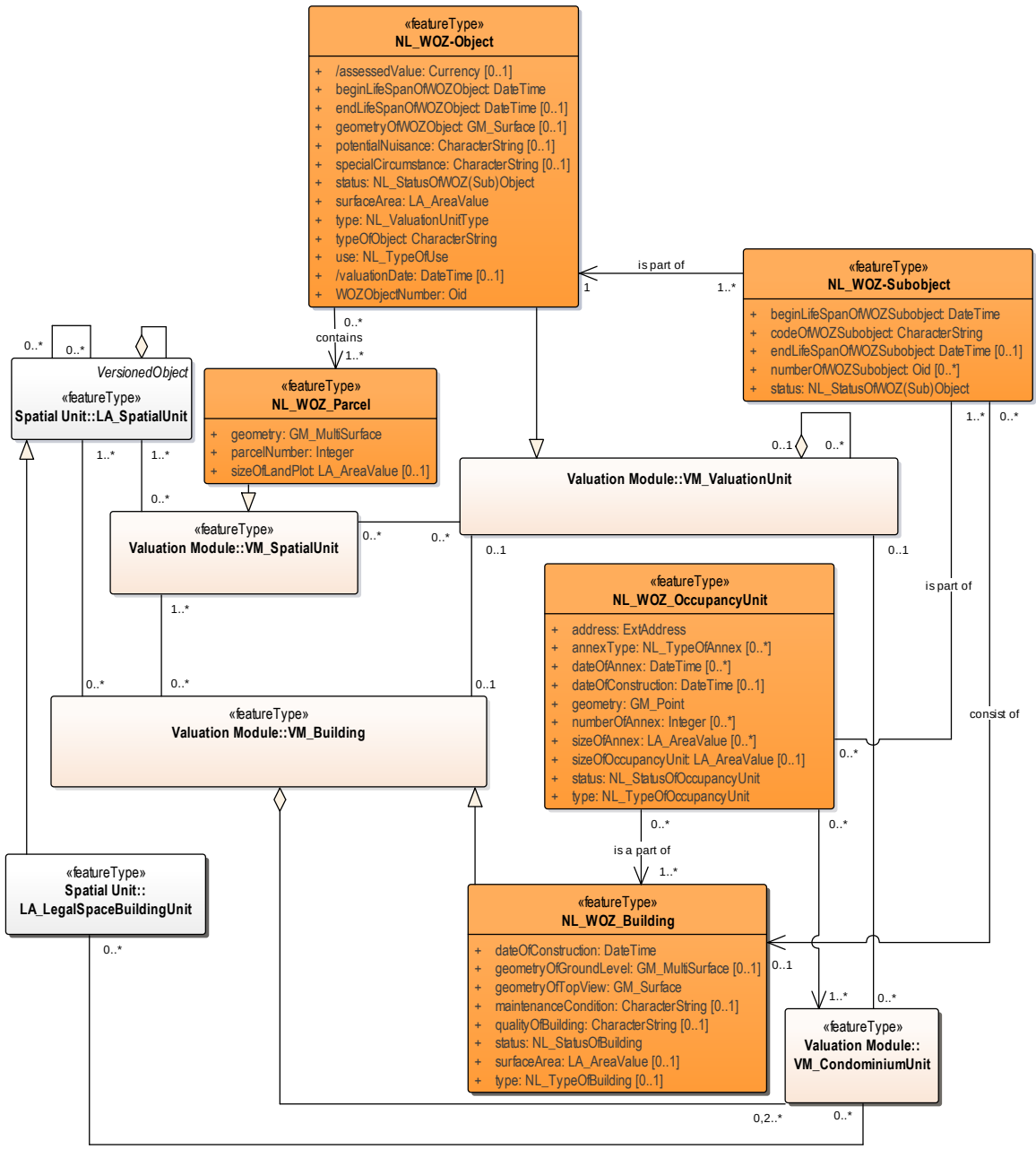


Figure 6. Objects of valuation part of the Netherlands LADM Valuation Information Model Country Profile

The VM_SpatialUnit class represents cadastral parcels, as well as sub-parcels with respect to property valuation. In this class, the current land use attribute is used to denote the existing use of a cadastral parcel while planned land use is used to show the future use of a parcel indicated by spatial plans. The VM_SpatialUnit class is extended with the NL_WOZ_Parcel class for covering parcel characteristics used in property valuation activities in the Netherlands.

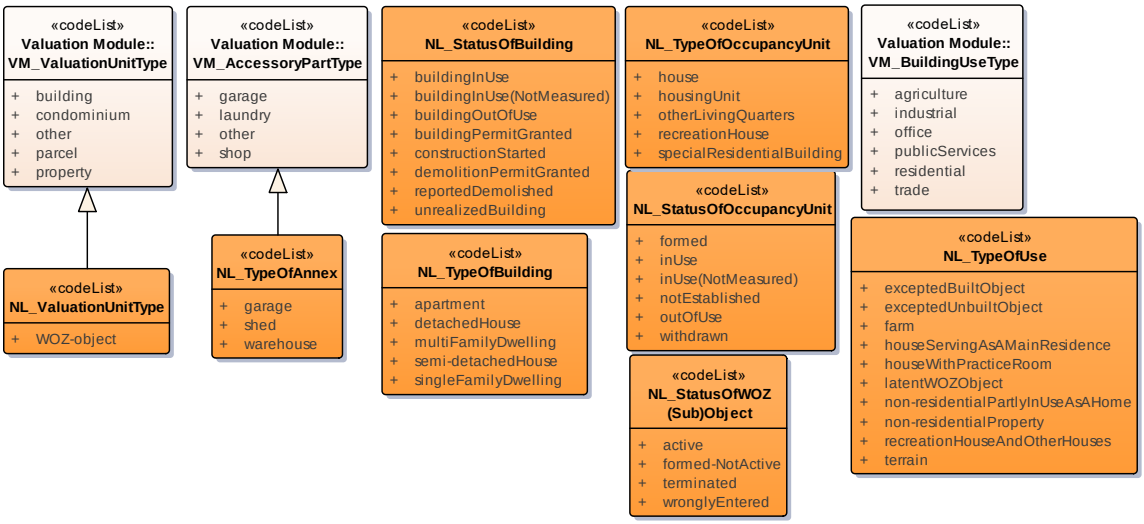


Figure 7. The code list classes of objects of valuation part of the Netherlands Country Profile

LADM is only concerned with the legal space of buildings and building parts that does not necessarily coincide with the physical space of a building (ISO 19152:2012, p. 11). It does not include any characteristics about physical space of a building, however, defines relationship between the legal space of building units (LA_LegalSpaceBuildingUnit) and with the corresponding physical building units recorded at external databases (External:ExtPhysicalBuildingUnit). In LADM Valuation Information Model, VM_Building class provides a set of common characteristics about buildings, building parts and other constructions that are required in property valuation activities. For the Netherlands Country Profile, NL_WOZ_Building class were created and described as subclass of VM_Building. The NL_WOZ_Building introduces new characteristics such as geometry of ground level, geometry of top level, maintenance condition, type and status. The type and status characteristics of NL_WOZ_Building are detailed in the code lists of NL_TypeOfBuilding and NL_StatusOfBuilding, respectively. The values of these code lists are shown in the Figure 7.

VM_Building can be considered as complementary parts of parcels, but may be valued separately from the parcels on which they are located buildings or condominium buildings that contain condominium units established according to condominium schemes (OGC, 2016). A condominium building consists of (i) condominium units (e.g. flats, shops); (ii) accessory parts (e.g. garages, storage areas); (iii) and joint facilities covering parcel, structural components (e.g. foundations, roofs), accession areas (e.g. entrance halls, spaces), and other remaining areas of buildings (e.g. staircases, heating rooms) (OGC, 2016). The characteristics of condominium unit are detailed in the VM_CondominiumUnit class. An occupancy unit (verblijfsobject), the smallest useable unit within one or more building, is registered in the BAG. Noted that than a detached house is also an occupancy unit that is registred in the BAG. An association relation was created between the classes NL_WOZ_OccupancyUnit and

VM_CondominiumUnit. It is noted that the geometry of occupancy unit in the BAG is specified as point. The NL_TypeOfOccupancyUnit and NL_StatusOfOccupancyUnit code lists are related with the NL_OccupancyUnit class. The values of these code lists are given in the Figure 7.

The area values of parcel, building and building unit are very critical in property valuation. LA_SpatialUnit class includes characteristics on area values, however, it is noted that the types of building floor area and size of building floor areas are not included in the LADM since it is not interested in physical characteristics of buildings. Therefore, LADM Valuation Information Model extends the core LADM (LA_AreaValue) with the VM_AreaValue class to cover building floor areas defined in the ISO 9836:2011. In the Netherlands, basis for measuring building floor areas is specified in the NEN 2580:2007 standard. The usable floor area (gebruiksoppervlakte) of residential units and the rentable floor area of office and retail buildings are used in the valuation practices. It is noted that the usable floor area has some different definition and measurement principles than net floor area (nettovloeroppervlakte). Calculating the building cost for estimating the depreciated replacement costs, gross floor area of NEN 2580:2007 is used in the Netherlands. Representing the floor area types of NEN 2580:2007 in the country profile, a new code list named NL_BuildingAreaType was created for representing the building area types in the Netherlands. Figure 8 depicts the area value and type part of the Netherlands LADM Valuation Information Model Country Profile.

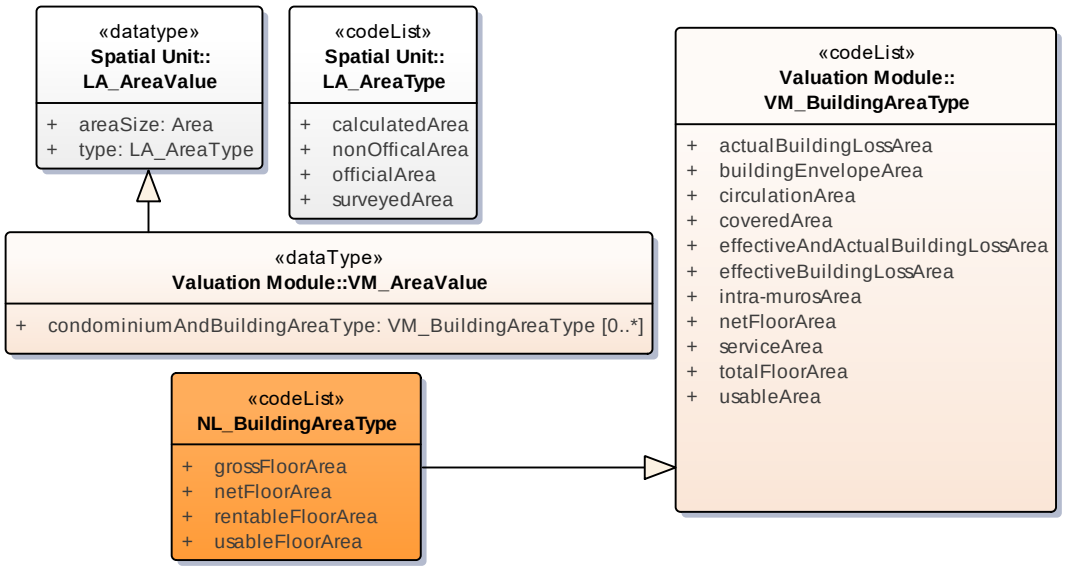


Figure 8. Area value and type part of the Netherlands Country Profile

The VM_Valuation class, as counterparts of ExtValuation external class of LADM, is created to specify valuation information. It mainly focuses on the output data produced within valuation activities. The VM_Valuation class was extended with the NL_WOZ-value class. Figure 9 shows the characteristics of NL_WOZ-value class.

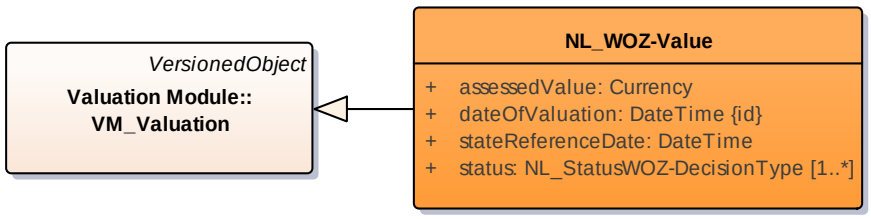


Figure 9. The characteristics of NL_WOZ-value class

There are two code lists that are related VM_Valuation class, which are the VM_ValueType and VM_AppealStatus. These code lists are extended with the NL_ValueType and NL_AppealStatus. Figure 10 shows the values of these code lists.

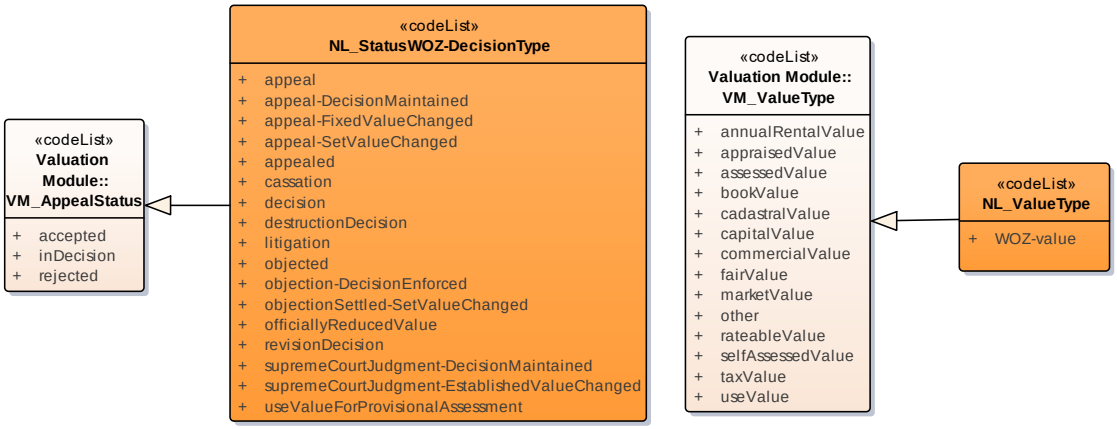


Figure 10. Code lists of NL_StatusWOZdecisionType and NL_ValueType

VM_ValuationApproach class specifies the valuation approach used in valuation activities. Generally, three main approaches are used in single or mass appraisal procedures, namely sales comparison, cost and income approaches. Therefore, VM_ValuationApproach data type class is created in the LADM Valuation Information Model. The valuation approaches related information are detailed in VM_SalesComparisonApproach, VM_IncomeApproach and VM_CostApproach classes. For the Netherlands Country Profile, VM_ValuationApproach class was extended with NL_ValuationApproach class. Moreover, a data type class was created for each used valuation approache in the Netherlands, namely NL_SalesComparisonApproach, NL_IncomeApproach, NL_CostApproach as seen in the Figure 11. Noted that a class was not created for depreciated replacement cost and discounted cash flow approaches since they are specialized forms of cost and income approaches, respectively.

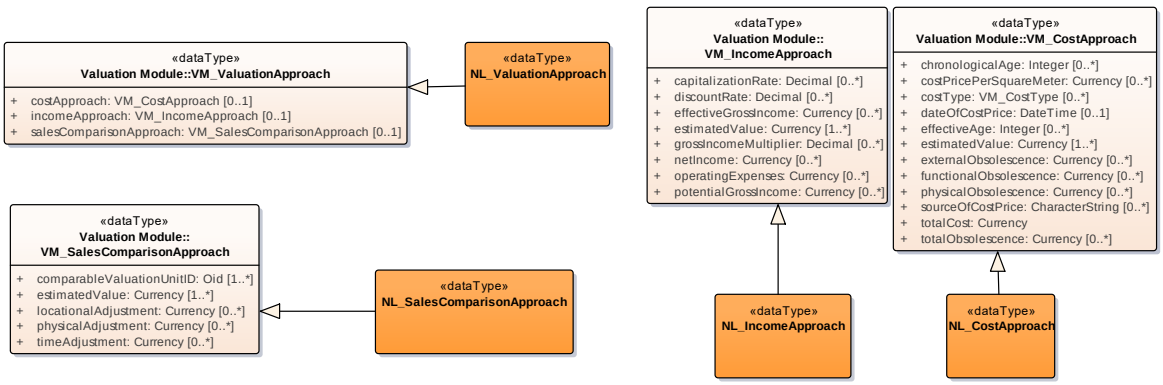


Figure 11. Valuation approaches part of the Netherlands Country Profile

In the Netherlands, mass appraisal is used for determining WOZ-values. Mass appraisal related information is represented with the VM_MassAppraisal class in LADM Valuation Information Model. To cover mass appraisal related information in the country profile, VM_MassAppraisal class is extended with the NL_MassAppraisal class as represented in the Figure 12.

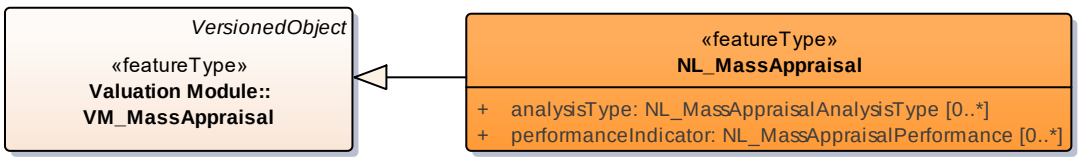


Figure 12. The characteristics of mass appraisal in the Netherlands

NL_MassAppraisal class includes the following characteristics, analysis type and mass appraisal performance indicator. In the Netherlands, cluster analysis and multiple regression analysis are used in mass valuations. Therefore, the NL_MassAppraisalAnalysisType code list were created as a child class of VM_MassAppraisalAnalysisType class. Moreover, NL_MassAppraisalPerformance data type class was created as a child class of VM_MassAppraisalPerformance class which has a performance indicator characteristics about mass appraisal such as the date of performance analysis, sample size, measures for appraisal level (e.g., mean, median), appraisal uniformity (e.g., coefficient of dispersion, coefficient of variation), and values for the selected measurements. Note that the use of IAAO ratio study as perfomace indicator is stimulated in the Netherlands. These ratio studies will result in three main indicators, namely level of appraisal, coefficient of dispersion and price related differential. Until now, usually only the measures for appraisal level (it is called ratio A) is used as indicator in the Netherlands. Figure 13 shows the NL_MassAppraisalAnalysisType, NL_MassAppraisalPerformance and VM_MeasureOfAppraisalLevel classes.

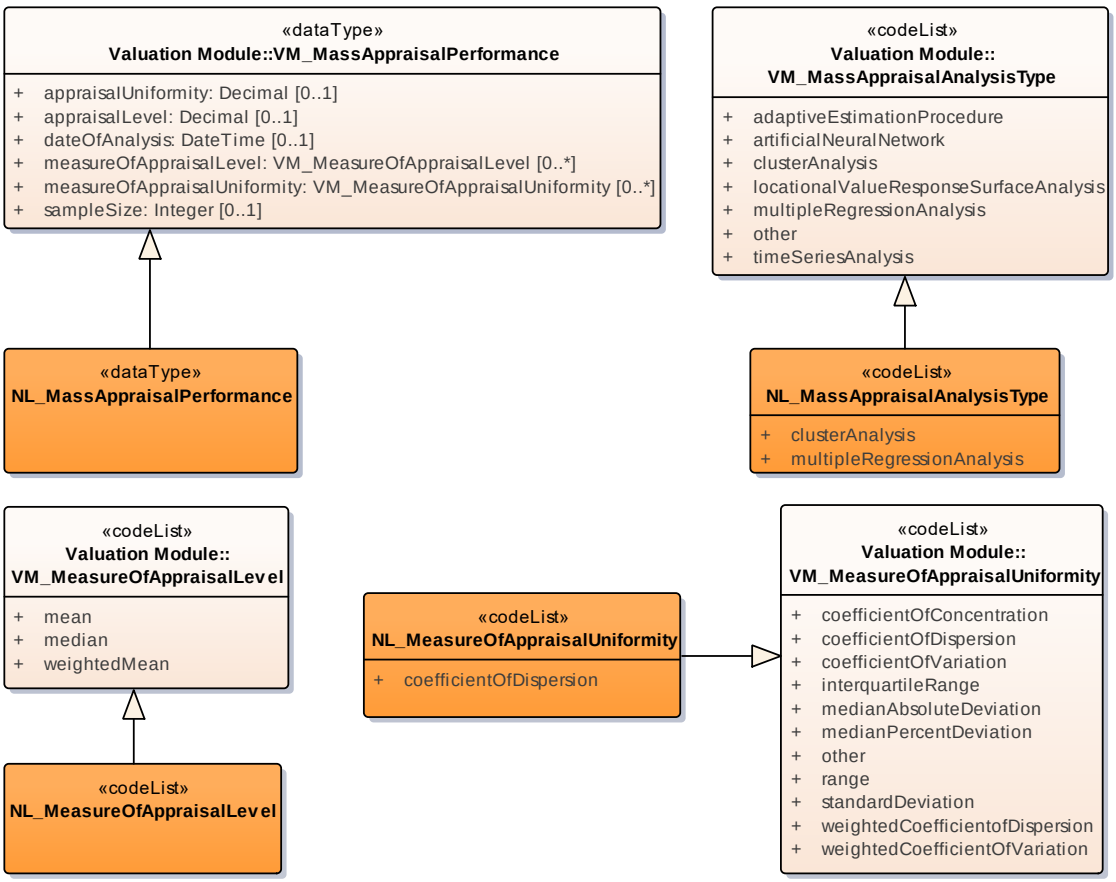


Figure 13. Mass appraisal related classes in the Netherlands Country Profile

Administrative and spatial source documents are represented in LA_Source class in core LADM. This class has a specialization, namely VM_ValuationSource class. Valuation reports can be recorded within this class. A valuation report is annually prepared for each of the valuation unit in the Netherlands for residential and non-residential properties. Valuation reports are available on the web for user and owner of properties. Furthermore, WOZ-values for residential properties are publically available on the web since 2016. VM_ValuationSource class was extended with the NL_ValuationReport class to cover valuation report related information in the Netherlands Country Profile. Note that NL_ValuationReport class has two specialization: NL_ValuationReportForDwellings and NL_ValuationReportForNon-residentialProperty. Figure 14 presents valuation reports related classes and their characteristics with the other classes of the Netherlands Country Profile.

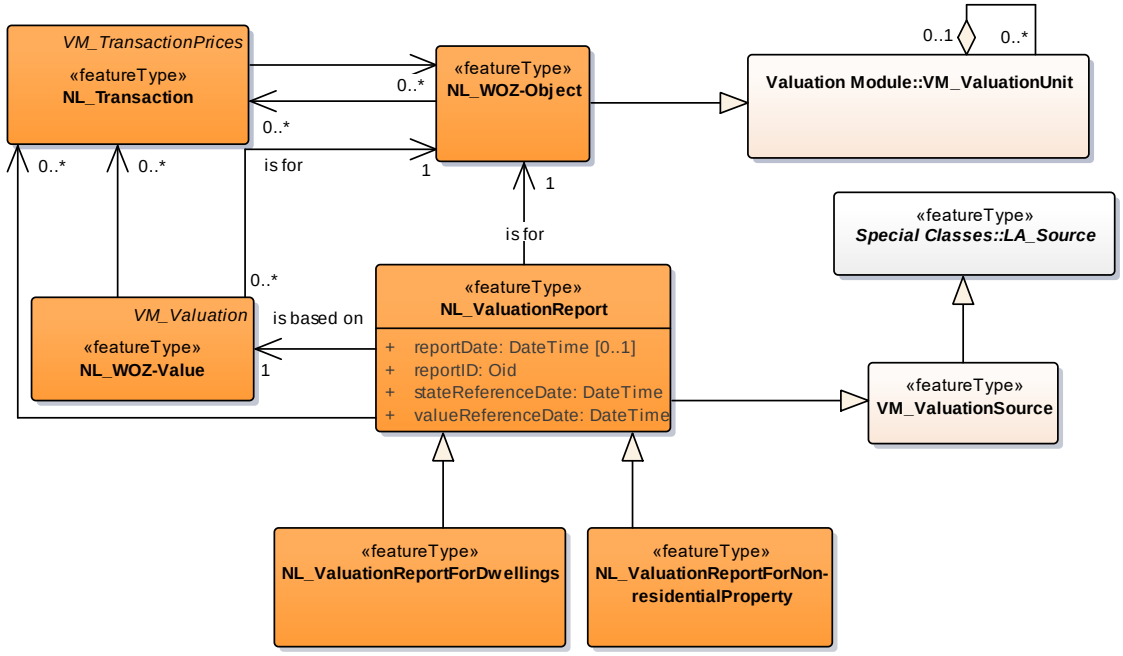


Figure 14. Valuation report characteristics in the Netherlands Country Profile

Many countries have registries to record data in relation to property transactions (e.g. transaction prices, type of transactions) and sales statistics (e.g. average values, changes in property values). Such registers are created and updated regularly with information provided from contracts or declarations submitted by the parties (e.g. buyer and/or seller) involved in the property transactions. LADM Valuation Information Model specifies characteristics of these datasets with VM_TransactionPrices and VM_SalesStatistics classes.

VM_TransactionPrices class includes information on transaction prices including the date of contract or declaration, price, transaction date and type of transaction (e.g., sale, heritage, forced sale, and rent prices). In the Netherlands, transaction prices are recorded in the cadastre, however, rent prices are not recorded. Since the rent prices of non-residential properties are needed for property valuation, are collected by municipalities in the Netherlands. Municipalities not only collect data on rent prices, but also on investments (building costs) as a base for the cost approach. To cover the transaction price and rent price related information in the country profile, the VM_TransactionPrices class was extended with NL_Transaction class as represented in the Figure 15. Note that NL_Transaction class not only records sale transactions, but also rental transactions and costs collected by municipalities. NL_Transaction class has relation with three different code list classes, namely NL_DesignationOfUsability, NL_TypeOfTransaction and NL_MarketInformationType. These code list classes are depicted in the Figure 16.

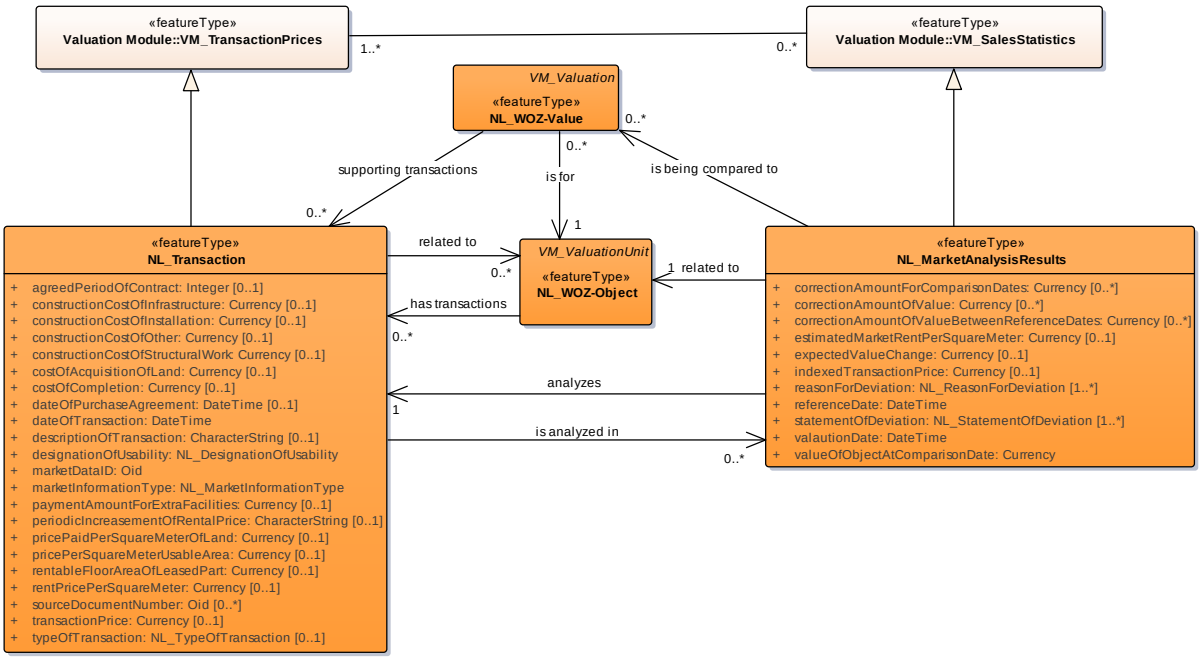


Figure 15. Transaction prices and sale statistics classes in the Netherlands Country Profile

VM_SalesStatistics class represents sales statistics produced through the analysis of transaction prices. It has characteristics to indicate the calculated average transaction prices per square meter of valuation units. Moreover, it has basePriceIndex and dateOfBasePriceIndex characteristics to record the value and date for specification of base index (e.g. Base Index Value = 100 at 2015 January), and priceIndex and dateOfPriceIndex characteristics to record the calculated price index at a given date (e.g. Index Value = 120 at 2016 January). The NL_MarketAnalysisResults give information about the usability of the transaction data for property valuation. Sale prices may not give a sound evidence of market value of the property, for example, property may have been altered after the transaction or price paid was not on market level because buyer and seller were related.

It should be added that transaction prices and valuation data might be used to create official house price indices (HPIs). Starting from 2008, the Kadaster, the Dutch land registry office, and Statistics Netherlands began jointly publishing house price index numbers for the whole country and for some specific dwelling types and regions. The indexes are computed using the Sale Price Appraisal Ratio (SPAR) method, which utilizes the ratios of transaction prices and previous appraisal values (De Vries et al., 2009). In the Netherlands, the official assessed value has been used as a base for this official index. It can be stated that the LADM Valuation Information Model can be extended to cover house price indices and market analysis as well. Therefore, the VM_SalesStatistics class was extended to cover market analysis information recorded in the Netherlands with the NL_MarketAnalysisResults class. NL_MarketAnalysisResults has relations with two code lists, which are NL_ReasonForDeviation and NL_StatementOfDeviation. The values of these code lists are shown in the Figure 16.

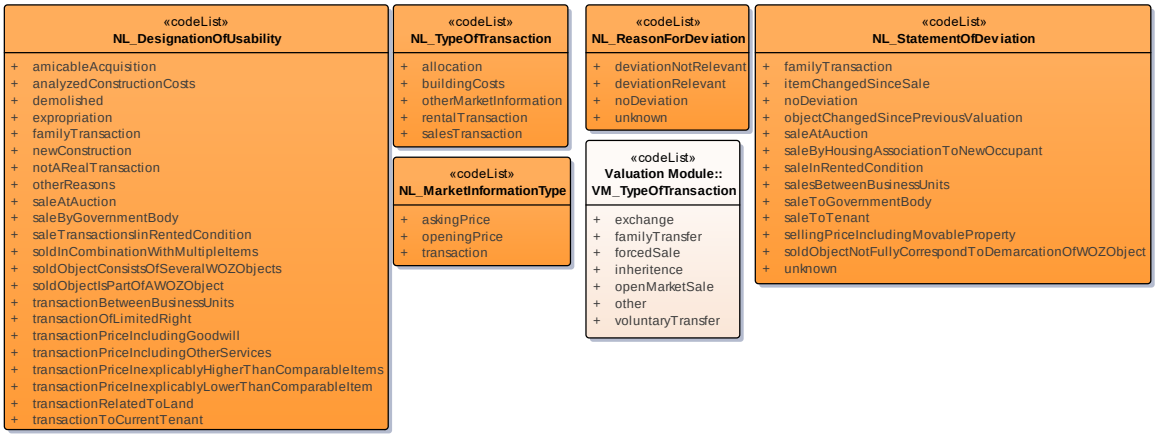


Figure 16. Code list classes of NL_Transaction and NL_MarketAnalysisResults

LA_Party class in the core LADM represents the natural and legal persons, and groups consisting of a number of parties both of which play a role in land administration. LA_PartyRoleType code list provides values for the role performed by the parties (e.g., surveyor or notary). This code list is extended with the valuation related roles (e.g. assessor, internal valuer, qualified valuer) in the LADM Valuation Information Model. For the Netherlands Country Profile, LA_Party class was extended with the NL_WOZ_Subject. Furthermore, NL_WOZ-Interest class was created as an association class between NL_WOZ-Object and NL_WOZ-Subject classes. Figure 17 shows the characteristics and relations of NL_WOZ_Subject and NL_WOZ-Interest classes.

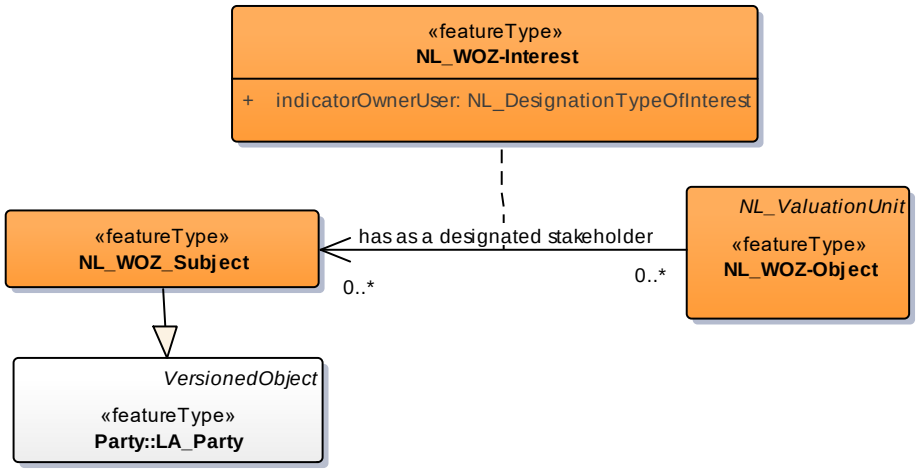


Figure 17. Party related class of WOZ-Interest in the Netherlands Country Profile

NL_WOZ-Interest class has related with the NL_DesignationTypeOfInterest code list that represents the valuation and real estate taxation related roles in the Netherlands. LA_PartyRoleType code list was extended with the NL_DesignationTypeOfInterest to cover

the country specific party roles in valuation activities. Figure 18 presents the values of NL_DesignationTypeOfInterest code list.

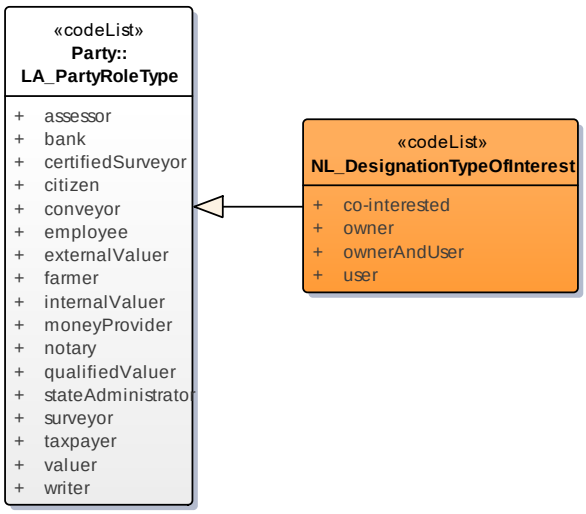


Figure 18. Code list class of designation type of interest in the Netherlands Country Profile

## 5. CONCLUSION

This paper proposes the Netherlands LADM Valuation Information Model Country Profile. LADM Valuation Information Model is designed to facilitate all stages of immovable property valuation, namely the identification of properties, assessment of properties through single or mass appraisal procedures, generation and representation of sales statistics, and dealing with appeals. More specifically, it enables the recording of data concerning the parties that are involved in valuation practices, property objects that are subject of valuation, as well as their characteristics. The flexible framework of LADM and LADM Valuation Information Model provides for the further development of country specific data models.

The paper examines the public property valuation system to determine the WOZ-value in the Netherlands. It is concluded that LADM Valuation Information Model is a solid base for structuring data for valuation and can be extended to cover property valuation practices in the Netherlands. In other words, the characteristics of WOZ register and its relation with other public registers (i.e. BAG, BRK and BRT) which are typical for the situation in The Netherlands can be represented as an extension of LADM Valuation Information Model. This study shows that LADM Valuation Information Model can be extended with country specific situation in property valuation in order to represent current state of property valuation or to determine plans for property valuation system. Since the Netherlands has a complete, effective and robust property valuation system, it can be stated that LADM Valuation Information Model is a complete model that provides decent basis for representing or designing a property valuation system. As a future work, it is intended to develop a prototype for the Netherlands LADM Valuation Information Model Country Profile to test and evaluate

whether the profile fulfills the needs of information management aspects of property valuation activities and whether it is complete and not over-ambitious.

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