LADM country profiles development: aspects to be reflected and considered

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LADM country profiles development: aspects to be reflected and considered

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Key words: ISO19152, LADM, country profile, national jurisdiction

SUMMARY

The wider recognition and use of ISO 19152 LADM Edition I, is mainly documented through the country profiles that have been developed in multiple jurisdictions across the world. Various approaches for developing country profiles have been followed, without acting in accordance with a specific (official or unofficial) roadmap or methodology. This has resulted in an interesting mosaic of country profiles, which at the same time, highlights the need to outline the basic steps that need to be followed in order to develop a country profile. Currently, the revision of the LADM Edition I is ongoing, and the discussion for the development, maintenance and update of the existing and future LADM-based country profiles has been initiated. Therefore, it is considered a good timing to address the experience gained from the developed country profiles and introduce methodological steps for the development of country profiles.

This paper reflects on the country profiles that have been developed so far, identifying similarities and discrepancies on the path followed, bearing in mind the scope and objective of the development of those profiles and their level of maturity, also conforming to the land registration system and national jurisdiction. Thus, the paper is separated in three main parts: the first part that introduces the LADM revision and its scope, reflects on the existing country profiles and outlines the components of the proposed methodology. The second part presents an LADM-based country profile for Malaysia, as an example application of the proposed methodology. Finally, the last part is dedicated to the discussion, conclusions and proposals for future steps in the context of LADM revision.

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1. INTRODUCTION

The broader acknowledgment and use of ISO 19152 LADM Edition I, is documented mainly through the country profiles that have been developed in multiple jurisdictions across the world. The development of the country profiles can be categorised in two groups depending their maturity level: the first country profiles that have been developed with the standardisation of LADM (2012) and the country profiles that have been developed afterwards and are based on existing knowledge. It is evident that some of the country profiles that have been initially developed and are also included in Annex D, of the Edition I, may need to be revised and completed.

For the development of country profiles various approaches have been followed, without acting in accordance with a common specific (official or unofficial) template or methodology. This has resulted in a usable material to exploit, i.e., an assortment of profiles, which also highlights the need to outline the basic steps that need to be followed in order to develop a country profile.

Currently, the revision of the LADM Edition I is ongoing, and the discussion for the development, maintenance and update of the existing LADM-based country profiles, as well as the development of new ones has been initiated. This paper aims to draw on the experience gained from the developed country profiles and draw some conclusions from them, as well as to introduce methodological steps for the development of country profiles. In Section 1.1 the scope and main directions of LADM revision are presented.

1.1 ISO 19152 LADM revision

The standardization project of the Land Administration Domain Model (LADM) (ISO19152, 2012) started back in 2008, when the first proposal was submitted as a result of activities within FIG since 2002. Following, a long period, the status as International Standard was obtained for LADM (first Edition) in December 2012.

ISO standards, which are being applied, are subject to periodic revision, typically in a 6 to 10-year cycle. As LADM is being used and implemented worldwide since 2012, areas for improvement and enhancement are identified, while the new users' demands should be depicted at a revised edition of the standard.

At an UN-GGIM Meeting of the Expert Group on Land Administration and Management, which was held on 2017 in Delft, The Netherlands, the main conclusion was that the revision

of LADM was needed in order to provide better tools to improve tenure security and better land and property rights for all. Therefore, the revision, started in May 2018 and is a joint activity as land administration is a rather complex domain, and thus, various stakeholders are and will be involved, namely: ISO, FIG, OGC, UN-Habitat, UN-GGIM, World bank, GLTN (Global Land Tool Network), IHO, RICS, etc.

The International Federation of Surveyors (FIG) submitted a New Work Item Proposal to ISO on the development of the LADM Edition II in April 2018. The proposal included the following scheduled main LADM extensions:

1. Extended scope of conceptual model. This includes: valuation information, SDG LA indicators, Performance Index, linking legal objects with physical ones, indoor models, support of marine spaces, spatial planning/zoning with legal implications, support of other legal spaces: mining, archaeology, utilities;
2. Improvement of the current conceptual model. This includes: formal semantics/ontology for the LADM Code Lists; more explicit 3D+time profiles; an extended survey and legal models;
3. Encodings/technical models towards LADM implementation. This includes: further integration with BIM/IFC, GML, CityGML, LandXML, LandInfra, IndoorGML, RDF/linked data, GeoJSON, and
4. Process models for survey procedures: map updating, transactions – including blockchain.

At the LADM Edition I, eight country profiles are included in Annex D, namely: Portugal, Queensland - Australia, Indonesia, Japan, Hungary, The Netherlands, Russian Federation and Republic of Korea. Since, then, the number of developed country profiles has been increased a lot, and it is considered expensive and not convenient to present all of them as an Annex of the revised ISO. What is more, questions are now posed, regarding the quality, the level of maturity and the level of LADM conformity of those country profiles. Discussion on those aspects is presented in Section 5.

The working draft of the revised Edition of LADM (ISO/WD1 19152-v2(E)), currently, includes an initial text regarding methodology for the development of LADM-based country profiles, considering both technical and non-technical aspects, in ANNEX D.1 “Methodology for developing a country profile”. This initial text, which is a step towards the development of a roadmap for LADM-based country profiles is further analysed and described in Section 3.

During the ISO/TC 211 48th Plenary meeting that took place in Maribor, Slovenia, in June 2019 there was a discussion about the country profiles, their structure, the need for a methodology and the maintenance options that need to be examined, as more and more profiles are now being developed. In this context, RMIR University underlined that guidelines around producing country profiles should be developed to assist in implementation.

2. LADM-BASED COUNTRY PROFILES – EDITION I

The major impact of LADM Edition I is through its recognition as an ISO standard for the domain of land administration (Lemmen et al., 2015). Its growing influence is revealed by the multiple country profiles that have been developed so far in various jurisdictions across the world.

This Section presents an overview of those country profiles, identifies their characteristics, and presents an inventory of the majority of them, including their versioning. Specifically, Section 2.1 presents a list and a discussion on the LADM-based developed country profiles, while in the following section (2.2), the lessons learnt, and conclusions drawn by those profiles are discussed.

It is noted that, apart from the profiles that are described in Table 1, various LADM-based profiles have been developed from several countries for the management and administration of specific domain areas, to name a few: archaeological sites; underground utilities; public (State) property; natural resources; marine space.; agricultural land uses. Those applications reveal that LADM meets the requirements of law and organizational administration and achieve sustainable utilization of land, air, water and other related natural resources. It is pointed out that the authors of those profiles did not follow a common specific methodology to create them, and each one acted with regards to the needs and requirements of their final model and their knowledge on LADM concept and classes.

All those efforts need to be considered and analysed carefully to outline the demands and requirements to be included in the Edition II of LADM, concerning country profiles development.

2.1 Inventory of LADM country profiles – Edition I

The following table presents an inventory of the LADM-based country profiles that have been developed to date, while *Table 2* lists the relevant references for those efforts.

Table 1. LADM-based country profiles

#	Country/ Jurisdiction	Prefix	Cadastral System Status	Mapping with LADM classes	Concep-tual Model/ UML	Confor-mance Level test (Annex A, ISO19152)	Technical Impleme-ntation	Develo-ped by
1	Colombia	COL_	Establi-shed and modernised	Yes	Yes	No	Yes (INTERLIS)	Academia & Gover-nment
2	Croatia	HR_	Establi-shed	Yes	Yes	Yes	No	Academia & Govern-ment
3	Cyprus	CY_	Establi-shed	Yes	Yes	No	No	Academia

#	Country/ Jurisdiction	Prefix	Cadastral System Status	Mapping with LADM classes	Concep-tual Model/ UML	Confor-mance Level test (Annex A, ISO19152)	Technical Impleme-ntation	Develo-ped by
4	Czech Republic	CZ_	Establi-shed	Yes	Yes	Yes	No	Academia & Govern-ment
5	Greece	GR_	Not fully establi-shed	Yes	Yes	No	Yes (INTERLIS)	Academia
6	Hungary	HUN_	-	-	Yes	No	No	Academia
7	Indone-sia	ID_	Establi-shed	Yes	Yes	No	Yes (3D visualisation)	Academia
8	Israel	IL_	Establi-shed	Yes	Yes	No	No	Academia
9	Japan	JP_	-	No	Yes	No	No	Academia
10	Korea	KR_	Establi-shed	Yes	Yes	No	No	Academia & Govern-ment
11	Malaysia	MY_	Establi-shed	No	Yes	No	Yes (Oracle Spatial – Bentley Microstation)	Academia & Govern-ment
12	Monte-negro	MNE_	Not fully establi-shed	Yes	No	Yes	No	Academia
13	Poland	PL_	Yes (cadastre & land registry)	Yes	Yes	No	No	Academia
14	Portugal	PT_	-	-	Yes	No	No	Academia
15	Queen-sland, Australia	QLD_	Establi-shed	No	Yes	No	No	Academia
16	Republic Srpska	BHRS_	Not fully establi-shed	Yes	Partially	No	No	Academia
17	Russian Federa-tion	RF_	Establi-shed	No	Yes	No	Yes (Interactive 3D visualisa-tion)	Academia
18	Serbia	RS_	Establi-shed	Yes	Yes	Yes	No	Academia
19	South Africa	-	Establi-shed	Yes	Yes	Yes	No	Academia

#	Country/ Jurisdiction	Prefix	Cadastral System Status	Mapping with LADM classes	Concep-tual Model/ UML	Confor-mance Level test (Annex A, ISO19152)	Technical Impleme-ntation	Develo-ped by
20	The Netherlands	NL_	Establi-shed	No	Yes	No	No	Academia
21	Trinidad and Tobago	-	Establi-shed	No	No	No	Partially	Academia
22	Turkey	TR_	Establi-shed	Yes	No	No	No	Academia
23	Victoria, Australia	VIC_	Establi-shed	Yes	Partially completed	No	No	Academia

Table 1 presents some of the characteristics of the developed profiles, that were taken into consideration in order to identify the parameters that should be considered when developing an LADM-based country profile.

Table 2. Relevant citations for the LADM-based country profiles

#	Country/ Jurisdiction	References
1	Colombia	Jenni et al., 2017
2	Croatia	Vučić et al., 2013; Mader et al., 2013 Mader et al., 2015; Vučić et al., 2017; Mader et al., 2018
3	Cyprus	Elia et al., 2013
4	Czech Republic	Janečka and Souček, 2016; Janečka and Souček, 2017
5	Greece	Psomadaki et al., 2016; Kalogianni et al., 2017;
6	Hungary	ISO 19152, 2012
7	Indonesia	ISO 19152, 2012; Budisusanto et al., 2013
8	Israel	Felus et al, 2014
9	Japan	ISO 19152, 2012
10	Korea	ISO 19152, 2012; Kim et al., 2013; Lee et al., 2015
11	Malaysia	Zulkifli et al., 2013 Zulkifli et al, 2014a; Zulkifli et al, 2014b; Zulkifli et al., 2015; Rajabifard et al., 2018
12	Monte-negro	Govedarica et al., 2018
13	Poland	Góźdź and Pachelski, 2014; Bydłosz, 2015
14	Portugal	ISO 19152, 2012
15	Queensland, Australia	ISO 19152, 2012; Karki, 2013
16	Republic Srpska	Govedarica et al., 2018
17	Russian Federation	Elizarova et al., 2012; ISO 19152, 2012
18	Serbia	Radulovic et al., 2017a; Radulovic et al., 2017b; Govedarica et al., 2018
19	South Africa	Tjia, 2014
20	The Netherlands	ISO 19152, 2012

#	Country/ Jurisdiction	References
21	Trinidad and Tobago	Griffith-Charles and Edwards, 2014
22	Turkey	Alkan et al., 2019
23	Victoria, Australia	Aien et al., 2011; Aien et al., 2012; Kalantari et al. 2018

2.2 Lessons learnt from LADM-based country profiles – Edition I

There is little research carried out in the field of reviewing the country profiles, that have been developed in multiple jurisdictions across the world and drawing conclusions from them. There is a knowledge gap to establish a flexible methodology to build LADM country profiles. To name the most relevant publications: Janečka et al., 2018; Kalantari and Kalogianni, 2018; Janečka and Souček, 2017; Govedarica et al., 2018 and Jenni et al., 2017.
The conceptual models that have been developed can be categorised into two groups; those applying a holistic approach where all aspects of cadastral information have been mapped, and to those applying focused approach where a specific part of the cadastral information is mapped in an LADM profile. Due to the modular (package) architecture of LADM, countries only use the parts they need to build a country profile. A design goal is to keep each package as simple as possible (this was also the design goal of LADM Edition I), thus try not to introduce many new classes, but use the LADM classes to serve the needs of the country.
Moreover, it is recognized that depending on the level of maturity of the existing land administration and/or cadastral information systems (CIS) and their needs in each situation, a different approach was (and/or have to be) followed.
In this context, a roadmap, consisting of six stages, to adopt the LADM in the cadastral information system has been presented by Kalantari et al (2015) analysing the potential impact of the LADM adoption in a jurisdiction with an established CIS and in a jurisdiction that is in the process of establishing a CIS. These factors include consideration of organisational motivation, institutional arrangements, information interpretation and organisation, governance framework and engagement, as well as capacity building.
What is more, Janečka et al. (2018) presented an overview of the issues met during the preparation of the LADM based country profiles for four countries (Croatia, Czech Republic, Poland, and Serbia). The authors outline three main ways (also a combination of them can be followed) in which the LADM based country profile can be developed:

- use LADM classes, attributes, code lists and relationships between classes “as is”,
- show an inherited structure between the LADM and the existing cadastral model,
- show a mapping of elements between LADM and the existing cadastral model.

In that paper, the necessity to bring together experts from academia, government and industry to work on the LADM country profile is highlighted.

Furthermore, in Colombia, the signing of the peace accords (2016) contains the agreement on an integral rural reform, including important aspects of a new Multipurpose Cadastre System. LADM was chosen to be adopted during this significant reform of the country, also due to the fact that several parcel-based land information systems with duplicated, redundant, and fragmented data, are involved in land administration processes in Colombia (The World

Bank, 2019). This is an example that countries (both developed and developing) also use LADM for their renewal (e.g. to include 3D aspects, to modernise their systems, etc.).

Furthermore, Kalantari et al. (2018) in the context of the Victorian LADM profile creation, has proposed some steps towards the creation of a country profile emphasizing on the spatial counterparts of the new model, while the mapping between ePlan and LADM classes has been performed, which is useful also for other jurisdictions that use ePlan.

From the so-far developed country profiles it is concluded that a number of parameters and of course the dynamic relationship between man and land ownership in each jurisdiction should be considered.

Given this context, a first approach towards the development of a generic country profile methodology has been introduced in Annex D1 of ISO_WD1_19152_TC211, by the authors of this paper.In the following Section, the proposed steps towards developing an LADM-based country profile are presented and further analysed.

3. METHODOLOGICAL STEPS TO DEVELOP LADM COUNTRY PROFILES

The methodology to develop a country profile based on LADM that is proposed in this paper, is based on the afore-mentioned research and builds on the existing technical knowledge and experience with LADM implementation, considering both technical (e.g. principles of data modelling, UML notation, etc.) and non-technical aspects (good knowledge of the domain of the cadastre and the related processes of the relevant jurisdiction, institutional and legal aspects, etc.) that is needed to be reflected in order a jurisdiction to adopt LADM as a step towards actual implementation.

It is noted that the following activities, are placed in a generic approach to be applicable and operationalized to serve the needs of all the jurisdictions. At a following stage, further categorisation and detailed description of those steps can be performed in order to provide a more detailed methodology for various jurisdiction types.

Starting with the development of the country profile, it is important to determine who will be involved, also referring to the existing system of land administration in line with the jurisdictional settings (civil law, common law, hybrid systems etc..), which is presented in the following paragraphs. Common practice, till today, has shown that the profiles have been developed by members of academia, national mapping agencies or similar institutions responsible for the cadastral system development and/or governmental organisation. It is important to involve members of all the related stakeholders, as mentioned before, in order to have a clear picture of the current situation, have access to land register and cadastre data and also be informed/share the vision of this country profile. As it is concluded from Table 1, most of the profiles have been developed by academia, and this is normal, as LADM has been widely known, initially, in the academic community, and there was a big interest to explore it in national level. However, having governmental and/or land administration bodies involved

in this process, provides a better insight of current situation and a more “official/formal” status of the profile.

Moreover, for a jurisdiction where a land administration and/or cadastral information system exist, one of the first steps is the analysis of the requirements defined in the national legislative framework and other relevant regulations. Rights, Restrictions and Responsibilities (RRRs) derive from the legislative framework of each jurisdiction. For those with a (well-) functioning land information system, its documentation, data model and data dictionaries should be studied and analysed, in order to be used for the code lists and enumeration enrichment.

What is more, already from an early stage, the scope of the country profile should be defined; thus, whether it will describe the current situation of the jurisdiction (and therefore it will be developed according to the existing cadastral model) or will be future proof (and include new elements/classes that are not currently registered at all, or they are not registered by the mapping authority). Specifically, for the latest case that a jurisdiction may wish to include concepts and elements that are not currently registered at its CIS, such as archaeological or other protected sites, utilities, spatial planning information, marine space, air-parcels, spatial planning information, etc., the LADM Edition II will provide separate modules that will allow the registration of such information.

Having analysed the current situation, legislation, data model and the vision/scope of the country profile, the modelling process begins by mapping the key concepts of the existing model(s) with LADM classes. Experience has shown that this modelling is not always one-to-one relationship and can also be a difficult task, as land administration is a quite complex domain. It may be the case that more than one classes/concepts of current cadastral model correspond to an LADM class and vice versa, or that there is no existing class that can be mapped with LADM concepts. This step is considered to be one of the most important, as it is the basis of the conceptual modelling.

Given this background, the conceptual modelling to capture concepts in the land information system is the next step. It is important to note that the more LADM core classes are being used, the less complex the profile will be. One of the objectives of LADM is to provide generic classes that may serve the needs of various cadastral systems across the world. At a next stage it can be considered to further categorise the needs of the different cadastral systems (deeds, titles, strata titles, etc.) and provide a more detailed matching with LADM classes to facilitate the design decisions of the developers. At the moment, the conceptual modelling of the profile will include technical and modelling aspects, such as: definition of a prefix for the jurisdiction, code lists and evaluations that will be used, new classes that need to be added, inheritance from LADM core classes, etc. The conceptual modelling should be performed in the Unified Modeming Language (UML) using tools that support the MDA-based approach, such as the Enterprise Architect (EA).

During the conceptual modelling, the following activities should take place; specifically:

- Inheritance from LADM core classes the relevant country-specific classes using a prefix denoting the country (eg. “NL” for the Netherlands);
- Creation of new classes to serve the needs of the country, only when the existing concepts do not fit to the LADM Edition I classes;
- Addition of new attributes, if needed, to address the national needs and requirements;
- Keep the associations as defined in LADM;
- Adjusting cardinalities according to national regulations and/or define relevant constraints to be imposed;
- Addition of new values to existing code lists. Use hierarchical structure of code lists as presented in Annex J of the of ISO_WD1_19152_TC211.
- Usage of the external classes to link the model with current external registries.

After the development of the UML model of the country profile its conformity with ISO 19152 should be tested, according to the criteria presented in Annex A of ISO 19152:2012 Edition I. Last but not least, instance level diagrams using real-world use cases should be created to test the proposed model.

Following, the conceptual model of the country profile in UML will be translated into the corresponding database schema and stored in relevant software (e.g. PostgreSQL and PostGIS) to allow the implementation of the proposed profile using technical encodings. Then, sample data will be loaded to test the access, use, update of data via prototypes. This is an iterated process and when needed the country profile will be adjusted and improved.

It is currently under discussion, whether implementation solutions for LADM models will be included in the second Edition of LADM (at least include schema matching techniques between LADM and the relevant encoding). Finally, during various phases of the development process, meetings and workshops with stakeholders should be organized to exchange opinions and agree on the final version of the model.

4. LADM-BASED COUNTRY PROFILE IN MALAYSIA

There have been several research and development activities in the past to model 3D cadastre in Malaysia in the context of LADM. However, these investigations mainly remain at a conceptual level and yet to be implemented in the real context of Malaysian jurisdiction. Therefore, at the research conducted by Rajabifard et al. (2018), the Malaysian government initiate the discussion of the practical pathway towards realising an LADM-based 3D cadastral system in alignment with jurisdictional settings of Malaysia. It focuses on data migration from existing database to open source database and the application modules for implementation of 3D cadastral system and 3D cadastral database by using open source platforms.

The understanding that LADM covers land registration and cadastre in a broad sense, suggests that it could improve interoperability between cadastral or related information systems. This would consequently improve the exchange of land information not only between local and national, but international organizations as well.

The current state of 3D cadastral registration in describing land administration data, in Malaysia, is being done using strata plans for above ground properties and stratum plans for underground properties. At the same time, there is the realization that modern cadastral systems need to move from the traditional concept of cadastre to a more integrated cadastral modelling approach.

Peninsular of Malaysia consists of eleven states and three Federation states. Land Offices register only administrative or ownership data. Each Land Office (of each state) has a slightly different method to register land., while they are different compare to how JUPEM (the Department of Survey and Mapping Malaysia) registers land (registers spatial data). Land Offices own eLand system and JUPEM owns eKadastre system. Therefore, LADM can be used as a common model to increase interoperability between different Land Offices and JUPEM in a national and international level (Rajabifard et al., 2018).

At the prototype system that has been developed in the context of LADM, it is investigated how the current 2D National Digital Cadastral Data Base should be upgraded to 3D and how the current workflows and associated data to be modified to support the realization of the 3D cadastral system. Both academia and government has worked together to achieve this result and actually use LADM to renew and update their current system, including 3D functionalities.

5. CONCLUSIONS AND DICUSSION

The last part of this paper is dedicated to the discussion, conclusions and proposals for future steps in the context of LADM revision. As presented in the previous sections, the paper reflects on the country profiles that have been developed since the final vote of LADM as ISO standard in 2012, identifying similarities and discrepancies on the path followed, bearing in mind the scope and objective of the development of those profiles and their level of maturity, also conforming to the land registration system and national jurisdiction.

To summarise the above mentioned, multiple LADM-based country profiles that have been developed, can be categorised into two groups; those applying a holistic approach where all aspects of cadastral information have been mapped, and to those applying focused approach where a specific part of the cadastral information is mapped in an LADM profile. Due to the modular (package) architecture of LADM, countries only use the parts they need to build a country profile.

Experience has shown that there is a knowledge gap when it comes to an established, flexible methodology to build LADM country profiles and hence, the methodology described in this paper, aims to bridge this gap. Specifically, this research highlights the flexibility of LADM Edition I to build country profiles taking into account specific requirements of the local Cadastre/ land registration system. In this context, there are several generic steps described that can be followed by various types of jurisdictions across the world, and at a next stage it can be considered to further categorise the needs of the different cadastral systems (deeds,

titles, strata titles, etc.) and provide a more detailed matching with LADM classes to facilitate the design decisions of the developers. During the meetings that are organised in the context of the LADM revision, subgroups with experts experienced in the different land administration systems maybe formed in order to perform a more detailed mapping of the characteristics of each system with LADM classes and outline more specific and detailed methodological steps for each system.

During the development of a country profile, there is the doubt of using the existing code lists, as proposed by LADM, introduce new ones that better describe the situation and the needs of the jurisdiction, or extend the existing ones with new values when introducing new concepts. In order to avoid complexity and redundancy, and to facilitate the update and the revision of the country profiles and the code lists, it is proposed that a hierarchical structure for code lists will be used. Therefore, it is needed to further progress the refinement and maintenance of code lists' values. Adding more content, meaning and structure to the code lists would then be another step in the development of LADM.

Semantic technologies (e.g. SKOS, RDF, linked data, and ontologies) should be used for further refinement of code list values (e.g. alternative terms, definitions of terms) or semantic relationships between the terms (e.g. hierarchical, associative), at the second Edition of LADM. Different data formats (e.g. XML, RDF/XML, JSON, and CSV) should be considered. More information about the proposed hierarchical structure of the code list can be found in Annex J of ISO_WD1_19152_TC211. In this context, the option of developing a joint code list management based on Cadastre and Land Administration Thesaurus (CaLAThe), as a coordinated action between ISO and OGC should be examined.

What is more, the proposed methodology will be offered to ISO TC211 to be included in Annex D of the LADM Edition II and a workflow clearly presenting the activities that a country needs to undertake and the possible iterations/ feedback loops, will be drawn. Currently, in Edition I, Annex D only includes some country profiles. At the second Edition it is expected that the methodology to develop LADM-based country profiles will be included in Annex D, and the developed country profiles will be on-line (isoladm.org). As also discussed during the ISO/TC 211 48th Plenary meeting that took place in Maribor, Slovenia, in June 2019, an inventory of the developed of country profiles should be created, where the profiles will be stored, maintained, organised and updated. This will allow for a faster and more flexible update of the profiles. It should be discussed and decided which organisation will be responsible for this inventory/registry (it could be ISO, FIG, the statistical division of UN, etc.).

An important aspect that should be discussed is the level of compliance of each country profile, according to Annex A of LADM Edition I and which organisation is responsible to decide and certify this level of compliance. In this context, obtaining a certification from the relevant organisation(s) of each jurisdiction for the development of the country profile should be discuss and added as a step at the methodology presented in the previous Sections.
Having that in mind, and as the Edition II of LADM aims to go beyond just a conceptual model, the requirements that set a software compliant with LADM implementation and its

level of compliance should be discussed, as there are various software providers interested to broad this market.

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