Are Croatian Official Registers complying with the LADM Fiscal/ Valuation Extension?

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SUMMARY

The primary purpose of a Land Administration System (LAS) is to support the processes of recording and disseminating information about the ownership, value and use of land and its associated resources. An important task of LAS is land valuation for taxation purposes, which supports land management processes. Land valuation for taxation implies mass valuation methods, which use statistical analysis of valuation indicators to assess the best use of many real properties at the same time. However, to make fair and correct assessments, sufficient accurate and up-to-date data for each land parcel together with accompanying buildings and other constructions on it must be available. Some of the required data exists, but they are stored across different land registers and other registers, and are administered by various public authorities.

To avoid further data redundancy, mass valuation information system can be based on existing data stored in distributed registers and shared by agreements between various public authorities. Therefore, the crucial part of the LAS is the data model, which needs to be carefully developed to efficiently fulfil the primary purpose of the system; its development should be based on best practices from countries with similar LAS using well-known standards.

This paper analyses the data models in the official Croatian registers and the possibilities of using them in land valuation and taxation extension in the Croatian Land Administration Domain Model (LADM) profile. The analysis identifies possible data, registers and responsible authorities whose data are appropriate to be used as an attribute for determining valuation indicators. The basic unit of such a system is real property, which can be generally seen as land and accompanying buildings or other constructions, or jointly owned individual parts of the property according to the property subdivision plan. Regardless of the valuation method used, each property type valuation indicator can be divided into external factors (e.g. location, zoning regulations) and internal factors (e.g. land parcel area, number of floors) for each property and can be seen in general as real property characteristics (e.g. land parcel area, number of floors).

Some of the required data are found to be redundant (e.g. personal data) and some are found to be missing (e.g. building characteristics). For multiple sources of data, the paper considers the most appropriate one, based on the assessment of data completeness and whether the data are up-to-date.

Schema matching is used to relate valuation attributes to appropriate LADM classes. Schema matching is a set of techniques used for comparing the schema of different data models, searching for similar or equivalent elements. The manual schema matching approach proved to be appropriate for the relatively small extent of the covered Croatian LADM data. The created UML class diagrams are used to show the level of compliance of available data with LADM valuation and taxation extension.

This work demonstrates that a detailed review of valuation attributes is crucial in the development process for a mass valuation system because the whole system greatly depends on the availability and quality of the chosen attributes. An appropriate mass valuation system based on these premises can improve the usability of existing LAS, which could be used not only to provide fair and efficient land taxation, but also as a tool to make urban and rural spatial planning more sustainable.

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1. INTRODUCTION

The primary purpose of a Land Administration System (LAS) is to support the processes of recording and disseminating information about the ownership, value and use of land and its associated resources (UN ECE, 1996). An important part of LAS is land valuation for taxation purposes, which supports land management processes. Land valuation for taxation implies mass valuation methods, which use statistical analysis of valuation indicators to assess the best use of many real properties at the same time. To make fair and correct assessments, sufficient accurate and up-to-date data for each land parcel together with any accompanying constructions and other structures on it must be available.

Land valuation for taxation purposes has always been an important part of the cadastral system. In the Croatian cadastre, land valuation was done in the time of the Franciscan cadastre (Roić, 2012), in which taxation was the main purpose. Land valuation was done through land-use and soil quality classification for the purposes of agricultural income determination. Although the fundamental goal for the establishment of most cadastral systems is land or real property taxation, in Croatia the determination of land tax based on the cadastral income was abandoned in 1997 owing to the claimed high collection costs.

The Croatian Science Foundation (CSF)-funded project "Development of Multipurpose Land Administration Systems" (Roić, Vranić, Kliment, Stančić & Tomić, 2017) addresses all the above mentioned issues by transformation from a LAS to a multipurpose LAS (MLAS). The proposed MLAS increases the efficiency and usability of the LAS through development of improved data process models for detected new LAS users. The usability segment of the project's approach focuses on the integration of the rights, restrictions and responsibilities (RRRs) aspect of the LAS with its land valuation and land-use components. These components are needed to support fair and efficient mass land valuation/taxation and integral urban/rural spatial planning. This can be achieved by introducing the additional attributes or additional feature classes to the existing data models. The project's proposed models are based and built upon the well-known international standard, the Land Administration Domain Model (LADM).

In the domain of national land administration systems, there are different drivers and requirements, often complex and changeable, that make it difficult to find a single solution for any country (Bennett, Rajabifard, Williamson & Wallace, 2012). The LADM (ISO 19152:2012) is a conceptual model and an ISO standard that defines land administration-related data models and standardised global vocabulary. The LADM deals primarily with the registration of RRRs to the land and considers the other aspects of land administration to be external (Lemmen, van Oosterom & Bennett, 2015). The most recent efforts in land administration have focused on reconsideration of whether LADM should include data

acquisition, maintenance and publication processes, as well as more detailed classification of the legal part of the LADM (Lemmen et al, 2017).

LADM is useful in many specific land-management activities, for example the design process for multi-purpose land consolidation (Lemmen, Jansen, Rosman & Rosman, 2012). An initial design of an LADM-based valuation and taxation data model (Çağdaş et al, 2016) introduced an extension module that responds to fiscal requirements used in real property valuation and taxation. The module describes the conceptual schema of the fiscal registry/database and its linkage to other official registries.

Analysis of the current registers showed that they contain a relatively large amount of redundant data, especially data related to natural and non-natural persons (Mađer, Matijević, & Roić, 2015). This is cited as being a direct consequence of the lack of any linkage between the official registers.

Based on LADM valuation and taxation extension and the Croatian LADM profile (Mađer 2015), in this paper we analyse the possibility of using data from official registers in the process of land valuation. Land valuation for the purpose of taxation implies the use of mass valuation methods, which use statistical analysis of valuation indicators to assess the value of multiple real properties concurrently.

However, the data are the most important and often the most expensive part of any information system. In addition to the official registers, public authorities collect and keep different real property data sets in separate registers (databases) for some specific purposes. Use of this data in a distributed environment would allow the development of a viable and cost-effective valuation/taxation information system. Valuation by means of official data and based on clearly defined valuation assumptions would make it possible to increase the transparency level, which is identified as one of the key points of the current UN FAO technical guide on valuing land tenure rights (UN FAO, 2017).

2. METHODOLOGY

To check the compliance of the official Croatian registers with the LADM fiscal/valuation extension, an outside-in approach was used to identify all the existing registers dealing with the required valuation data. The LADM fiscal/valuation extension, developed as an LADM extension and based on international taxation and valuation standards and best practices, was considered suitable for the data modelling for a mass real property valuation system for effective taxation purposes.

The Croatian LADM profile (Vučić, 2013) and papers dealing with the linking of key registers (Mađer et al, 2015) and the development of a multipurpose LAS (Roić et al, 2017) were used as the starting point for the analyses of the official registers. The main task in this research was the identification of the required valuation data (valuation attributes) registered in official registers and comparison against the LADM fiscal/valuation extension.

This process of comparing two or more data models is called schema matching (Batini, Lenzerini & Navathe, 1986). Because of the relatively small number of classes and attributes, manual schema matching was used. Based on the data obtained from manual schema matching, compliance analysis was carried out showing how many of the identified attributes correspond with the LADM fiscal/valuation extension. However, it is expected that some of the LADM fiscal/valuation extension attributes will be found to be missing because there is currently no mass real property valuation system running in Croatia and thus possible valuation attributes (especially detailed real property physical characteristics) are not registered for taxation purposes.

3. OVERVIEW OF CROATIAN OFFICIAL REGISTERS

The analysis of the official registers included all available registers (and some additional important data sources) that contain information about the land (and connected building or other structures and their characteristics) and/or the persons who have an interest in it (Table 1).

Table 1. Analysed registers and data sources

Authority	Register/data source
State Geodetic Administration (SGA)	– Cadastre (Land Book) – Register of spatial units – Utility cadastre
Judicial Authority/Ministry of Justice	– (Cadastre) Land Book – Register of non-natural persons
Tax Administration (TA)	– Register of personal identification numbers – Collection of real property purchase prices
Ministry of Public Administration	– Register of natural persons
Ministry of Construction and Physical Planning	– Physical Planning Information System (Register of physical planning documentation) – Register of buildings energy certificates – Real Estate Market Information System
Ministry of Agriculture	– Register of agricultural land parcels: Land Parcel Information System (LPIS, Croatian abbrev.: ARKOD)
Local authorities	– Communal fee data
Croatian Bureau of Statistics	– Price trends and indexes, regional development index (RDI)

The Croatian legal system is built on Roman law, which is common to the countries of Western Europe. Official registers can be classified into registers of persons, properties and rights (Mađer et al, 2015).

The Real Property Registration and Cadastre Joint Information System (JIS) is a unified database and application for keeping and maintaining the land/property and rights/charges data (Land Book and Cadastre). Jurisdiction over the JIS is divided between two institutions (the State Geodetic Administration and the Ministry of Justice) through a steering committee that includes members from both institutions.
The Register of Spatial Units (Croatian abbrev: RPJ) contains various types: administrative units, cadastral units, statistical units, etc. For each unit type, there is a registered ID, names,

boundary and some connected attribute data. The address register is a part of the RPJ. ARKOD is the national system of agricultural parcel identification, which registers the agricultural use of land in the Republic of Croatia. Its purpose is to enable farmers to apply for subsidies in agriculture as well as their more transparent use. It is under the authority of the Ministry of Agriculture.

The Physical Planning Information System (Croatian abbrev: ISPU) stores and administers spatial information related to physical planning. It keeps information on the intended land use, conditions and limitations of the usage of space, infrastructure and programmes for protection of the space.

The Tax Administration (TA) is an administrative organisation within the Ministry of Finance. Its primary task is the application of tax regulations. The TA records the data on real property transactions, which are copied into the Real Estate Market Information System (e-Nekretnine), operated by the Ministry of Construction and Physical Planning. The TA carries out tasks related to the determination and assignment of a personal identification number (Croatian abbrev: OIB). A personal identification number is assigned to both natural and non-natural persons.

3.1 Current state of valuation and taxation in the Republic of Croatia

As described, owing to the claimed high collection costs, the determination of the amount of land tax based on the cadastral income was abandoned in 1997. Currently, there is still no tax on any real property types, although it was planned to introduce a tax in 2017. Real property is taxed based on the income from certain types of real property, the acquisition of real property and the ownership, but only on some types of real properties. Local taxes (responsibility and income of local self-government units) are paid for housing and office facilities, but there is no flat property tax in Croatia. It is expected that the local tax will be replaced by a real property tax. Exemptions are covered by regulations and all taxpayers (both natural and non-natural persons) have a personal identification number (Croatian abbrev.: OIB).

Individual real property valuation is prescribed by the Property Valuation Act (Official Gazzette of the Republic of Croatia, 2015). Property valuation may only be performed by authorised persons. The Act prescribes three main real property valuation methods: sales comparison, income approach and cost approach. Based on transactions, real property purchase prices are collected and maintained by the TA of the Ministry of Finance. Records are stored in the Real Estate Market Information System (e-Nekretnine). These data are used by authorised persons (sworn court experts and sworn court valuers) to make individual property valuations. Currently, no public organisation/authority uses these or any other data for the assessment of properties for property taxation purposes.

3.2 Croatian LADM profile

The first version of Croatian LADM profile was developed in 2012 (Vučić, Roić & Kapović, 2013), and some small changes were introduced a year later (Vučić, 2013) (Figure 1). Based on the created profile, some conclusions were drawn on the compliance of the Croatian land administration system (LAS) with LADM.

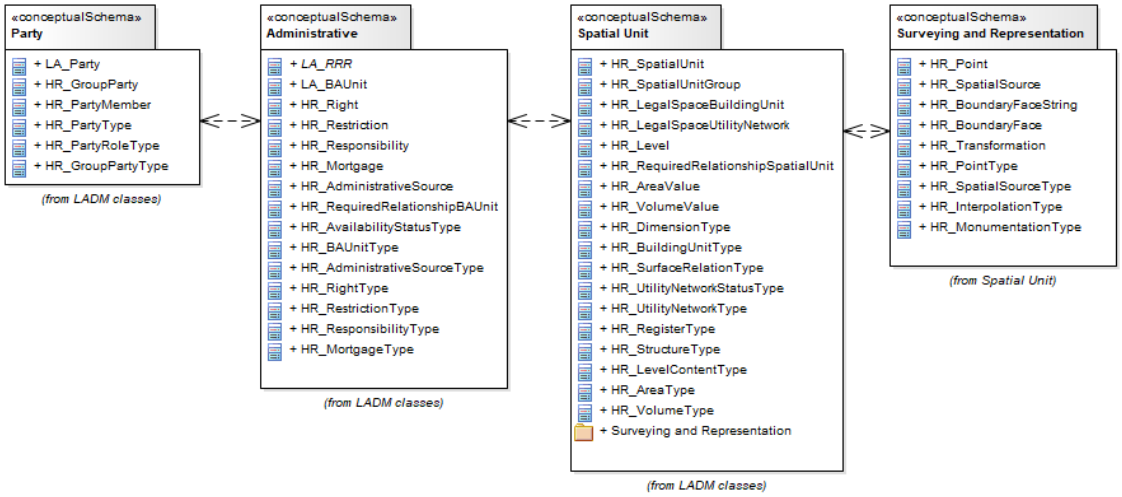

Figure 1. Croatian LADM profile overview – packages with classes (Vučić, 2013)

A high level of compliance was confirmed, meaning that most of the classes can apply directly to the Croatian LAS. Only two classes were unable to be matched and were added to the final country profile (Vučić et al, 2013). The created profile included all main packages and classes: party, administrative and spatial unit package, together with matched attributes found in the Croatian LAS registers.

4. LADM VALUATION/TAXATION FISCAL EXTENSION

The initial design of the ISO 19152:2012 LADM-based valuation and taxation data model (Çağdaş et al, 2016) proposes an LADM extension module, dealing with management of datasets in relation to real property valuation and taxation. The paper considers the fiscal registry/database as one of the core registries of national land administration, and discovers the gap between international standards related to procedural aspects of immovable property valuation and the required standard that defines semantics and data of fiscal register (database). Integration of distributed databases, maintained by different authorities, can be achieved through spatial data infrastructure (SDI). However, for now, SDI includes only technical data on land and not interests. In Croatia, great efforts have been undertaken to harmonise existing datasets and to enable spatial data services that meet the needs of NSDI (Cetl, Tóth & Smits 2014).

The LADM fiscal extension consists of review of external LADM classes dealing with taxation and valuation (ExtValuation and ExtTaxation) and fiscal extension core classes (Figure 2), together with datatypes and code lists. The proposed extension is designed to facilitate all stages of immovable property taxation.

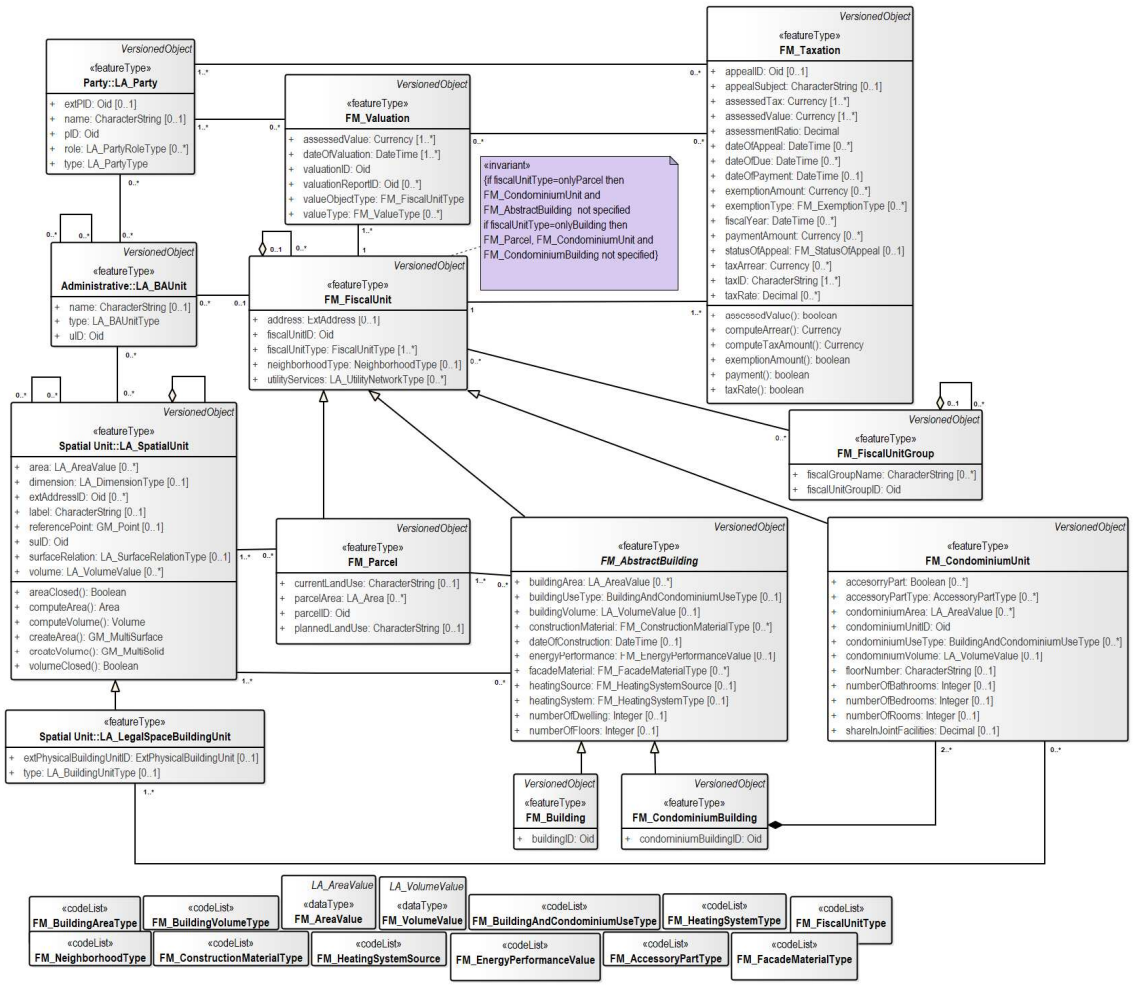

Figure 2. Core classes of fiscal extension module (URL 1)

The main classes of FM_Valuation, FM_Taxation and FM_FiscalUnit are specified and explained in detail using UML class diagrams, showing datatypes, code lists and related classes. The extension is developed to support different property taxation scenarios: taxation of immovable properties including cadastral parcels, buildings and other structures, only cadastral parcels, only buildings or only condominium units with privately owned building parts. FM_FiscalUnit represents the basic recording units of fiscal registries and it is associated with LA_BAUnit. It is associated with FM_AbstractBuildings class to specify buildings and/or building parts and their physical characteristics. This class has two concrete classes: FM_Building and FM_CondominiumBuilding, which represent buildings whether they are considered complementary parts of parcels or not. Class FM_Valuation and FM_Taxation are created to specify valuation and taxation information, whether it is produced by individual or mass valuation.

5. DATA REQUIREMENTS

As mentioned, there are three main methods of real property valuation, mainly used for assessment of individual properties. Mass valuation is the procedure that, based on valuation factors and by using statistical methods, assesses the value of many real properties. In order for this assessment to be fair and correct, it is necessary to acquire appropriate data on each parcel of real property (UN ECE Working Party on Land Administration, 2001). Some of the required data (for both single and mass valuation) are collected and maintained in the LAS and they are identified in the Croatian LADM profile, but it is expected that some of the required valuation data (e.g. real property characteristics like number of rooms/bathrooms, heating type) is not systematically registered in one or more of the key registers.

In our previous papers (Kuburić, Tomić & Mastelić Ivić, 2012; Tomić, Mastelić Ivić & Roić, 2014), we divided the problem of data management needed for mass valuation into two sub-systems, as illustrated in Figure 3.

– spatial unit's valuation data: external – location factors, common to all the properties in one area;
– real property characteristics: recognised important characteristics of each individual real property.

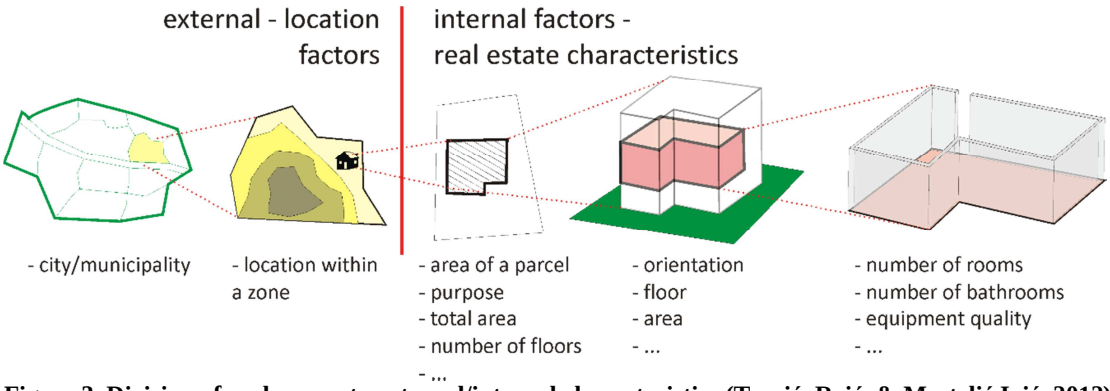

Figure 3. Division of real property external/internal characteristics (Tomić, Roić, & Mastelić Ivić, 2012)

5.1 Classification of real property and their valuation attributes

Application of automatised mass valuation techniques demands clearly structured and classified data. The Croatian official register includes data about properties, interests and persons involved, but lacks detailed real property characteristics. The TA collects detailed real property characteristics from processed contracts but the data is not structured in a way that enables automatic processing. Based on the mass valuation system requirements derived from international best practices (Bagdonavicius & Deveikis, 2006; Smodiš & Mitrović, 2012; TEGoVA, 2012; UN ECE Working Party on Land Administration, 2001; World Bank, 2016) and our previous research (Tomić, 2015; Tomić et al, 2012) and projects (Roić et al, 2017), a real property classification for taxation purposes was created, together with the associated valuation attributes (Table 2).

Table 2. Proposal for real property classification for taxation purposes

Agricultural land	Forest land	Building land	Single-family house	Residential condominium	Commercial condominium	Parking space / garage	Attribute	Authority/Register
x	x	x	x	x	x	x	ID	Cadastre (HR_SpatialUnit: label)
x	x	x	x	x	x	x	Purchase price	Ta Administration
x							Land use	LPIS
x	x	x	x	x	x	x	Location	Cadastre (HR_SpatialUnit: referencePoint)
x		x					Shape	Cadastre (HR_SpatialUnit)
x	x	x	x			x	Surface area	Cadastre (HR_SpatialUnit: area)
x							Height above sea level	Cadastre
x							Slope	Cadastre
x							Orientation	Cadastre
x							Soil type	-
x	x						Land cover	Environmental information system (Corine Land Cover)
x							Precipitations	Croatian hydrometeorological institute
x							Number of sunny hours	Croatian hydrometeorological institute
x	x						Improvements	-
	x						Wood mass	-
		x	x				Utility infrastructure	Cadastre (Utility cadastre)
		x	x		x		Zone	Physical Planning Information System
		x	x				Buildable area	Physical Planning Information System
			x				Number of flats (1–2)	-
			x	x	x		Building surface area	Cadastre (HR_SpatialUnit:usageTypeBuilding)
			x	x	x		Net usable area	Local authorities (Communal fee data)
			x	x	x		Terrace, balcony and loggia area	-
			x	x	x		Surface area of parking space	Local authorities (Communal fee data)
			x	x	x		Surface area of garage	Local authorities (Communal fee data)
				x	x		Elevator	-
			x	x	x		Date of construction	-
			x	x	x		Date of last renovation	-
			x	x	x		Energy class	Register of buildings energy certificates
			x	x	x		Number of rooms	-
			x	x	x		Number of bathrooms	-
			x	x	x		Heating type	-

				x			Number of flats in the building (3 and more)	-
				x	x		Floor	-
				x	x		Number of floors	-
				x	x		Construction completeness	-
					x		Commercial type	-
					x	x	Structure type	-
					x		Direct entrance	-
					x		Street side	-

Many identified attributes are not the subject of the registration and for those the most appropriate register should be identified. The most real property valuation attributes are registered in the cadastre and local tax registers (local authorities). These attributes, combined with TA data on transaction prices, can be used to start a mass valuation system to some extent.

6. RESULTS AND DISCUSSION

Schema matching included determination of class and attribute matching for the LADM fiscal/valuation extension (LADM_FM) against identified classes and attributes in the Croatian official land registry and other registries. For the unmatched attributes, compliance with proposed classification for taxation purposes is examined. Compliance means semantic matching of two sets of attributes. This is often indicated as a ratio of the number of corresponding attributes to the number of not corresponding attributes. The LADM_FM was divided into three groups of classes: FM_FiscalUnit and related classes, FM_Valuation and related classes, and FM_Taxation and related classes. Most of the matched attributes are found in the Joint Information System of Cadastre and Land Book (

Table 3The analysis shows that there are many missing data related to detailed real property characteristics.

Table 3. Attributes of FM_FiscalUnit and related classes

Class	Attribute and code list/datatype class	Register
FM_FiscalUnit	fiscalUnitID	Cadastre
	fiscalUnitType: FiscalUnitType	Cadastre
	address	Cadastre
	neighborhoodType: NeighborhoodType	Cadastre
	utilityServices	Cadastre
FM_FiscalUnitGroup	fiscalUnitGroupID	Cadastre
	fiscalGroupName	Cadastre
FM_Parcel	parcelID	Cadastre
	parcelArea: LA_Area	Cadastre
	parcelVolume: LA_VolumeValue	Cadastre
	currentLandUse	Cadastre
	plannedLandUse	Physical Planning Information System
FM_AbstractBuilding	buildingarea: LA_AreaValue	Cadastre/Land Book
	buildingVolume: LA_VolumeValue	-
	buildingUseType:	Cadastre/Land Book

	BuildingAndCondominiumUseType	
	numberOfDwelling	-
	numberOfFloors	-
	dateOfConstruction	-
	constructionMaterial: FM_ConstructionMatherial	-
	facadeMaterial: FM_FacadeMaterialType	-
	heatingSystem: FM_HeatingSystemType	-
	heatingSource: FM_HeatingSystemSource	-
	energyPerformance: FM_EnergyPerformance	Register of buildings' energy certificates
FM_Building	buildingID	Cadastre/Land Book
FM_CondominiumBuilding	condominiumBuildingID	Cadastre/Land Book
FM_CondominiumUnit	condominiumUnitID	Land Book
	condominiumArea: LA_AreaValue	Land Book
	condominiumUseType: BuildingAndCondominiumUseType	Land Book
	condominiumVolume: LA_VolumeValue	-
	floorNumber	-
	accessoryPartType: AccessoryPartType	-
	shareInJointFacilities	Land Book
	numberOfRooms	-
	numberOfBedrooms	-
	numberOfBathrooms	-

Matched attributes are fully compliant with the LADM fiscal valuation/taxation extension. Missing attributes were matched against proposed classification for taxation purposes and unmatched attributes are discussed in conclusion.

Matching of the FM_Valuation and related classes (Table 4) shows only a few matched attributes, registered in the TA department of the Ministry of Finance. The matched attributes are fully compliant.

Table 4. Attributes of FM_Valuation and related classes

Class	Attribute and code list/datatype class	Register
FM_Valuation	valuationID	-
	valuationReportID	-
	dateOfValuation	-
	valueType: FM_ValueType	-
	valueObjectType: FM_FiscalUnitType	-
	assessedValue	-
FM_SinglePropertyAppraisal	valuationBySalesComparisonMethod: FM_SalesComparisonMethod	Tax Administration
	valuationByIncomeMethod: FM_IncomeMethod	Tax Administration
	valuationByCostMethod: FM_CostMethod	Tax Administration
FM_MassAppraisal	mathematicalModel	-
	sampleSize	-
	analysisType: MassAppraisalAnalysisType	-
	performanceIndicator: FM_MassAppraisalPerformanceIndicator	-
	estimatedValueByMassAppraisal	-
FM_TimeSeriesData	analysisID	-

	dateOfAnalysis	-
	averagePricePerSquareMeter	-
	basePriceIndex	-
	dateOfPriceIndex	-
	priceIndex	-
	dateOfPriceIndex	-
FM_TransactionPrices	contractOrDeclaration	Tax Administration
	dateOfContractOrDeclaration	Tax Administration
	transactionPrice	Tax Administration
	typeOfTransaction: FM_TypeOfTransaction	Tax Administration

Table 5. Attributes/operation of FM_Taxation and related classes

Class	**Attribute/class operations and code list/datatype class**	**Register**
FM_Taxation	taxID	-
	fiscalYear	-
	assessedValue	-
	assessmentRatio	-
	exemptionAmount	-
	exemptionType: FM_ExemptionType	-
	taxRate	Tax Administration
	assessedTax	-
	dateOfDue	Tax Administration
	paymentAmount	-
	dateOfPayment	Tax Administration
	taxArrear	Tax Administration
	appealID	-
	dateOfAppeal	-
	appealSubject	-
	statusOfAppeal: FM_StatusOfAppeal	-
	assessedValue()	-
	taxRate()	-
	exemptionAmount()	-
	computeTaxAmount()	-
	payment()	-
	computeArrear()	-

The lack of a mass valuation system for taxation purposes is the reason that there are only a few matched attributes of FM_Taxation and related classes (Table 5). Additionally, matched attributes compliance cannot be checked owing to the unavailability of an exact TA data model. Attributes found to be missing in LADM_FM are mainly related to valuation of agricultural land (height above sea level, slope, orientation, soil type, precipitations, number of sunny hours) and condominium and single-family houses characteristics (area of terrace, balcony and loggia, surface area of parking space, surface area of garage, elevators).

7. CONCLUSION

This paper analyses data in Croatian official registers to test for compliance with the LADM fiscal valuation/taxation extension. The basic premise was that a mass valuation information system can be based on existing official data stored in distributed databases and shared by agreements between various state authorities. As expected, schema matching of LADM_FM against the limited number of available attributes registered in Croatian registers showed full compliance of the matched schemas. This expectation was because previous researchers working on this topic found a high rate of compliance between Croatian registers and the LADM. However, many valuation attributes are missing in the Croatian land registry and other registries.

The outputs from the scientific project dealing with increasing the efficiency and usability of LAS (Development of Multipurpose Land Administration Systems) were considered to develop a proposal for real property classification for taxation purposes. The classification divides real property based on type and attributes, which affects the value. It was used to check whether the required valuation attributes could be found in official registers to complete missing attributes found in schema matching.

The schema matching of the FM_FiscalUnit and related classes against the proposed classification shows that most of the LADM_FM attributes are matched. There are some attributes missing in the proposal (FM_AbstractBuilding:facadeMaterial, FM_CondominiumUnit:numberOfBedrooms) since they are considered not to be necessary because their values can be correlated to existing, matched attributes: FM_AbstractBuilding:energyPerformance and FM_CondominiumUnit:NumberOfRooms.

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