The 6th Land Administration Domain Model (LADM) Workshop

16-17 March 2017

Delft, the Netherlands

TU Delft welcomes the participants in the 6th Land Administration Domain Model Workshop and wishes them an inspiring and fruitful meeting.

Content

Global Organizations

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- UN-Habitat/GLTN
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Public Bodies

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- Norwegian Mapping Authority
  Olaf Magnus Østensen
- Ordnance Survey – United Kingdom
  John Clutterbuck
- Spanish Directorate General for Cadastre
  Amalia Velasco Martín-Varés
- State Geodetic Administration - Croatia
  Nikola Vučić
- Surveyor General Branch - Natural Resources Canada
  Paul Egesborg

Universities

- AGH University of Science and Technology
  Jarosław Bydłosz
- TU Delft
  Abdullah Alattas
  Sangmin Kim
  Peter van Oosterom
  Hendrik Ploeger
  Sisi Zlatanova
- GIMA (Utrecht University, TU Delft, University of Twente and Wageningen University)
  Carline Amsing
  Jennifer Oldfield
- National Technical University of Athens
  Efi Dimopoulou
- Technical University Munich
  Thomas H. Kolbe
- University of Gävle/National Land Survey of Sweden
  Jesper M. Paasch
- University of Melbourne
  Mohsen Kalantari
- University of Twente
  Mila Nikolaeva Koeva
- University of West Bohemia
  Karel Janecka

Industry

- Esri USA
  Brent Jones
- Hansa Luftbild AG – Germany
  ChristianTimm
- NAMA Consulting Engineers and Planners S.A. – Greece
  Eftychia Kalogianni
- *TLF Consortium – Switzerland*
  Manohar Velpuri

Welcome message from the workshop organizers

Dear Participants,

Welcome to this 6th LADM Workshop! It is a great pleasure to have you in Delft, first time in LADM history. Previous workshops were organized in the Netherlands (2003), Germany (2004), Canada (2008), again in the Netherlands (2012), and in Malaysia (2013). The first Edition was published by ISO in 2012 – and now we can see the use of the standard already in countries all over the world.
Security of tenure for all is a global demand. This is clear in The UN 2030 Agenda for Sustainable Development, the UN Habitat's New Urban Agenda and in the UN FAO Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security.

A reliable and well-functioning land administration is needed to organize a complete overview of people to land relationships to support tenure security. Whilst many countries have this overview – we still have a way to go to achieve global coverage. Existing systems continue to develop – 3D Cadastres is an emerging trend. There is agreement that with current available data sources, imagery combined with modern GPS devices and data management, it is now possible to achieve the global ambitions. However this will require data acquisition and maintenance of that data at a scale that has not seen before. Well-functioning supporting tools and devices are needed. This is a challenge for the geoinformation industry and for database and service providers.

The LADM workshop will focus first on the scope and functionality of the second edition. This starts by sharing current LADM/STDM experiences and next discussing possible extensions to the conceptual LADM eg. further modelling of LADM's rights, restrictions and responsibilities; a fiscal/valuation extension module, Marine Cadastre, more explicit relations with Building Information Modelling, further modelling of LADM's survey and spatial representation and 3D/4D Cadastre.

Secondly we will need to focus on the Operational Standards in Land Administration. This includes addressing the technical models for LADM: CityGML, IndoorGML, LandInfra, InfraGML, LandXML, and GeoBIM. In addition, also the aspects beyond Information models will be discussed: Organization, Best practices, Legal/financial aspects, OpenCadastre approach, Crowd sourcing, Workflow modelling, Blockchain and ledger technologies. The workshop will be concluded with a summary of decisions/proposals, a time schedule and agreements on coordination between involved organization and the outline of a Global Action Plan for development of LADM for Land Administration.

The workshop is organised by TU Delft and Kadaster International, in close co-operation with the UN Global Geospatial Information Management, Expert Group on Land Administration and Management (UN GGIM-LA), UN-Habitat, Global Land Tool Network (GLTN), International Standardisation Organisation (ISO TC211), Open Geospatial Consortium (OGC), Royal Institution of Chartered Surveyors (RICS), the International Federation of Surveyors (FIG), International Hydrographic Organization (IHO), and International Society for Photogrammetry and Remote Sensing (ISPRS).

We want to thank our fellow organizers, CheeHai Teo, Mohsen Kalantari, Eva-Maria Unger, Suzanne Valkman, Elfriede Fendel, Monica Boen, and Itziar Lasa Epelde, for their endless efforts and support during the very dynamic preparations of this 6th LADM workshop. It was a pleasure to work with this professional and motivated team!

Have a very good time in historical Delft (the weather looks promising), enjoy, learn a lot, discuss in openness, and let's create together the foundation for LADM Edition II.

Delft, March 2017,

Denise McKenzie,
Kees de Zeeuw,
Christiaan Lemmen,
Peter van Oosterom.

I. Motivation Participants 6th Land Administration Domain Model Workshop

- Global Organizations
- Public Bodies
- Universities
- Industry

Open Geospatial Consortium

Denise McKenzie

Address : OGC, 2.3 Silverwood Close, Winchester, SO224QP, UK
Email : dmckenzie@opengeospatial.org
Position : Executive Director Communication & Outreach

Motivation

1. *Background (expertise, role in land administration)*
   Prior her role in the OGC she has 12 years of policy and project experience with the Victorian Government in Australia in areas of Crown Land Management, Land Survey, Valuation and Geospatial.

2. *Current experience or opinion related to ISO 19152 (LADM)*
   It is generally recognised that the LADM is in need of revision. She is keen to see that the revision is done in collaboration with all the organizations who rely on this standard and to also look at how it connects to other existing and potential standards that will connect to it. She is also co-chairing and facilitating the 2 day event with Kees de Zeeuw.

3. *Selected issues/questions to be addressed/answered during (or after) the workshop*
   1) *What* other standards need to be looked at in collaboration with the review of the LADM?
   2) Which organizations should be involved in this activity?
   3) Can we develop a diagram that shows all the international organizations who work in the Land Administration domain and identify what functions and responsibilities they have in order to ensure we do not have overlap or duplication of efforts?

Athina Trakas

Address : OGC, Heerstrasse 162, Bonn, Germany
Email : atrakas@opengeospatial.org
Position : Services Director Europe, Central Asia & Africa

Motivation

1. *Background (expertise, role in land administration)*
   In her nearly 20 years in the business she has worked in various projects related to Land Administration (LA), geospatial interoperability and standardization. In her current role at the OGC she helps facilitating the OGC LA DWG, network with members and interested organizations in the context of the OGC LA DWG and helps to understand the importance of OGC standards as part of the overall land administration interoperability framework. Recently she has participated in GLTN member meetings and have some background knowledge in STDM.

2. *Current experience or opinion related to ISO 19152 (LADM)*
   Her experience with LADM is limited. For any planned revision or further development of the standard, interoperability with other related standards and the OGC standards framework should be part of the work. In the context of the joint the workshop OGC's focus is to work with LA partners to assure comprehensive interoperability solutions are available for all Land Administration and Management implementations across developing and developed nations.

3. *Selected issues/questions to be addressed/ answered during (or after) the workshop*
   1) How can the standardization effort in Land Administration be best coordinated amongst standards bodies and other involved players? Who are these organizations?
   2) Joint activities and re-use of work and information instead of re-inventing the wheel.
   3) Get a common understanding and agreement on what is meant with “Land Administration”.

UN-Habitat/GLTN

Cyprian Selebalo

Address : UN-Habitat, PO Box 30030, Nairobi 00100, Kenya
Email : cyprian.selebalo@unhabitat.org
Position : Land tools developer and supporter for country implementation of tools

Motivation

1. *Background (expertise, role in land administration)*
   Over thirty years of experience in the field of land management, land administration and land policy which include technical experiences, policy development, land reform and human settlements. This has been acquired through the current work in UN-Habitat, Land and GLTN Unit. Prior to joining UN-Habitat he worked as Land Specialist in World Bank Cambodia Office; headed the National Mapping Agency in Lesotho 1995 to 2007; served as a Project Coordinator for Land Reform project in Lesotho; and various positions in the Survey Department since 1982, including land survey, management and computerisation of cadastral records.

2. *Current experience or opinion related to ISO 19152 (LADM)*
   The Global Land Tool Network is developing and supporting implementation at country level of Social Tenure Domain Model (STDM) - A pro-poor land information tool that is based on the ISO-certified Land Administration Domain Model (ISO 19152 : 2012) and built on top of free and open source software. STDM supports the continuum of land rights and is participatory-driven, gender-sensitive, affordable and scalable.

3. *Selected issues/questions to be addressed/answered during (or after) the workshop*
   1) Key considerations for increasing land information coverage in developing countries.
   2) Means of providing technical support towards achieving that objective.
   3) Capacity requirements for actualizing the paradigm shift.

Dutch Council for Real Estate Assessment

Ruud M. Kathmann
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Email : r.kathmann@waarderingskamer.nl
Position : Member Managementteam

Motivation

1. *Background (expertise, role in land administration)*
   Mass valuation/mass appraisal for taxation and other purposes. Responsible for defining and quality assurance of 'Base Register of Assessed values The Netherlands'.
   Quality control and guidelines for mass appraisal by municipalities in the Netherlands including control of valuation administration in relation to other base registers.
   In cooperation with World Bank advising for projects implementing real estate taxes.

2. *Current experience or opinion related to ISO 19152 (LADM)*
   Interested in the possibilities of LADM for an uniform and simple modelling of data for taxing and valuing real estate without limiting the choices shaping the tax systems based on the legal and market conditions.

3. *Selected issue/question to be addressed/answered during (or after) the workshop*
   1) Is the proposed modelling of data for valuation and taxation a valuable extension of the LADM?

Federal Maritime and Hydrographic Agency - Germany

Hans-Christoph Schreyer
Address : Bundesamt für Seeschiffahrt und Hydrographie (BSH), Bernhard-Nocht-Straße 78, 20359 Hamburg, Germany
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Position : Dipl.-Ing. for Surveying and Cartography/Data product developer, Data modeler

Motivation

The Federal Maritime and Hydrographic Agency (Bundesamt für Seeschiffahrt und Hydrographie – BSH) is the responsible authority for Maritime Spatial Planning (MSP) in the German Exclusive Economic Zone (EEZ). Marine Spatial Planning (MSP) as a planning tool is, such as land administration, working with geo-spatial data, like land parcel boundaries, as well with non-spatial data, such as information about people/organizations, relationships among people/organizations and furthermore with the legal aspects of the relationship between people/organizations and land/area.
One important part of the MSP is the offshore wind farms planning and development process. The planning and development permission of offshore wind farms is a long term process and involve many different multidisciplinary use cases where different stakeholders both from public authorities and from private companies:

- Lawyers are interested in the legal aspects of MSP for the exclusive economic zone (EEZ).
- Biologists carry out an assessment of environmental effects for seabirds and marine mammals during the construction period and later during the operation.
- Geologists create a technical documentation of the subsoil.
- Engineers develop the technical design for the wind mills under consideration of the results of the meteorological and oceanographic measurements/studies.

Because of the conceptual character of the LADM I can see an important influence for the marine domain especially for the marine spatial planning (MSP).

1. *Background (expertise, role in land administration)*
   He is a Graduated Engineer in Cartography and Surveying with 22 years experiences in the GIS and IT sector. He has worked 22 years in Denmark in different positions (developer, project manager, head of section). Since 1.6. 2016 he is working in Hamburg at the BSH as a data product developer and responsible for the further development of the BSH SDI.

2. *Current experience or opinion related to ISO 19152 (LADM)*
   He is coming from the hydrographical and navigation side in the ISO 19100 world working a long time with IHO S-100 and the marine themes of INSPIRE.

3. *Selected issues/question to be answered during (or after) the workshop*
   1) Meeting people interested in this part of the LADM.
   2) Some good discussions about MSP and LADM.
   3) Building up a network.

Guyana Lands and Survey Commission

Trevor Benn

Address : Guyana Lands and Survey Commission, 184 Century Palm Gardens, D"Urban Backlands, Georgetown, Guyana, South America
Email : trevor.benn@ glsc.gov.gy
Position : Commissioner/Chief Executive Officer

Motivation

1. *Background (expertise, role in land administration)*
   Trevor Benn has over twelve years' experience working in the field of land management and development, 1989 to 1999 and 2016 to present. During the period he served in the capacity of Land development Officer, Senior Land development Officer, and now Commissioner/Chief Executive Officer. As Land development Officer my chief responsibility included the overall management of the Land Development Scheme, supervision of office an field staff, liaise with local government bodies and members of the respective communities, support the maintenance of community infrastructure including, roads, electricity, potable water and ingress and egress, advise clients on the land application processes, and land tenure regularisation.

2. *Current experience or opinion related to ISO 19152 (LADM)*
   His current positions Commissioner/Chief Executive Officer commenced in 2016 and now he has responsibility for the overall functioning of the national land agency, specifically for Land Administration, Surveying, Land Use Planning and Land Information and Mapping.
   He is very interested in implementing an effective land administrative system and see the ISO 19152 (LADM) as a good reference model to achieve that.

3. *Selected issues/questions to be addressed/answered during (or after) the workshop*
   1) What global regulatory and incentive instruments and measures exists for sustainable land development?
   2) What good examples are they in Land Governance?
   3) What is the best approach to building capacity for participatory and integrated land use planning, information systems?

Kadaster – The Netherlands

Eric Hagemans
Address : Kadaster, PO Box 9046, 7300 GH Apeldoorn, the Netherlands
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Position : Advisor Product and Process Innovation

1. *Background (expertise, role in land administration)*
   Since 2014 geodetic specialist and innovation advisor at Kadaster in The Netherlands. Working on a project of quality-improvement of the Dutch cadastral map and on the innovation of cadastral surveying and corresponding registrations. Before he worked as teacher and manager at the University of Applied Science in Utrecht and as geodetic engineer at the engineering companies Arcadis and Sweco. He studied geodesy at the Technical University in Delft in the 1980's.

2. *Current experience or opinion related to ISO 19152 (LADM)*
   At the Kadaster we have started a research to integrate the exact location information stored in millions of field documents to the cadastral map and to generate and show more metadata about the geometric quality. We intend to do this by creating a much richer database management system for the surveying data and the map, trying to extract measurement data from historic, analog documents and recalculate the map respecting each individual measurement. The LADM has been an inspiration for developing the data model for the DBMS.

3. *Selected issues/questions to be addressed/answered during (or after) the workshop*
   1) Finding out if more countries has tried to store all survey data in one, integrated system?
   2) Gaining best practices for providing metadata to the public
   3) Optimising the first ideas for the preliminary data model.

Kadaster – The Netherlands

Christiaan Lemmen
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Email : Chrit.Lemmen@kadaster.nl
Positions : Geodetic Advisor
Director OICRF
Chair FIG Commission 7 Working Group 7.1 Fit-For-Purpose Land Administration

Motivation

1. *Background (expertise, role in land administration)*
   Christiaan Lemmen is Senior Geodetic Advisor with the Netherlands Cadastre, Land Registry and Mapping Agency (Kadaster). His expertise concerns land-management, land administration, land consolidation, institutional and organizational development, strategy development, (initial-) data acquisition for land administration, quality management, data and proces modelling, ICT aspects, evaluation and monitoring, Land Administration Domain Model, Social Tenure Domain Mode. Christiaan is Visiting Researcher at ITC, the Faculty of Geo-information Science and Earth Observation, University of Twente, the Netherlands. He holds a PhD in Land Administration from Delft University of Technology. He brings contribution to knowledge development and science in a series of publications – and he has experience in teaching, thesis supervision (MSc) and design of educational modules. He is contributing editor of the professional journal 'GIM International'. During his professional career he organised many events related to Land Administration and cadastre and he gave many presentations at conferences, the workshops, seminars, etc. He has a position as Working Group Chair on 'Fit-For-Purpose Land Administration' of the Commission 7 on 'Cadastre and Land Management' of the International Federation of Surveyors (FIG). Earlier he chaired the Working Group on 'Pro-Poor Land Tools'. He is director of the OICRF, the international Office for Cadastre and Land Records, a documentation centre for land administration and a permanent institution of the FIG.

2. *Current experience or opinion related to ISO 19152 (LADM)*
   He is co-editor of the International Standard for the Land Administration Domain Model ISO – 19152. He is the designer of the Social Tenure Domain Model - in close co-operation with UN HABITAT. He is co-author of the Guide for Fit For Purpose Land Administration - guiding principles for country implementation.

3. *Selected issues/questions to be addressed/answered during (or after) the workshop*
   1) Interoperability: LADM as language.
   2) International Tenure Atlas.
   3) Basis for development LADM Edition II.

Kadaster – The Netherlands

Paul Saers
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Email : paul.saers@kadaster.nl
Position : Senior Land Administration Advisor

Motivation

1. *Background (expertise, role in land administration)*
   Paul Saers initially trained as a cadastral cartographer and surveyor, specialising in legal and administrative aspects of cadastral processes. After a spell as a freelance surveyor he joined Dutch Kadaster as regional survey team manager. He was subsequently trained as land administration system analyst and developer. Later he took on new responsibilities as land datacentre manager. He was certified as an IT Service Manager, acquiring additional quality and security management expertise. Subsequently he became responsible for the management of all Enterprise Resource Planning systems in Dutch Kadaster.
   Currently Paul Saers works as a Senior Land Administration Adviser with Kadaster International, specialising in land information planning and land administration process redesign. In this quality, he shares his broad experience with other land professionals in the interest of implementing affordable and effective land administration in developing countries. He has worked with Global Land Tool Network, The Dutch Foreign Ministry, the EU and GIZ in Namibia, Algeria, Bangladesh, Egypt, Rwanda, Uganda, Benin, Togo, Aruba, Mozambique, Suriname and Indonesia.

2. *Current experience or opinion related to ISO 19152 (LADM)*
   He was involved in the development of a strategy for the further development, use, application, and dissemination of the GLTN tool 'Social Tenure Domain Model' with a focus on country level work and targeting the land professionals. Other activities relate to the integration of third party or legacy land data sets to existing national-level land administration systems. It has become clear that the availability of legacy and third party data brings complications in the field of data validation and representation.

3. *Selected issues/questions to be addressed/answered during (or after) the workshop*
   1) Exploration of the potential of LADM for accommodating informal and legacy land data sets.
   2) The business case for implementing LADM compliance to existing systems.
   3) The business case for extending LADM functional domain with taxation, valuation, 3D, 4D, BIMs, Land Use Planning cycle, Marine and Utilities.
   4) The necessity for LADM to accommodate structured metadata on the sources, procedures and legal context and general quality of the land.
   5) Exploration of the potential for facilitating and consolidating national level to global level land data sets for instance tenure system catalogue.

Kadaster – The Netherlands

Pieter Soffers
Address : Kadaster, PO Box 9046, 7300 GH Apeldoorn, the Netherlands
Email : pieter.soffers@kadaster.nl
Position : Junior Advisor Product and Process Innovation

Motivation

1. *Background (expertise, role in land administration)*
   His graduation project of the MSc 'Geomatics for the Built Environment' at the TU Delft involved a research to the workflow of the Dutch Kadaster. This research focussed on the relation between survey documents and the Dutch cadastral map. It seems logical that a boundary is surveyed, documented and then directly added to the Dutch cadastral map, depicting its accurate position. The Dutch cadastral situation is dynamic, which results in an increasing fragmented relation between survey documents and the Dutch cadastral map. The relation is getting even more complex since the Kadaster used various survey methods, the existence of multiple survey sources by boundary reconstruction and administration via parcels instead of boundaries. These issues reveal that the workflow of the Kadaster leaves space for improvements.

2. *Current experience or opinion related to ISO 19152 (LADM)*
   In his research he used the expertise of the LADM to create a data model for a better workflow. The data model has to meet stated requirements in order to be an improvement. The question was to which extent the LADM could meet these requirements and which elements of LADM should be adapted.
   After his graduation in February 2017, he started to work for the Kadaster as Junior Advisor Product- and Process Innovation, where I will participate in the project Terrestric registration.

3. *Selected issues/questions to be addressed/answered during (or after) the workshop*
   1) How is LADM implemented in other countries and what kind of requirements do they have?
   2) Basis for development LADM Edition II.
   3) Gaining knowledge about the implementation of 3D cadastral data and the management of topology data in LADM.

Kadaster – The Netherlands

Eva-Maria Unger
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Email : Eva.Unger@kadaster.nl
Positions : Land Administration Advisor
Chair FIG Young Surveyors Network

Motivation

1. *Background (expertise, role in land administration)*
   Eva-Maria Unger is a Land Administration Advisor at Kadaster International in the Netherlands since 2017. She obtained a MSc in Geoinformation and Surveying in 2011 from Vienna University of Technology, Austria. Her MSc thesis was focusing on the semantic transformation of the Austrian Cadastre System into the INSPIRE Cadastral Parcels Theme. From 2011 until 2017 she worked at the Austrian Federal Office for Metrology and Surveying in Vienna. Since 2013 she is enrolled as a PhD student at ITC University of Twente focusing on Land Administration and Disaster Risk Management. She is a member of the UN-Habitat GLTN STDM Advisory Board and since 2014 chair of the FIG Young Surveyors Network.

2. *Current experience or opinion related to ISO 19152 (LADM)*
   Within her role as the chair of the FIG Young Surveyors Network she organised various Training of Trainer events of STDM around the world. Within her work and research she is constantly working with the LADM and its specialisation the STDM. She sees the LADM and its application as the key for the realisation of Fit-For-Purpose Land Administration and ultimately as the key to work towards the SDGs.

3. *Selected issues/questions to be addressed/answered during (or after) the workshop*
   1) If and how the current version of the LADM is delivering towards the SDGs and its indicators?
   2) If and how the version of LADM is in line with the Fit For Purpose approach?
   3) How other specialisations of the LADM (3D cadaster, Marine cadaster, Address systems…) should be included or handled separately of the LADM?
   4) How to motivate national agencies around the world to apply LADM in their national SDIs?

Kadaster

Kees de Zeeuw

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Positions : Director Kadaster International
Chair UN-GGIM Expert Group on Land Administration and Management

Motivation

1. *Background (expertise, role in land administration)*
   Kees de Zeeuw is director of Kadaster International at the Cadastre, Land Registry and Mapping Agency (Kadaster), The Netherlands and chair of the United Nations Group of Experts on Land Administration and Management (UN-GE-LAM). He holds an MSc degree in land and water management (1989). After long term contracts in Rwanda and Bolivia he has been working more than 10 years in environmental and geo-information sciences at Wageningen University and Research Centre. After being responsible at Kadaster for product and process innovation (2007 – 2010), he now is responsible for the coordination of Kadaster's international activities and international cooperation projects. He is involved in the development of land administration systems in all its components. Kadaster International provides worldwide advisory services in the domain of land administration, e-governance, geo-information services and SDI.

2. *Current experience or opinion related to ISO 19152 (LADM)*
   Many of the international advisory projects under the responsibility of Kadaster International are related to fit for purpose land administration and the role of standardization in this. LADM is therefore an important component in achieving our main objective: "land rights for all".

3. *Selected issues/questions to be addressed/answered during (or after) the the workshop*
   1) If and how the current version of the LADM is delivering towards the SDGs and its indicators?
   2) If and how the version of LADM is in line with the Fit For Purpose approach?
   3) How other specialisations of the LADM (3D cadaster, Marine cadaster, Address systems…) should be included or handled separately of the LADM?
   4) How to motivate national agencies around the world to apply LADM in their national SDIs?
   5) What message to take to the OGC TC meeting and the Land and Poverty conference of the World Bank in the week after this event in Delft?

Land Administration Authority – Lesotho

Mahashe Chaka

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Positions : Director General and Chief Executive
Co-Chair UN-GGIM Expert Group on Land Administration and Management – Co-chair

Motivation

1. *Background (expertise, role in land administration)*
   Mahashe Armstrong Chaka holds an MBA – International Business Management from University of Kwazulu Natal – South Africa. Currently he is also doing his PhD research in the field of Entrepreneurship at the University of Pretoria-l (South Africa) At the moment he holds the position of Director General and Chief Executive of the Land Administration Authority (LAA) – Lesotho. Furthermore In 2017 he as been re-appointed for the second time as Board Chairperson of the Road Fund Secretariat – Lesotho. For 15 years he held senior executive positions in the banking and communications sector. His strongest area of expertise is that of managing the relationship of Government expectations and that of the private sector. Thereby being invited by the Cabinet even for matters not related to the land sector.

2. *Current experience or opinion related to ISO 19152 (LADM)*
   Since August 2015 he is the co-chair of the UN-GGIM – Expert Group on Land Administration and Management. He has been a member of the team that prepared the Costing and Financing of Land Administrations Systems (FoFLAS) headed by LEI and driven by GLTN.
   The main goals of UN-GGIM: EG-LAM are:
   - Play a leading role at the policy level by raising political awareness and highlighting the importance to decision makers of the need for timely and fit for purpose land administration and management and;
   - Encourage the use of geospatial information tools and systems to improve the legal certainty of all citizens in the world with respect to the registration of the relation between people and land.

3. *Selected issues/questions to be addressed/answered during (or after) the workshop*
   1) What are the future LA needs (from UN-GGIM side) as input for LADM revisions?
   2) How to create a good cooperation structure between the involved organizations?
   3) How to maintain the good foundation of STDM when LADM is revised?

Management Institute GLIS

Silvano Tjong-Ahin

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Position : Managing Director

Motivation

1. *Background (expertise, role in land administration)*
   Silvano Tjong-Ahin is an economist with long standing (international) experience in development cooperation, particularly in the field of institutional development and public finance. Since 2010, he is am the first Managing Director of the Management Institute GLIS, a new Institute set up to consolidate land administration, cadastre and the geo-information platform in one single institute based on modern principles. The institute is the sole land administration authority for the whole of Suriname. While many challenges are still ahead, the institute has made significant progress in modernising land administration in Suriname and meets many international efficiency standards on land administration.

2. *Current experience or opinion related to ISO 19152 (LADM)*
   Although the MIGLIS has not adopted ISO 19152 as a defined guide for its development, many aspects of this standard are already included in its day-to-day practice. His motivation for participating in this the workshop is to gain experience as how to integrate this standard in our work program.

3. *Selected issues/questions to be addressed/answered during (or after) the workshop*
   1) Which strategies have other developing countries applied to integrate LADM into their work program?
   2) How do we integrate the fit-for purpose principle with LADM
   3) What kind of supportive systems are in place to assist less developed countries in modernizing their cadastre and land administration systems

National Land Survey of Finland

Heikki Lind
Address : National Land Survey of Finland, PL 8009, 96100 Rovaniemi, Finland
Email : heikki.lind@nls.fi
Position : Director

Motivation

1. *Background (expertise, role in land administration)*
   Experiences of developing Finnish cadastral LIS system as a system specifier representing end users of cadastral LIS system.
   Role today, Director in NLS, main responsibility of cadastral register including Rights, Responsibilities and Restrictions (RRR) in Finland and some other official registers in NLS as well. Interested in cadastral data models both nationally and internationally. Active in Nordic co-operation in cadastral issues.

2. *Current experience or opinion related to ISO 19152 (LADM)*
   All the major extensions of LADM II are actual in Finland. As a director I would like to be familiar with both ISO 19152 (LADM) and LADM II before the influence of models becomes more visible in my country.

3. *Selected issues/questions that I like to be answered during (or after) the the workshop*
   1) More information of possibilities to implement LADM in Finland.
   2) More information of RRR development for LADM II.
   3) How could I promote LADM 1and II in Finland.

National Land Survey of Finland

Markku Markkula

Address : National Land Survey of Finland, PO Box, 84 00521 Helsinki, Finland
Email : markku.markulla@maanmittauslaitos.fi
Position : Deputy Director General at the Central Administration

Motivation

1. *Background (expertise, role in land administration)*
   He worked as a law counselor at NLS. His work includes dealing with law issues regarding real estates and real estate formation with the Ministry of Agriculture and Forestry in Finland. He also visits quite often the Finnish Parliament where new laws or law reforms regarding NLS are handled. In case NLF considers it necessary he gives or suggests amendments regarding existing laws to the ministry involved. He is also the second substitute for the Director-General Arvo Kokkonen for NLS.
   LADM and ISO standard is known in Finland since the year 2012. Here is some information about Finland and ISO 19152 on power points:
   www.fig.net/resources/monthly_articles/2011/april_2011/april_2011_ppt_myllymaki_pykala.pdf

2. *Current experience or opinion related to ISO 19152 (LADM)*
   Regarding LADM NLF considers it very important that restrictions between properties via servitudes and easements are taken to cadastre with uniformity in EU countries. It is the same with common areas which are jointly owned units belonging to properties, not the persons. Such specialities as special interests for fishing which we have in the northernmost part of Finland towards the border to Norway are one challenge to the cadastre in our country. How to make register entries concerning this kind of rights in a way that is understood by all EU citizens who want by properties in Finland is one issue which is important for us.
   Besides the land area, buildings and private water area a property in Finland can include easements, shares to common areas like common water areas in lakes or rivers and also in the Northern Lapland special private or jointly owned rights for salmon fishing etc.
   Private roads in Finland can include several properties as a shareholder. To maintain cadastre regarding private roads and their shareholders is quite a challenge in rural areas with several summer cottages in the lakesides, farms and other settlement etc. The amount of the shareholder properties can be very high and for example dividing the maintenance of the private road between the property owners is a problem for the shareholders.

3. *Selected issues/questions to be addressed/answered during (or after) the workshop*
   1) More information of RRR development for LADM II.
   2) More information of fiscal and BIM connections for LADM II.
   3) How to promote LADM I and II in Finland?

National Land Survey of Finland

Tarja Myllymäki
Address : National Land Survey of Finland, PL 84, 00521 Helsinki, Finland
Email : tarja.myllymaki@nls.fi
Position : Chief Expert

Motivation

1. *Background (expertise, role in land administration)*
   Member of ISO 19152 (LADM I) working group and Member of INSPIRE thematic working group Cadastral Parcels.
   Experiences of developing Finnish cadastral LIS system, developing of NLSF information interfaces etc.
   Role today, promoting and supporting interoperability of data and use of enterprise architecture, both inside NLSF and between Finnish public sector, concerning cadastral data and other data related to cadastre.

2. *Current experience or opinion related to ISO 19152 (LADM)*
   After the LADM I work I'm still interested to develop LADM further. All the major extensions of LADM II are actual in Finland, especially fiscal connection and BIM are under development.

3. *Selected issues/questions to be addressed/answered during (or after) the workshop*
   1) Relationship between ISO and OGC work, both LandInfra and Land Administration.
   2) More information of RRR development for LADM II.
   3) More information of fiscal and BIM connections for LADM II.

National Land Survey of Sweden

Christina Wasström
Address : Lantmäteriet, 801 82 Gävle, Sweden
Email : christina.wasstrom@lm.se
Positions : National SDI coordinator
Chair ISO/TC211

Motivation

1. *Background (expertise, role in land administration)*
   Today she works as the national contact point towards the European Commission regarding the EU INSPIRE directive. In that role she supports and coordinates the Swedish implementation of the INSPIRE directive on a national level, in both strategic and technical issues. As a member in the maintenance and implementation group (MIG) that has been established by the European Commission to maintain and develop INSPIRE, she takes part in the development of the directive. She is currently also active in different network at Nordic and European levels, e.g. EuroGeographics.
   Since the first of January this year (2017) she became the new chair for ISO/TC211. As you probably know, Olaf Østensen has had that role for over 20 years, so she is still in a learning process.

2. *Current experience or opinion related to ISO 19152 (LADM)*
   She has not any specific experience regarding ISO 19152, but she is already aware of the strategic importance with Land Administration. Both Olaf and Christana are planning to participate, to bridge knowledge.

3. *Selected issues/questions to be addressed/answered during (or after) the workshop*
   1) How is the standard being used today?
   2) Why is it of importance to link to Building Information modelling and OGC standards? (Note; she does not question it, but is just interested to understand more about of the background).
   3) Practical steps on how to go forward, who does what?

Netherlands Hydrographic Service

Thijs Ligteringen

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: PO Box 10.000, 1780 CA, Den Helder, the Netherlands
Email : t.ligteringen@mindef.nl
Position : Advisor on geodesy

Motivation

1. *Background (expertise, role in land administration)*
   Thijs Ligteringen has a background in geodesy (Delft University of Technology, 1994-2000). Working on maritime boundaries of the Kingdom of the Netherlands. Recently he joined the S-121 project team of the International Hydrographic Organization. The objective of the S121 project team is to develop IHO S-121 Maritime Limits and Boundaries Product Specification. This includes the definition of a data model which is built on ISO 19152. For example: The Spatial Attribute Type as defined for S121 is derived from the class LA_SpatialUnit defined in ISO 19152.

2. *Current experience or opinion related to ISO 19152 (LADM)*
   Building up knowledge of ISO 19152 since the start of the S121 Project Team in 2016. The S121 PT accepted ISO19152 as a solution to support administrative information within the Maritime Limits and Boundaries context and to other context such as fisheries and environment at a later stage.

3. *Selected issues/questions to be addressed/answered during (or after) the workshop*
   1) As a hydrographic / maritime community, to learn from experiences with LADM on land.
   2) To make sure that the people revising ISO 19152 realize that the work in IHO exists.

Netherlands Hydrographic Service

Ellen Vos

Address : Frederikkazerne, Gebouw 32
: PO Box 10.000, 1780 CA, Den Helder, the Netherlands
Email : em.vos@mindef.nl
Position : Maritime Informatics at the Royal Netherlands Navy

Motivation

1. *Background (expertise, role in land administration)*
   Ellen Vos has a background in Marine Spatial Data Infrastructures (MSDI) in the realm of the (international) geo standardization of coastal and ocean management. She is/has been a member of several Working Groups (dealing with technical policies, overall MSDI and more detailed work on Product Specifications) within the IHO (International Hydrographic Organization), in which the S-100 standardization framework plays a large role. IHO is also represented in UN-GGIM, OGC and ISO/TC211. She is also a (agenda) member of the Dutch national NEN commission on NEN3610. Other experience: Biology (MSc).

2. *Current experience or opinion related to ISO 19152 (LADM)*
   Experience about the outlines of LADM, wondering how LADM can help to close the gap between land and sea information management (UN-GGIM).

3. *Selected issues/questions to be addressed/answered during (or after) the workshop*
   1) How can LADM contribute to closer connections between the IHO community with other geo-standardization bodies?
   2) Can the LADM community benefit from work that has been accomplished or work that is in progress within the MSDI community? Perhaps based on S-100?
   3) Is Marine Spatial Planning a fruitful subject/theme to work on to span the boundary between land and sea information management? (Other boundary spanning themes could be Coordinate Reference Systems, security and safety, INSPIRE, cables and pipelines, oil and gas and more…).

Norwegian Mapping Authority

Olaf Magnus Østensen
Address : Belsetsvingen 38, 1348 Rykkinn, Norway
Email : olaf.ostensen@kartverket.no
Position : Director Technology and Innovation

Motivation

1. *Background (expertise, role in land administration)*
   He has been working with geospatial standards since the mid-80ies, first at national level, then as convenor of WG1 in CEN/TC 287 from 1991/1992 and as chair of ISO/TC 211 from 1994 until 1.1.2017. His initial task in the geospatial domain was to assist in implementing the computerized central register for real estate cadastral parcels), addresses and buildings (GAB) in Norway. later his work has included the implementation of NSDI in Norway, initiating the service based infrastructure from around 200 and onwards. He has been involved in several EU-funded R&D projects, like DISGIS, ACE-GIS (coordinator), ESDIN, EURADIN, ENVISION, and now latest, as coordinator on behalf of 39 partners in the European Location Framework – E.L.F. project (CIP ICT PSP 325140) of which TU Delft has been one of the partners).
   Also representing the Norwegian Mapping Authority (Statens kartverk) which has a strong commitment to land administration and being involved in numerous relevant project around the globe, and especially in the Balkans and former Soviet republics.

2. *Current experience or opinion related to ISO 19152 (LADM)*
   Besides being chair of ISO/TC 211 while ISO 19152 LADM was developed, and agreeing to co-organize the workshop, he had several contacts with Christiaan Lemmen and Peter van Oosterom concerning a revision of ISO 19152, and also discussed the idea with representatives of the World Bank. He has also been promoting ISO 19152 several times in UN-GGIM sessions.

3. *Selected issues/questions to be addressed/answered during (or after) the workshop*
   1) General revision, extending the model, incorporating the STDM, extending land registry functionality, etc.
   2) Profiling LADM for less developed countries or use, using the 'fit-for-purpose' approach making ISO 19152 even more important in a UN context.
      ISO 19152 as a recognized and recommended best practice from UN-GGIM?
   3) Is blockchain technology of interest to LADM, especially for countries or use where no strong, well-organized authorities exist?

Ordnance Survey – United Kingdom

John Clutterbuck
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Email : john.clutterbuck@os.uk
Position : Senior Solution Architect

Motivation

1. *Background (expertise, role in land administration)*
   Over 20 years' experience in Land Administration processes and solutions covering Land Charges, Rural Payments and most specifically Land Registration (Registers of Scotland and some international LRs).

2. *Current experience or opinion related to ISO 19152 (LADM)*
   Relatively new to ISO 19152 itself, although he has a very good understanding of UK title and parcel data.

3. *Selected issues/questions to be addressed/answered during (or after) the workshop*
   1) How ISO 19152 can accommodate data from long established registers?
   2) How ISO 19152 can accommodate the complexity of rights association between Titles, Parcels and Parcel subdivisions?
   3) How ISO 19152 supports change through long running registration processes?

Spanish Directorate General for Cadastre

Amalia Velasco Martín-Varés
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Email : amalia.velasco@catastro.minhap.es
Position : International Affairs Coordinator

Motivation

1. *Background (expertise, role in land administration)*
   She has worked 28 years in the Spanish General Directorate for Cadastre in several technical and management task, with increasing responsibility degree: 15 years in the area of Rural Cadastre; 4 years in Urban and Rural Cadastre, as Deputy Director of the Regional cadastral Office of Catalonia, and since February 2007 she is the International Affairs Coordinator. In that position she represents the SDGC in the international associations and working groups (EUROGEOGRAPHICS, PCC, WPLA, OEA, World Bank, INSPIRE, LADM, etc. …). Furthermore she has been appointed by the Spanish Government to participate in UN-GGIM.
   Spanish General Directorate for Cadastre (SDGC) has a strong link with Latin-American Countries. We are referent for directives in the Permanent Committees on the Cadastre in Latin-America (CPCI).
   The cadastral organizations of Latin-American countries request very often our collaboration and adviser because in most of the cases they inherited our juridical and social system and because we all speak the same maternal language.
   The Spanish Cadastre does annually a prestigious on-line Cadastral Management Course for the Latin-American Experts in Cadastre, in collaboration with the CEDDET organization and the Spanish Cooperation Department (AECID) http://www.ceddet.org/ficha-curso/2201/. The course is well known in all the cadastral organizations in Latin-America and she is, as International Affairs Coordinator of SDGC, the director of this program. She is also the Coordinator of the Cadastral Experts Network of CEDDET: http://www.redes-finanzas-aecid.org/index.php

2. *Current experience or opinion related to ISO 19152 (LADM)*
   She has participated in the workshop previous to the LADM approbation including the particular issues of Spanish and Latin-American countries. She has participated in the translation to Spanish of the norm.
   She has written some articles and made presentations to explain the ISO 19152 to the Spanish Cadastre and the Latin-American cadastres.

3. *Selected issues/questions to be addressed/answered during (or after) the workshop*
   1) How to implement LADM in much consolidated cadastres that have a strong model with lots of relations? Some examples.
   2) What are the benefits of the transformation to LADM in those cases? Is it worthy?
   3) Examples of practical (non-academic- non-theoretical) applications of LADM.

State Geodetic Administration – Croatia

Nikola Vučić
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Email : nikola.vucic@dgu.hr
Position : Head of the Department for Administrative and Professional Supervision

Motivation

1. *Background (expertise, role in land administration)*
   Nikola Vučić graduated in Geodesy from the University of Zagreb, Faculty of Geodesy. In 2015 he received a PhD from the University of Zagreb for the thesis "Support the Transition from 2D to 3D Cadastre in the Republic of Croatia". He is Head of the Department for Administrative and Professional Supervision at the State Geodetic Administration of the Republic of Croatia. His main research interests were and still are land administration systems, cadastres and geoinformatics, especially 3D cadastre, land registry and LADM - ISO 19152.
   He is a member of the Croatian Geodetic Society. He is also researcher on scientific project *Development of Multipurpose Land Administration System* – DEMLAS at University of Zagreb.

2. *Current experience or opinion related to ISO 19152 (LADM)*
   He studied LADM a few years. Most important contribution of his PhD thesis is to build a new land administration system model focused on the a third dimension. It proposes possibilities to collect data on the volume of buildings and other structures and especially on the volume of special parts of the property. A LADM part of his research deals with strata buildings, overlapping complex buildings with natural objects (tunnels, bridges, viaducts, etc.), utility lines and other relevant factors of 3D cadastre. A LADM-based national profile for the Republic of Croatia has been created and it represents a generic model of Rights, Restrictions and Responsibilities of the Croatian 3D cadastre. Classes and packages of the described model are compared in detail to the existing Land Administration System in the Republic of Croatia. An overview of the compatibility between existing land management system and suggested 3D model has been given. An application of the new 3D model is addressed through several case studies which show that this model is more effective than 2D system in terms of registration and description of real property. He believes that ISO 19152 is very good tool for Land Administration.

3. *Selected issues/questions to be addressed/answered during (or after) the workshop*
   1) Plans (timetable) for LADM support for Marine Cadastre?
   2) Possibilities for 3D cadastre improvement of the conceptual model?
   3) Detailed plans for further modelling of LADM's survey and spatial representation?

Surveyor General Branch – Natural Resources Canada

Paul Egesborg
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Position : Manager Cadastral Survey Information

Motivation

1. *Background (expertise, role in land administration)*
   He holds a BSc in land surveying and a MSc in land information from Laval University. He worked for the Surveyor General Branch for the last 30 years in land information system on cadastral survey and boundary related information. His role as Manager of the Cadastral Survey Information unit includes leading and managing the development and implementation of data models, standards, applications and procedures related to the collection, maintenance, analysis and dissemination of cadastral survey and boundary related data.

2. *Current experience or opinion related to ISO 19152 (LADM)*
   He was actively involved, between 2008 and 2012, in the development of the ISO19152 standard as Canadian expert for the Canadian Advisory Committee on ISO/TC211 of the Standards Council of Canada. He has been involved in adapting our data model to ensure compliancy with ISO19152 and promoting ISO19152 nationally (Canadian Hydrographic Services) and internationally (Chile). Recently, he is involved in the IHO project team on Maritime Limits and Boundaries (S121) to appropriately integrate concepts of ISO19152 into the management of maritime limits and boundaries.

3. *Selected issues/questions to be addressed/answered during (or after) the workshop*
   1) Discussing requirements for the marine cadastre and more specifically requirements for marine limits and boundaries where the need is more towards the boundary itself and not as much on the associated rights.
   2) Discussing implementation issues with a focus on current limitations (i.e. uniqueness and one to one relationship between RRR and BAUnit) and ways to implement improvements while limiting incompatibilities with the previous version. There is also a need to review and address the geometry side which creates confusion between LADM geometry and ISO19107 – Spatial Schema. Discussion on various extensions to ISO19152 (Valuation, Land Use) and developing a good plan to address them. Would like to discuss the option to present as separate work items (Create additional ISO19152 Parts). It will become important in this discussion to clearly define the scope of ISO19152 Part 1 to avoid a scope creep in the review process.
   3) Since ISO19152 is a data model and not an application schema, the OGC standards can play an important role in the development and implementation of operational standards that support ISO19152. Our current cadastral survey information data management processes would greatly benefit the development of OGC standards that could be implemented and supported by various Software vendors. This would greatly facilitate private land survey firms that play a key role in data collection and transfer of spatial information that would be structured to readily meet land administration standards such as ISO19152.

AGH University of Science and Technology

Jarosław Bydłosz
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Position : Senior Researcher/Lecturer at the Department of Geomatics

Motivation

1. *Background (expertise, role in land administration)*
   He works at the Department of Geomatics (AGH University of Science and Technology in Cracow, Poland) as a senior lecturer and researcher. He is a faculty member since the year 2001. He obtained his postdoctoral degree (habilitation) in June 2016, for monothematic series of publications "modelling of country cadastral profile". His scope of interests are Geographic Information Systems, cadastre and standardization. The recent activities concern 3D cadastre and ISO 19152 "Land Administration Domain Model". He is a member of Polish Real Estate Scientific Society, Polish Association for Spatial Information and member of the FIG Joint Commission 3 and 7 Working Group on 3D Cadastres.

2. *Current experience or opinion related to ISO 19152 (LADM)*
   ISO 19152 is one my main scientific interests since 2012. Since then, he has written series of papers and has given several presentations on ISO 19152, both in English and Polish. He believes that they have positive impact on popularization and further works concerning LADM, especially in Poland. He also attended the 5th Land Administration Domain Model Workshop in Kuala Lumpur (2013).

3. *Selected issues/questions to be addressed/answered during (or after) the workshop*
   1) Further modelling of LADM's Rights, Restrictions and Responsibilities (including 3D cadastre).
   2) LADM and OGC standards.
   3) Fiscal and valuation extension of LADM.

Delft University of Technology

Abdullah Alattas

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Position : PhD at TU Delft
(in the past lecturer Geomatics, King Abdulaziz University, Saudi Arabia)

Motivation

1. *Background (expertise, role in land administration)*
   Abdullah F Alattas obtained an MSc in Cartography in 2014 from theTechnische Universität München, the Vienna University of Technology and the Technische Universität Dresden. In October 2015 he started as a lecturer at Geomatics department, Faculty of Environmental Designs, King Abdulaziz University, Jeddah, Saudi Arabia. Currently he is enrolled as PhD student at the TU Delft under supervision of Sisi Zlatanova and Peter van Oosterom.

2. *Current experience or opinion related to ISO 19152 (LADM)*
   The PhD research topic concerns Indoor modelling (IndoorGML) and LADM. Land Administration is a huge field that focusses on rights, responsibilities and restrictions influencing land and their geometrical elements. It is considered the foundation for country's sustainable development which is used to provide a foundation for security of tenure, valuation and taxation, spatial planning and land management. A variety of applications, including LA, demand integration of data that represent the indoor and outdoor, which reveal 3D modelling and management of information. The representation of 3D modelling is used for 3D visualization and analysis. The IndoorGML and LADM have been developed for different purposes and scopes. However, there some similarities. Both models can be deal with semantically annotated 3D spaces. Both of them can operate with abstract space. Also, they have a notion of primal space with geometry and topology. Both of the models maintain several subdivisions of space. During the PhD research, which is currently in its initial phase, it will be investigated what are the requirements for a 3D SDI to supporting the different approaches and standards for indoor modelling with respect to the LA.

3. *Selected issues/questions to be addressed/answered during (or after) the workshop*
   1) Relation conceptual model LADM and IndoorGML (and InfraGML, LandXML, CityGML, BIM/IFC).
   2) LADM country profile Saudi-Arabia including indoor and outdoor RRRs.
   3) Role of land administration within GII (SDI) supporting link physical objects/space – legal objects/spaces.

Delft University of Technology

Sangmin Kim

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Email : S.Kim-2@tudelft.nl
Position : Guest Researcher at TU Delft
(former PhD student at Yonsei University, Korea)

Motivation

1. *Background (expertise, role in land administration)*
   He received a PhD at Yonsei University, Korea. The title of his dissertation was "Design and Implementation of 3D Underground Cadastral System in Korea". His main research interests are in database modelling and 3D building modelling with a focus on the real-world implementation of 3D land administration and cadastral system. Currently, he is a guest researcher at the 3D GeoInformation Section of the Department of Urbanism, Faculty of Architecture and the Built Environment, Delft University of Technology.

2. *Current experience or opinion related to ISO 19152 (LADM)*
   ISO 19152 LADM is one of his research interests. I has written research papers related with LADM such as "Introduction of ISO Land Administration Domain Model (LADM) to Korea Land Information System (KLIS)", "Comparing the Survey Package of Land Administration Domain Model with the Cadastral Information Model in Korea", and "Development of 3D underground cadastral data model in Korea: Based on land administration domain model". His current and recent research topic is visualization and documentation of the As-build BIM and 3D cadastral system via LADM Spatial Representation.

3. *Selected issues/questions to be addressed/answered during (or after) the workshop*
   1) Relationship between LADM, CityGML, LandXML and Landinfra.
   2) How to generate a document of 3D property based on LADM?
   3) How to integrate property valuation system into LADM?

Delft University of Technology

Peter van Oosterom

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Positions : Professor in GIS-Technology
Chair FIG Joint Commission 3 and 7 Working Group on 3D Cadastres
Co-chair OGC DWG Land Administration & DWG Point Clouds

Motivation

1. *Background (expertise, role in land administration)*
   Peter van Oosterom obtained an MSc in Technical Computer Science in 1985 from Delft University of Technology, the Netherlands. In 1990 he received a PhD from Leiden University. From 1985 until 1995 he worked at the TNO-FEL laboratory in The Hague. From 1995 until 2000 he was senior information manager at the Dutch Cadastre, where he was involved in the renewal of the Cadastral (Geographic) database. Since 2000, he is professor at the Delft University of Technology, and head of the 'GIS Technology' Section, Department OTB, Faculty of Architecture and the Built Environment, Delft University of Technology, the Netherlands. Member of INSPIRE drafting team Data Specification and Hamonisation and member of the INSPIRE thematic working group on cadastral parcels. He is the current chair of the FIG Working Group on '3D Cadastres'.

2. *Current experience or opinion related to ISO 19152 (LADM)*
   Involved in the development of LADM and its predecessor (CCDM) since the start in 2002 at FIG congress in Washington. Organized several the workshop, created various versions of the model, and edited several special issues in journals such as CEUS and LUP on the topic (Cadastral systems, LADM, 3D Cadastres, etc.). He is co-editor (with Christiaan Lemmen and Harry Uitermark) of ISO/TC 211 Geographic Information - Land Administration Domain Model (LADM in short), which was formally published by ISO on 1 December 2012 as ISO 19152. Within OGC he co-chairs the DWE Land Administration and the DWG Point Clouds. Supervisor of the PhD thesis by Jantien Stoter: 3D Cadastres (2004), supervisor of the two PhD-theses on LADM at TU Delft (Christiaan Lemmen: A Domain Model for Land Administration, and João Paulo Hespanha: Development Methodology for an Integrated Legal Cadastre) and external member of the PhD committee of Jesper Paasch at KTH: Standardization of Real Property Rights and Public Regulations, last three all concluded in 2012. He was further supervisor of several MSc Geomatics or GIMA theses on 3D Cadastre, CCDM, LADM, etc.
   In the past he acted as guest editor of various special issues of CEUS en LUP. At present he is editor of CAGEO and IJGI). He assisted with the development of various country profiles (Korea, Russia, Malaysia, Greece, Israel, etc.).

3. *Selected issues/questions to be addressed/answered during (or after) the workshop*
   1) If and how to used semantic technologies for capturing the meaning and supporting maintenance of code list values (e.g. using SKOS)?
   2) How to manage the link physical objects/space – legal objects/spaces, especially in the case of 3D Cadastre, all aspects: survey, legal aspects, data models, databases, dissemination, visualization?
   3) Should valuation package be part of LADM or become its own standard?

Delft University of Technology

Hendrik Ploeger

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Positions : Associate Professor in Land Law & Land Administration at Geo-information & Land Development Section
Professor in Land Law & Land Administration at VU Amsterdam

Motivation

1. *Background (expertise, role in land administration)*
   Hendrik Ploeger holds master degrees in Dutch and Civil Law (Leiden University & VU University Amsterdam, the Netherlands)). In 1997 he obtained his PhD (horizontal division of property rights in land). His research interests are land law and land registration, especially from a comparative legal perspective. He chaired the FIG Working Group on 3D Cadastre from 2003 to 2006.

2. *Current experience or opinion related to ISO 19152 (LADM)*
   Co-author on several papers and scientific articles on LADM.

3. *Selected issues/questions to be addressed/answered during (or after) the workshop*
   1) How to create a further classification of rights, restrictions and responsibilities in LADM?
   2) Can LADM facilitate the transnational land and mortgage market. (esp. in the context of the concept for Eurotitle).
   3) How to develop the use of BIM and integrate BIM in LADM for 3D registrations, esp. in the context of operational lease in business models based on circular economy principles.

Delft University of Technology

Sisi Zlatanova

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Positions : Associate Professor in 3D modelling at 3D GeoInformation Section
Co-chair OGC Standard Working Group (SWG) IndoorGML
President ISPRS Commission IV Spatial Information Science

Motivation

1. *Background (expertise, role in land administration)*
   She graduated as a surveyor at the University of Architecture, Civil Engineering and Geodesy, Sofia, Bulgaria in 1983 and has obtained her PhD degree on 3D GIS for Urban Development at the Graz University of Technology, Graz, Austria in 2000. Her research interests are in 3D geo-information: 3D object reconstruction, 3D data structures, 3D spatial relationships (topology) and 3D visualisation (VR and AR). She has been working on topics related to structuring and organization of semantically reach 3D data (above, beneath and on the surface), organization of Level of Details (including textures), developing of new data types (e.g. freeform curves and surfaces), spatial functions (e.g. for navigation and evacuation) and query and simplifications of IFC models (and their matching to CityGML schema). Since 2010 she is actively involved in 3D indoor modelling. She has participated in the development and currently working on the maturing of the OGC standard IndoorGML. She is co-chair of the OGC Standard Working Group (SWG) IndoorGML.

2. *Current experience or opinion related to ISO 19152 (LADM)*
   She has been familiar with LADM for years, but only since last year she began actively studying it in relation to IndoorGML. IndoorGML is the first standard dedicated to indoor space subdivision for the purpose of indoor navigation. The two standards are designed for different domains: IndoorGML focuses on indoor space modelling while LADM is intended for countries territory, including outdoor, water and surface spaces. The space subdivision of IndoorGML is based on navigable areas and their connectivity. The spaces defined by LADM are the result of legal/administrative rights, restrictions and responsibilities. But these different views on space subdivision can be of benefit for both models. IndoorGML can be augmented with space cells based on rights, restrictions, responsibilities and LADM can inherit the geometry from the IndoorGML partitioning and/or aggregation. For example, defining accessible spaces by specifying security clearance in IndoorGML is often guided by legal restrictions or rights.

3. *Issues/questions to be addressed/answered during (or after) the workshop*
   1) Define a set of use cases in which legal rights, restriction and responsibilities can be used to guide space subdivision for navigation. RRR have many facets and can be highly depended on the type of user (visitor, maintenance team, employee, cleaning, deliver, etc.).
   2) Establish a formal link between the two models either via a dedicated space layer (a formal mechanism provided by IndoorGML) or direct link between related classes.
   3) Investigate an approach to create the legal spaces. Normally legal spaces are verbal and not very accurate. A set of geometric and topological operations might be needed to ensure that the descriptive definition would be accurately modelled.

GIMA
(TU Delft, Utrecht University, University of Twente and Wageningen University)

Carline Amsing

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Position : MSc GIMA student, Intern Kadaster International

Motivation

1. *Background (expertise, role in land administration)*
   Carline Amsing is a MSc GIMA (Geographical Information Management and Applications) student who wrote her thesis on smart sketch maps for Fit-for-Purpose Land Administration in Eastern Africa. Its4land commenced in 2016 and aims to develop innovative land tenure recording tools, being smart sketch maps, UAVs, automated feature extraction and geo cloud services. She has recently started her internship at Kadaster International where she is (amongst other things) conducting an evaluation of Fit-for-Purpose Land Administration initiatives.

2. *Current experience or opinion related to ISO 19152 (LADM)*
   Her thesis research focused on using qualitative spatial information for the purpose of providing land tenure security. LADM is not yet suitable for implementing qualitative spatial information which could potentially be of added value in customary situations where tenure is communally constructed and recognised.

3. *Selected issues/questions to be addressed/answered during (or after) workshop.*
   1) How can LADM be extended to also include qualitative spatial information for recognizing land rights?
   2) How can different types of spatial information be incorporated to support the recognition of land rights, and how can this be supported by the LADM?
   3) Is STDM a generalization of LADM or is LADM a specialization of STDM?

GIMA
(TU Delft, Utrecht University, University of Twente and Wageningen University)

Jennifer Oldfield
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Positions : MSc GIMA student
Post Grad. Dip. Teaching English to Speakers of Other Languages

Motivation

1. *Background (expertise, role in land administration)*
   Jennifer Oldfield is a MSc GIMA (Geographical Information Management Applications) student who has spent the last year researching how BIM and a 3D Cadastre created within the context of the LADM can best be correlated.
   Prior to beginning my thesis, she worked on two Dutch national standards. IShe translated the CityGML toolkit and 2000 terms for the CB-NL (Dutch Concept Dictionary). The fact that there are often many English words to describe one Dutch word, that many Dutch technical terms either do not exist in English or are not listed in any dictionary and the structure of the information model itself meant that the latter task became one of data modelling as much as translation.

2. *Current experience or opinion related to ISO 19152 (LADM)*
   The research for her thesis was conducted within the context of Open BIM standards, managed by BuildingSMART. It made use of BIM in the sense of 3D data, thus the IFC (Information Foundation Class) but also incorporated two other BIM standards - the MVD (Model View Definition) and the IDM (Information Delivery Manual). The results of her research are a Model View Definition of the IFC entities required to obtain information for the LADM, use cases illustrating these and a workflow modelled in the IDM about how these entities can be obtained.

3. *Selected issues/questions to be addressed/answered during (or after) the workshop*
   1) How could the fact that the IFC leverages from one local coordinate (IfcSite Local Placement) which is then extended by means of Cartesian points best be adapted to the fact that the LADM works from many survey points (LA_SourcePoint)?
   2) Could a workflow which mandates that IFC information required for legal spaces be provided during the building registration process be applied internationally?
   3) Could the existing common property sets (p_set) included in IFC2x3 which allow the inclusion of, for example, custom identifiers (IfcIdentifier) mean that no formal additions need to be made to the IFC model in order for it to be used by the LADM?

National Technical University of Athens

Efi Dimopoulou

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Position : Associate Professor

Motivation

1. *Background (expertise, role in land administration)*
   Efi Dimopoulou's "active" relation with the LADM practically started in 2012, when attending Chrit Lemmen defending his PhD Thesis and then joining the Workshop "LADM from Research to Implementation - Land Administration Domain Modelling at a threshold" (6th of July 2012, Kadaster Office Rotterdam). Soon after that the model became an international standard (ISO 19152). In 2013, she participated (as PC member and author) in the International FIG Workshop on LADM in Kuala Lumpur, Malaysia from 24 to 25 September 2013.

2. *Current experience or opinion related to ISO 19152 (LADM)*
   Being an academic in the field of Cadastre and Land Administration Systems, she followed LADM's evolution as a reference model that provides, a conceptual schema for spatial and non-spatial land administration data and extensibility to systems in various application areas. For this purpose she supervised related Diploma, Master and PhD theses at her university. She coordinated/co-authored related papers that have been presented in conferences and or published in international scientific journals. These projects have been based or extensively used in different fields of LADM, such as the Hellenic Cadastre, the Hellenic Archaeological Cadastre and the Cultural Heritage, LPIS, INTERLIS, INSPIRE, Public Property in Greece and the Marine space along with 3D development options.

3. *Selected issues/questions to be addressed/answered during (or after) the workshop*
   Development through the various country profiles (for 2D and 3D) and applications in different domains:
   1) Meeting 3D Cadastre requirements.
   2) Property valuation.
   3) Interoperability issues.

Technical University Munich

Thomas H. Kolbe
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Positions : Professor in Geomatics at Department of Civil, Geo and Environmental Engineering
Visiting Professor (academic year 2016-2017) at Faculty of Architecture and the Built Environment of TU Delft

Motivation

1. *Background (expertise, role in land administration)*
   Thomas H. Kolbe studied computer science at the University Dortmund between 1988 and 1993. After completing his studies he worked as a research assistant at the Institute for Computer Science III at the University of Bonn and the Institute for Environmental Sciences at the University of Vechta until 1999. He was awarded his doctoral degree in 1999. From 1999 he was a research assistant, and later a senior research assistant, at the Institute for Cartography and Geoinformation at the University of Bonn. Between 2006 and 2012 he held the Chair of the Department of Geoinformation Technology at TU Berlin. Since 2012 he has been president of the German Society for Photogrammetry, Remote Sensing and Geoinformation (DGPF) and a professor at the Technische Universität München (TUM).
   Thomas Kolbe is visiting professor at the faculty of Architecture and the Built Environment of TU Delft this academic year. His research field is the development of methods for the spatial, temporal and semantic modelling, storage, analysis and visualization of the environment. Key areas are virtual 3D city and landscape models, city system modelling, smart cities, 3D geodatabases, 3D geoinformation systems, GIS & simulations and indoor navigation. Professor Kolbe is the initiator and co-author of the international standard CityGML for semantic 3D city and landscape models.

2. *Current experience or opinion related to ISO 19152 (LADM)*
   CityGML.

3. *Selected issues/questions to be addressed/answered during (or after) the workshop*
   1) How can CityGML and LADM be used together?
   2) Are changes in CityGML/LADM needed in the future?

University of Gävle – National Land Survey of Sweden

Jesper M. Paasch
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Positions : Senior Lecturer/Associate Professor in Land Management at Department of Industrial Development, IT and Land Management –
Research Coordinator at National Land Survey of Sweden

Motivation

1. *Background (expertise, role in land administration)*
   Jesper M. Paasch has been engaged in cadastre and land administration for 27 years at Lantmäteriet, the Swedish mapping, cadastral and land registration authority.

2. *Current experience or opinion related to ISO 19152 (LADM)*
   He has been a member of the ISO expert group producing the LADM. After its publication in 2012 he has published a number of conference proceedings and peer-review papers on the further development of the LADM, specially for a legal point of view. The subject of his doctoral thesis was classification of private and public rights, restrictions and responsibilities. He has also chaired a working session at the 5th Land Administration Domain Model workshop, Kuala Lumpur, Malaysia, 2013.
   He is a Swedish delegate in FIG commission 3 (Spatial Information Management) and member of the FIG joint commission 3 and 7 3D-cadastre working group. He has been chairman of the Swedish Standards Institutes technical committee for metadata for geographical information 2005-2016 and member of the institutes technical committee for standardization of geographical information during the same period.
   Since September 2017 he works part time (50%) as senior lecturer/associate professor in land management at the University of Gävle, and as coordinator of research at the National Land Survey of Sweden (Lantmäteriet).

3. *Selected issues/questions to be addressed/answered during (or after) the workshop*
   1) The interaction between the LADM and the LandInfra inititative.
   2) How to create a more detailed classification of the LADMs RRR classes?
   3) The relation between LADM boundary (surfaces) and surfaces in e.g. City-GML.

University of Melbourne

Mohsen Kalantari

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Positions : Senior Lecturer in Geomatics Eng. At Melbourne School of Engineering
Associate Director Centre for Spatial Data Infrastructures and Land Administration
Co-chair OGC DWG Land Administration & DWG Point Clouds

Motivation

1. *Background (expertise, role in land administration)*
   Senior Lecturer in Geomatics, Associate Director of Centre for SDI and Land Administration, The University of Melbourne. He also teachwa the land administration systems subject. Besides he is Reviews Editor of the Journal of Spatial Science

2. *Current experience or opinion related to ISO 19152 (LADM)*
   He has been following LADM from its inception (CCDM) and has evaluated earlier versions of it and contributed to the review process leading to ISO 19152. Furthermore he published a road map for its implementation. He co-chairs the Land Administration of DWG of OGC.

3. *Selected issues/questions to be addressed/answered during (or after) the workshop*
   1) Interoperability between LADM and IFC (BIM).
   2) Physical implementation of LADM.
   3) LADM database schema.

University of Twente

Mila Nikolaeva Koeva

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Position : Assistant Professor in 3D Land Information at ITC Faculty, Department of Urban and Regional Planning and Geo-information Management (PGM) Department

Motivation

1. *Background (expertise, role in land administration)*
   Mila is an Assistant Professor working in 3D Land Information. She holds a PhD in 3D modelling in architectural photogrammetry from the University of University of Architecture, Civil engineering and Geodesy in Sofia. She also holds a MSc. degrees in Engineering (Geodesy) from the same institution obtained in 2001. Her professional career began at the GIS-Sofia Ltd. - a Municipality Company dealing with cadastre of the city of Sofia, firstly as a specialist in Photogrammetry, and later on becoming a Head of the department. In 2012 her career development continued in a private company - Mapex Jsc. as a Project manager. Her daily task was to apply multidisciplinary approach while organizing and coordinating projects between the departments in the company. Later she moved to University of Twente at the faculty of Geo-Information Science and Earth Observation (ITC) where she was teaching topics of Photogrammetry and Remote sensing like Image processing, DTM, Orthophoto creation, GPS and 3D modelling. From the University of Twente she holds a university teaching qualification (UTQ).

2. *Current experience or opinion related to ISO 19152 (LADM)*
   Her main areas of expertise include 3D modelling and visualization, 3D Cadastre, 3D Land Information, UAV, digital photogrammetry, image processing, producing large scale topographic and cadastral maps, GIS, application of satellite imagery for updating cadastral information among others. Currently she is also co-chair of ISPRS WG IV/10 "Advanced Geospatial Applications for Smart Cities and Regions".

3. *Issues/questions to be addressed/answered during (or after) the workshop*
   1) 3D Cadastre and BIM. Opportunities to use BIM for 3D Cadastre, etc.
   2) 3D Visualization of the RRR in 3D Cadastre.
   3) CityGML and GeoBIM, best practices and crowd sourcing.

University of West Bohemia

Karel Janecka
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Position : Junior Researcher at Faculty of Applied Sciences Department of Geomatics

Motivation

1. *Background (expertise, role in land administration)*
   The motivation to participate in the LADM meeting is given by several factors. In the past, I had been a researcher and a database programmer at the Czech Office for Surveying, Mapping and Cadastre (COSMC; a body responsible for cadastre in the Czech Republic) responsible for example for design of a new data model for storage of digital cadastral map. This data model was a core of a new database (so called Publication database) serving for publication of digital cadastral map in the web environment.

2. *Current experience or opinion related to ISO 19152 (LADM)*
   Furthermore, it is quite interesting to compare the current data model of cadastre with the conceptual model presented in LADM. Together with the colleague of mine from COSMC we have proposed the Czech country profile based on LADM. We have also examined its compliance with LADM.
   Last but not least, in October 2014, the Czech government approved the conception of The Strategy for the Development of the Infrastructure for Spatial Information in the Czech Republic to 2020 (GeoInfoStrategy), which serves as a basis for the National Spatial Data Infrastructure (NSDI). The set of measures for development of the regulatory framework in the field of spatial information were then defined in the GeoInfoStrategy Action Plan. This Action Plan considers the adoption of the ISO 19152 standard in various government initiatives. The proposed country profile based on LADM can be potentially extended to support the registration of 3D parcels (spatial units) in the future. It could serve as a base for an extension of the current data model of the cadastre in the standardized way. Therefore it would be useful to know in which way the ISO 19152 will be further modified or extended.

3. *Selected issues/questions to be addressed/answered during (or after) the workshop*
   1) Database schemas for LADM with focus on 3D parcels (best practices).
   2) Relationship between LADM and BIM.
   3) Utilities in 3D cadastre (best practices).

Esri USA

Brent Jones
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Positions : Global Manager Cadastre/Land Records
Member of UN-GGIM: EG-LAM

1. *Background (expertise, role in land administration)*
   Based in Washington D.C., Brent Jones oversees Esri's worldwide strategic planning, business development, and marketing activities for land records, cadastral, surveying, and land administration. As a recognized technology innovator, Jones specializes in modernizing existing land administration systems and designing new GIS-based cadastral management platforms for small and large governments around the globe. He is a member of the URISA board of directors, past president of the Geospatial Information and Technology Association and a current member of the United Nations Committee of Experts on Geospatial Information Management sitting on the Expert Group on Land Administration and Management.

2. *Current experience or opinion related to ISO 19152 (LADM)*
   His experience with LADM is configuring GIS cloud and offline mobile device COTS components for a low-cost, secure, saleable, and easily deployed solution to developing countries. These configurations on GitHub have been posted to be shared globally. He has spent many years focusing on high accuracy GIS and have configured a system to use external GPS with Android/iOS devices for LADM field data collection. KI has been supporting two separate pilots in Colombia and Kenya. He is also working on a valuation system following the same fit-for-purpose scheme and ensuring low-cost, secure, scalable and easily deployed system using Excel and cloud mapping/analytical capabilities.

3. *Selected issues/questions to be addressed/answered during (or after) the workshop*
   1) Data Collection Workflow:
      - Track and Managing Field Workers and Work Status.
   2) Data Analysis.
   3) Data Sharing/Publication:
      - Security, Permissions, Identity.
   4) Delivering a complete, low cost system.

Hansa Luftbild AG – Germany

Christian Timm

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Email : timm@hansaluftbild.de
Position : Deputy Head of the software development group and team leader for land administration projects

Motivation

1. *Background (expertise, role in land administration)*
   Christian Timm is leading and managing the land administration system development team at Hansa Luftbild, currently developing the National Rural Land Administration Information System (NRLAIS) on behalf of the Ministry of Agriculture (MoA) in Ethiopia. Previously Hans Luftbild has developed the Land Administration System for the City Administration of Addis Ababa. Both systems are designed and developed using LADM as man conceptual source.
   Whereas the system for Addis Ababa was build on proprietary software, NRLAIS is completely build on Open Source Software.
   Beside my management task, he is responsible for consulting service on Land Administration System and for the software design.

2. *Current experience or opinion related to ISO 19152 (LADM)*
   The system currently under development (NRLAIS) is strictly based on the concepts of LADM. One of his main tasks has been the conceptual and physical design of the database.
   Furthermore he is involved in the it4land research project (https://its4land.com/). One of the research topics is about combining formal LADM structures and qualitative descriptions of land tenures.
   Especially in the context of developing countries, informal rights and vague boundaries definitions of interest in land are difficult to address with LADM. In the actual project, the development of NRLAIS, the issue of modelling pastoralist rights, which are vague and flexible in terms of time and space by nature, is faced.

3. *Selected issues/questions to be addressed/answered during (or after) the workshop*
   1) Including standard processes into LADM. Especially case management and maintenance.
   2) Handling informal and vague RRR.
   3) Guidelines / how-to / best practice on how to build a software system on LADM. Something like a pattern catalogue and one extra topic: Impact of block chain techniques on LADM.

NAMA Consulting Engineers and Planners S.A. – Greece

Eftychia Kalogianni
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Position : Associate Engineer/Expert

Motivation

1. *Background (expertise, role in land administration)*
   Eftychia Kalogianni is a Rural and Surveyor Engineer, graduated from NTUA in 2012. She obtained her MSc degree "Geoinformation" from the same University in 2015 and her MSc degree "Geomatics" from TU Delft a year ago. Her research interests lie primarily in 3D geo-information (modelling semantically rich data, 3D visualization, etc.); linking the physical with the legal reality of 3D objects; 3D Cadastre & modelling; spatial databases (3D, constraints, etc.) & GIS. The last years she is author and co-author of scientific papers in those fields, being at the same time an active member of the FIG Young Surveyors family. Currently she is working in Athens at a Consulting Engineering Company on the project of privatization of 14 Regional Airports in Greece. Last year she participated in the project of "Cadastral Survey for the completion of creation of the Hellenic Cadastre"; while 4 years ago, she joined the project "Update of Cadastre in Greece – Trans Adriatic Pipeline (TAP)". Those two projects were the match between her university education (core courses & research focused on land administration) and how those can be implemented in real world.

2. *Current experience or opinion related to ISO 19152 (LADM)*
   When she presented her Diploma Thesis "Design of a model for the management of the Greek state property" LADM passed the final vote towards becoming an International Standard. She has been studying all the preparatory steps (CCDM, Versions A, B, C) since then and her Master Thesis in NTUA "Design of a 3D multipurpose land administration system in Greece in the context of ISO 19152" was an opportunity to further explore LADM, study country profiles and conclude to a proposed country profile, describing the current situation and at the same time being future proof, as a Multipurpose system for complex land management. Last but not least, her TU Delft Thesis "Linking the legal with the physical reality of 3D objects in the context of Land Administration Domain Model" continued the work she has done in NTUA, while exploring the possibilities of INTERLIS, a national (Swiss) Standard, for the implementation of LADM in DBMS. So far, her academic career was based on ISO 19152, and thus, it is interesting and at the same time important to be part of the preparation of the second edition of LADM.

3. *Selected issues/questions to be addressed/answered during (or after) the workshop*
   Bringing up rear, the top three issues I would like to discuss at the The workshop are:
   1) Legal – Physical: Technical models (especially BIM), their relation with conceptual operational standards in land administration, as well as the different approaches towards direct implementable results from LADM conceptual models.
   2) Industry Implementation – LA_Level: Specializations of Spatial Unit & their organization using LA_Level class based on structure or content. How can "LA_Level" be ultimately used in country profiles and if this is applicable to the industry?
   3) 3D Cadastre & LADM Country Profiles: conclusions from the country profiles and their implementation (problems/ challenges) – 3D geometries described as spatial units.
   4) Further discussion about some technical issues such as enumerations and code lists in country profiles and how they are "translated" into technical models.

   To conclude, her expectations for this workshop are high, including participation into different topics, as it would be a great opportunity to broaden her professional network and to experience her value as a researcher. As such, she is expressly interested in a position at the "LADM 2017 Workshop" for this upcoming event.

TLF Consortium – Switzerland

Manohar Velpuri
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Email : manohar.velpuri@gmail.com
Positions : Partner to TLF consortium
Secretary/Vice chair FIG Commission 9 Valuation and Management of Real Estate

Motivation

1. *Background (expertise, role in land administration)*
   Manohar Velpuri is a civil engineer with specialisations as surveying since 2005. Cadastral surveying was one of his core areas of research during his involvement with IDEA League (idealeague.org/). He has been associated with FIG in different commission's 7/9/2 since 2009. Since 2012 he is involved in FIG as the Secretary/Vice chair of Administration for Commission 9: Valuation and Management of Real Estate, FIG Office, Denmark. In addition, he is fulfilling duties as executive director for Absolut Assets (Switzerland), Absolutum Consultancy (India, Singapore) and Absolutum Soleil in Singapore. Our expertise is to research on the subjects that lead or hinder better valuation, real estate management and Land administration practices.
   As a certified business operation professional and with experience in valuation and financial consulting of over ten years TLF is currently exploring the ease of registering properties in six nations - Sweden, Georgia, Honduras, Ghana, Denmark and in India with FinTech expertise from the Singapore FinTech Association. Recently as an MIT-FinTech cohort the focus has been on aiding digitalization of land register records and land administration processes using fourth generation technologies like Blockchain.
   Working Group 9.2 along with support from Commission 7 is being chaired by him resulting in successful discussions on several topics on land administration and security of blockchain in Greece and Portugal and its importance to lead to effective land administration. The Cadastre 4.0 Conference at Coimbra, Portugal also emphasised the need for standards in technology that lead to better Land administration. So in this context ISO 9152 it is important for the valuation practise and in real estate management.

2. *Current experience or opinion related to ISO 19152 (LADM)*
   He was also part of the Expert Group Meeting on Guide to Valuation of Unregistered Lands organized in cooperation with UN Habitat/GLTN and FIG in Greece. During which time the guideline has been designed. Furthermore input has been provided to community involvement for better standards to be followed in valuation. The discussion was well acknowledged and has also emphasised the importance of standards in Land Administration Domain Model.
   A draft data module was introduced at the 11th 3D Geoinfo Conference and the questionnaire was refined through further activities held by a circulation in the Joint Working Group under FIG Commission 7 and FIG Commission 9 in collaboration with other relevant international valuation bodies.
   As part of the Working Group on ISO LADM, the draft questionnaire has been developed by representatives from Commission 7 and 9 to gather input regarding the LADM expansion module. Th questionnaire has been refined to aim at developing a LADM based international information model for property valuation, namely an ISO LADM Valuation Module for the specification of registries used in immovable property valuation.
   As part of commission 9's involvement the questionnaire has been circulated among delegates of FIG Commission 7 and FIG Commission 9. UN-GGIM-LADM members were also informed. The refined version of the Valuation Module is foreseen as input to ISO TC211 for the revision of ISO 19152:2012, which starts next year and should result in LADM 2.0. As part of the research methodology, answers to the questionnaire from Denmark, Singapore and views from other developing nations were submitted.

This inputs may lead to the creation of an inventory that reveals commonalities and differences among valuation systems, especially used for recurrently levied immovable property taxes.
In the future his collaborators are also planning to role courses for ISO in LADM with Cambodia as training base. In light of all the aforesaid - he too opines “the need for operational standards to support Land Administration is now widely recognised”. Training courses for auditing in different ISO standards are offered as well.

3. *Selected issues/questions to be addressed/answered during (or after) the workshop*
   1) ISO/TC 307 Blockchain and electronic distributed ledger technologies are important for the land registration process and hence leads to better land administration. The work program is not clearly defined for ISO/TC 307
      http://www.iso.org/iso/home/store/catalogue_tc/catalogue_tc_browse.htm?commid=6266604&development=on
      Scope of ISO/TC 307: Standardization of blockchains and distributed ledger technologies to support interoperability and data interchange among users, applications and systems.
      This scope can also be linked to our effort to development of an Information infrastructure for the full use of modern information and communication technology.
      There are 16 participating countries and 17 observing countries. Given the scope of this ISO what is our strategy to Link the ISO on 9152 and ISO/TC 302 as data acquisition and ledger systems play a key role to valuation of land and henceforth Land registration a key to Land administration modelling.
   2) Integration and development of a Community Driven Cadastral mapping is seen as Cadastre 4.0 approach. Although we have emphasised of Cadastre 4.0, we are short of or may not have any implementation cases of this approach for mapping. How exactly can a standard be defined in this case?
      I reckon that this ISO is trying to look an Integration of the fourth temporal dimension, valuation, does it have a possibility to include fifth dimension too (anticipation) in this case what would be the approach?
   3) Careful work on semantics – correction and clarification of terminology and other concepts which are used by different land administration systems.
      Valuation of unregistered lands has been of great emphasis and we were gathering several case studies as part of the guide being developed by GLTN. How much and in what procedures does these standards address the issue of valuation of unregistered lands and how does we ensure the reduction in social ill practices of land grabbing using these standards.
      Social tenures are different in different member nations. We’ve seen in six countries the stage of tenure domain model at different sophistication. What is our approach to get a level playing standard for such varying social tenure domain.
      Fit for purpose administration practices for informal markets is still required to be evaluated. While formal markets have defined guidelines, Fit for purpose administration methods are unclear and vary in different informal markets. ISO definition to represent a standard for formalising the informal is to be drafted.

II. OGC White Paper Land Administration

First and incomplete draft – for review
March 9th 2017

1. INTRODUCTION

The scope of implementation of Land[1] Administration Systems is broad. Land Administration supports the provision of security of tenure; it is a basis for valuation and taxation of property, for access to credit (as a basis for investment), for sustainable land use, minimisation of land conflicts, and better management of natural resources. Just like these issues benefit from proper land administration, land administration systems themselves benefit from proper data standards. In many countries the responsibilities and tasks in land administration are distributed among different branches of government and government agencies. Sometimes those organisations deal with different administrative territories, all of which may have subdivisions again: central, regional and local responsibilities, with either public or private roles. Many systems are related to administration of specific tenure types based on specific legislation and regulations. As a result, the governance and quality aspects of the datasets vary. Land administrations worldwide are often incomplete; data are not up-to-date and not fit for purpose. At the same time, new land administration systems are being developed repeatedly all over the world. Sometimes countries even have more than one computerised system for land administration. The wheel keeps being re-invented. This has a huge impact on the continuity and effect of land administration systems.

Satellite imagery, GPS and a world connected by the internet open up new opportunities that were unimaginable just a few decades ago. Standards like the Land Administration Domain Model (LADM) (ISO, 2012) are helping to jump-start new initiatives and are connecting top-down and bottom-up projects together.

Processes such as initial data acquisition may concern millions of spatial units (amongst them parcels) where people to land relationships have to be determined, documented and reviewed. The organisation of this process requires geospatial support in logistics and case management based on geographic information. During field work a check on the completeness of the data acquisition needs to be performed – in an easy way. Tools, transport, paper, imagery, awareness, local support from local authorities (in co-management with traditional authorities), grass root data collectors combined with professional expertise has to be organised at the right place and time.

2. GLOBAL AGENDA

Land is a cross-cutting theme in the global development discourse. The UN Post-2015 Development Agenda (UN, 2012,2014a,b) includes consideration of land related issues across a wide range of objectives. Good land governance should also be seen as a means of supporting the global agenda such as the Post 2015Agenda. The vision includes issues relevant for development, implementation and use of land administration systems. For example: 'universal access to clean water and sanitation' 'resilience to natural hazards', 'eradicating income poverty and hunger'; 'ensuring access to land and natural resources, and 'conflict-free access to natural resources'. The UN Committee of Experts on Global Geospatial Information Management guides the development of technology infrastructure to support land applications (UN-GGIM, 2013). The Food and Agricultural Organisation of the United Nations (FAO) has initiated and developed the 'Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security' (FAO, 2012). This comprehensive guide recommends that, where possible, states should ensure that the publicly held tenure rights are recorded together with tenure rights of indigenous peoples and the rights of the private sector in a single, or at least linked, land record system. In addition, the UN-Habitat's continuum of land rights is now a widely accepted philosophy (UN-Habitat, 2008). In the 'continuum of land rights approach' land rights are viewed as existing along a continuum, with

[1] Land is the surface of the Earth, the materials beneath, the air above and all things fixed to the soil.

some settlements being more consistent with law than others. This view makes it possible to include the people with the weakest tenures in the idea of sufficient legal access. Apart from formal tenure types also informal and customary types of tenure are recognised and included. This breakthrough in the perspective of land rights is implemented in current land tools, as well as in those under development by the Global Land Tool Network. Implementation of the 'Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security' and of the 'continuum of land rights' is the driving force behind a new era of land administration. The International Federation of Surveyors (Enemark et al, 2014) argues for the need to move beyond mere advocacy of the accepted continuum of land rights approach and focus on embedding it into real land administration solutions. The World Bank has combined with the International Federation of Surveyors to promote the Fit-For-Purpose Land Administration approach that provides the opportunity to build appropriate land administration systems within a relatively short time, for low costs with the option to upgrade when required.
See:

- http://www.fig.net/pub/figpub/pub60/figpub60.htm

and

- https://www.fig.net/news/news_2016/2016_07_gltnguide/fit-for-purpose-land-adm-guiding-principles-for-country-implementation.pdf).

The fit-for-purpose approach is promoted by the Global Land Tool Network (GLTN/UN Habitat/Kadaster, 2015 and FIG/WB, 2014) and is integrated in the UN-GGIM Addis Ababa Declaration – Geospatial Information Management Towards Good Land Governance for the 2030 Agenda (http://ggim.un.org/docs/Addis%20Declaration%20Final%2022Apr2016.pdf) and in the New Urban Agenda (UN, 2016).

3. LAND ADMINISTRATION AND STANDARDISATION

LADM, an international standard for the domain of land administration, is intended to assist the alignment of land administration design with societal demands embedded in national and state land polices. Fundamentally, the model is built upon and adheres to the concepts of the continuum of land rights when describing land interests. It covers basic information related to components of land administration: land administration includes water and elements above and below the earth's surface (ISO, 2012), and people. Those components concern: party related data; data on RRR[2]s and the basic administrative units where RRRs apply to; data on spatial units and on surveying and topology/geometry. The models of the data sets in those components are represented in UML packages and class diagrams. All data in a land administration are supposed to be documented in (authentic) source documents. Those source documents are the basis for building up a trusted and reliable land administration, as basis for transactions and for the establishment of new land rights in a land administration. LADM is capable of supporting the progressive improvement of cadastres, including both the geographic and other elements and of supporting fit-for-purpose cadastral requirements. LADM can potentially be used to support organisational integration, for example, between often disparate land registry and cadastral agencies. LADM can help to reconcile superfluous government databases and reduce the large amount of data redundancy that currently exists.

LADM is of one of the first spatial domain standards within ISO TC 211. TC 211 is the Technical Committee on Geographic Information within the ISO. This knowledge domain specific standardisation captures the semantics of this domain. This is required for communication between professionals (and between professionals and grass root surveyors and citizens in participatory approaches), for system design, system development and system implementation purposes and for purposes of data exchange and data quality management. Operationalisation of such a standard as LADM will enable Geographical Information Systems (GIS) and Database Management System (DBMS) providers and/or open source communities to develop products and applications. And in turn this will enable land registry and cadastral organisations to use these components to design, develop, implement and maintain systems in an even more efficient way. LADM provides a shared ontology, defining a terminology for land administration. It provides a flexible conceptual schema with three basic packages: parties, rights (and restrictions/responsibilities) and spatial units. LADM

[2] Rights, Restrictions and Responsibilities.

supports the development of application software for land administration, and facilitates data exchange with and from distributed land administration systems. An important aspect in the development of coherent (Spatial) Information Infrastructures(S)II is that the various standardised domain models are reusing the same model patterns as solutions for the same situations. The standard supports data quality management in land administration. Use of standards contributes to the avoidance of inconsistencies between data maintained in different organisations, because data duplication can be avoided as much as possible. It should be noted here that implementing a standardised data model can be supportive in the detection of existing inconsistencies.

LADM includes the STDM – a pro-poor land information management system that can be used to support the land administration of the poor in urban and rural areas, which can also be linked to the cadastral system in order that all information can be integrated. This can be combined with a range of representation options for spatial units.

The Open Geospatial Consortium (OGC) has set up a domain working group on land administration (OGC, 2016). This OGC initiative was prepared and discussed during the World Bank Conference on Land and Poverty in 2016. OGC has a close cooperation with World Bank in this domain. OGC has standing liaisons with major players in the land administration domain, including Technical Committee 211 of the ISO TC211, the Royal Institute of Chartered Surveyors, the World Wide Web Consortium, OASIS, the International Federation of Surveyors, and the Global Land Tool Network. OGC always strives to use, build on and complement existing standards. However, while there are some standards describing elements of an administrative system, such as in LADM, there might be gaps in the way that they incorporate geographic descriptions of land records, and/ or inadequate rules for defining and describing the quality of the records. The Land Administration Domain Working Group aims to assess the existing standards and address any gaps it finds.

The OGC members drafted a charter for a working group for the land administration domain. The charter describes how to improve the interoperability, effectiveness and efficiency of land administration systems by optimising the use of OGC and complementary open standards. Land administration activities in all countries can benefit from improved interoperability. Improved interoperability contributes to for example reduced deployment time, lower system lifecycle costs, improved flexibility and scalability, improved choice from the IT marketplace, and improved ability to share, exchange and integrate information related to land administration. See (OGC, 2016).

4. PUSH FOR DEVELOPMENT OF LAND ADMINISTRATION SYSTEMS GLOBAL AGENDA

Land information provides an overview of people-to-land relationships. It shows us how people relate to the environment around them. The information can be used to realise responses to major societal and developmental challenges including attaining the United Nations 2030 Agenda for Sustainable Development.

Land information tells us about the ownership, use, value and development of land – whether statutory, informal or customary. Many of those relations are neither recognised nor documented. There is no inclusiveness for all. Meanwhile, populations and cities are growing and the pressure on land and natural resources is continuing to increase and in some instances, significantly. This leads to disputes and also conflicts.

Land administration develops and improves over time, the pace at times dictated by rate of change in technology as much as societal demands. In many places, land administration is either weak or not in place yet and the reasons for such a situation is multifaceted, and can be institutional setup, complex regulations and procedures, lack of capacity and political support.

From the geospatial perspective, many tools are already available to support and enhance this progress, *but further steps are needed to operationalise them at scale. This development requires a push from policy level based awareness, needs and requirements, resources and capacity and ease to implement.*

The global importance of geospatial information was recognised by the United Nations in July 2011 the Economic and Social Council (ECOSOC), recognizing the urgent need to take concrete action to strengthen international cooperation in the area of global geospatial information management by establishing the United Nations Committee of Experts on Global Geospatial Information Management (UN-GGIM). As the peak inter-governmental mechanism to make joint decisions and set directions on the production and use of geospatial information within national and global policy frameworks UN-GGIM also provides the forum for Member States to strengthen the geospatial information management capacities of developing countries for better policy making at national, regional and global levels.

We also need to be reminded that the 2030 Agenda for Sustainable Development is a universal and transformative agenda that aims to improve the wellbeing of people and planet in our lifetime. The 2030 Agenda specifically recognizes the need for new data acquisition and integration approaches to improve the availability, quality, timeliness and disaggregation of data to support the implementation of the new development agenda at all levels, including to exploit the opportunities availed by a wide range of data, including geospatial information. Maximizing the value of fundamental geospatial information including land information at the national and sub-national levels to capture elements of the 2030 Agenda, for informed policy-making, decisions and actions is going to be critical. Such national bottom up approach can only be achieved within the time frame of the 2030 Agenda when standards are readily available and embraced. Hence there is the urgent need and requirement for the development and agreement of standardised, which are flexible, easy to use, affordable and transparent approaches in land administration and management.

Standardisation is a strategic issue in national information systems where information management is a primary process. This is also valid in federal states.

Tbd: Scope of systems – deed or title / Positive or Negative / Map Enemark with Regional variations (French/English/German).

5. LAND AND TENURE DATA FOR THE 2030 AGENDA AND ITS GLOBAL INDICATOR FRAMEWORK

5.1 Identifying Fit-for-Purpose Land Data and Providing Timely and Reliable Land and Geospatial Information

A Fit-For-Purpose approach for Land Administration has been developed by global stakeholders. It is a gender sensitive, transparent and highly participatory approach. With the support of geospatial technologies this approach can be implemented quickly. This approach is recognised and affirmed in the Addis-Ababa Declaration 'Geospatial Information Management towards Good land Governance for the 2030 Agenda'. In this declaration, the need for standardisation within land administration is underlined.

The Fit-For-Purpose approach argues for cost-effective, time-efficient, transparent, scalable and participatory systems. The philosophy is driven by the idea that, in many situations, it is sufficient, for example, to identify visual boundaries based on imagery. This means making use of photographs, images or topographic maps in boundary adjudication and surveying activities. Alternatively, apps on mobile devices can be combined with imagery to identify one's occupancy or use of land, thus avoiding misinterpretation of visual boundaries on the image. Images can be collected from satellites, traditional aircraft or unmanned aerial systems (UAS). In cases where values of land is high or of intensive land use, conventional field surveys using high-precision instrumentations may be deployed. Imagery can be used for many purposes, for example interaction between government and citizens and business, and not merely for the adjudication of boundaries or limits.

All those types of surveys require support in adjustments of those new (calculated) coordinates to existing maps and the keeping original observations.

LADM/STDM do not include land administration processes for initial data acquisition, data maintenance and data publication. This is because these processes were considered to be country-specific when the first edition of LADM was prepared; a generic and global approach was likely to be difficult to model. This view may now need reconsideration – it may be possible to provide some generic processes for support in logistics and initial data acquisition.

The fit-for-purpose land administration approach arguably allows for identification of more generic process-related modules in data acquisition and data handling and also maintenance and publication. Standardisation can also make it easier to monitor the progress of global indicators relating to land tenure security.

Standardisation does not mean loss of flexibility, it means better understanding each other. It supports structuring data in standalone and distributed land administration environment. A set of so called 'code tables' allow the inclusion of, for example, a broad range of (local) types of recognised land rights, types of restrictions, types of responsibilities, types of holders, types of spatial units.

Computerising large sets of legacy data (maps and archives) requires analogue-to-digital conversion processes, geo-referencing and linking to digital data from other sources. Such data, for example, may be used for taxation, tenure security purposes, slum upgrading, city management, to highlight a few. This also includes land use and zoning plans implemented by land consolidation and land readjustment processes. Statistical information such as fragmentation index and price index may need to be derived from the land administration system.

5.2 Further Modelling of LADMs RRRs

A more detailed classification of the legal part of the LADM is proposed for inclusion in LADM Edition II - i.e. interests in land. More detailed than described in the LADM Edition I from 2012 (ISO, 2012). The proposal from Jesper Paasch from Sweden is to further developing the LADM's 'right', 'restriction' and 'responsibility' (RRR) classes and associated code lists. Besides the more obvious formal right descriptions, this proposal also deals with informal rights' descriptions as introduced STDM as a foundation for further LADM development. The proposal is based on the Legal Cadastral Domain Model, as developed by and described in the PhD thesis of Paasch, which is used as a conceptual basis for adding an additional level to the LADM. Interests in land can be classified in this model as limiting or beneficial to real property ownership. The extended classification is further based on the paradigm that there are two major types of interest in land, privately agreed interests and regulations imposed by a public agency. The incorporation of a specialized classification of RRRs in the LADM is of value for more inclusion of social tenure in (inter-)national land administration registers. The LADM allows national profiles to be added to the standard, however, such profiles are relevant within a country. These profiles are needed in cases where detailed data of interests in land have to be exchanged internationally. International data exchange requires maintenance of code tables representing the different RRRs in use within countries. See also the section 7.2 of this paper on National Tenure Atlas.

5.3 Interoperability, Data Sharing and Data Integration

The Open Geospatial Consortium (OGC) recognises that worldwide, effective and efficient land administration is an on-going concern, inhibiting economic growth and securing land and property rights extensively. Existing approaches are at significant risk of data loss and failure due to, for example, disasters and lack of interoperability (OGC, 2016).

Interoperability, data sharing and data integration will be needed going forward and examples include:

- access to libraries with cloud free compositions of imagery,

- initial data acquisition,
- public review/inspection,
- check on complete coverage,
- reporting land disputes,
- request for information,
- publication of land data,
- provision of products and services,
- formalisation,
- map renovation, and:
- quality improvement and digital archiving.

See also section 8.2.
Providing timely and reliable land and geospatial information in areas where land administration is developed finds other requirements – development of 3D cadastre, inclusion of marine spaces, linking up with building information modelling and 3D city management for mega cities than in countries with less or non-developed land administration.
Data sharing means the data are collected once and used many times through establishing linkages. Duplicative efforts in data collection and maintenance can be avoided. Data are 'kept to the source'. A considerable amount of national resources can be conserved but also requires an increasing ICT effort – but the perception is that this effort is easier when implementing with standards from scratch than from legacy automated systems.

6. STANDARDS FOR GLOBALLY COMPARABLE LAND AND TENURE DATA FOR THE SDGS GLOBAL INDICATOR FRAMEWORK

The 2030 Agenda for Sustainable Development responds to the aspirations of all people seeking a world free of want and fear. The Agenda demands the need for new data acquisition and integration approaches, including exploiting the contribution to be made by earth observations and geospatial information. Land and tenure data is an integral part of this data ecosystem needed to measure, monitor and inform on progress in sustainable development as well as evidence-based policy formulation and informed decisions. For the 2030 Agenda for Sustainable Development, monitoring and accountability will be through the agreed 17 Goals and 169 Targets. Alongside these goals and targets, a global indicator framework currently comprising 230 indicators.

The new data needs are for determining and measuring the relationship between "people and land". This will require the production, availability and easy accessibility for consistent and comparable data including land and tenure data. There is a need for considerably more integration across the various national data, information systems and platforms in order to leverage the most effective data and analysis for evidence-based policy formulation and decision making.

Geospatial information, technologies and services, a crucial component of any national data and information systems, have become critical tools to support national development, social wellbeing, environmental management, economic growth, improved evidence-based policy formulation and decision-making, and have enhanced the ability of governments to analyse, model, monitor and report social, environmental and economic development challenges and ultimately ensure sustainable development.

Internationally agreed standards will be key alongside agreed global concepts and evidence-based approaches.

6.1 Land/Tenure Data and ISO 19152

Standards like the LADM are crucial to jump-start new initiatives and are connecting top-down and bottom-up projects. It is very important that there is awareness of this at policy level. Policies should support the implementation of standards particularly when such standards are globally agreed.

The LADM facilitates the efficient set-up of land administration and can function as the core of any land administration system. LADM is flexible and widely applicable. LADM is of one of the first spatial domain standards. Apart from the Continuum of Land Rights there is also a continuum of accuracy, of land recordation, of types of spatial units, of types of parties involved, and of data acquisition approaches.
All this is supported within LADM – allowing for a flexible, systematic and incremental approach in the development of a land administration and management system catering to the needs, priorities and requirements of users and society – including a focus on the needs of the poor. In this context attention should be given to issues such as: participatory maintenance of an informal land administration practice; unconventional transactions (for example formalising informal land use and legalising women's land rights or shares in land rights); conversion of land rights after review/inspection (from recordation to registration) and strategies for data protection and for IT development (with a focus on keeping systems running).

Development of a second edition of the LADM is scheduled for the coming years within ISO TC211, with input from stakeholders. This includes expansion of the RRR functionality; 3D Cadastre (mining, marine, underground utilities, complex buildings and constructions), link to topographic information (IndoorGML, InfraGML, LandXML, CityGML, BIM/IFC, etc.) and wider application of STDM. In the development of LADM Edition II, attention to processes in land administration (data acquisition, data maintenance, data sharing, see section 8.2) is relevant for the development of operational standards. Whereas special procedures for developing countries need to be taken into account. There are links to Smart Cities to be explored (life cycle of buildings, internet of things, URL per parcel/address, etc.).

The marine environment (administering marine spaces and marine cadastre) may be included in LADM. A proposed approach is that the marine environment is a related domain – similar to valuation/property taxation, buildings registrations, land use/land cover, mining and extractive licence register, archaeology and heritage cadastre, spatial planning zones (restrictions), road cadastre, physical utility networks, and address registrations. The important aspect is that of 3D in many of these domains and these can only be useful and integrated when there is interoperability, standards based datasets, within all related and varied domains.

The marine environment is an integral domain – terrestrial and marine datasets can be seamlessly integrated. This allows for effective analysis and modelling of the physical realm leading to improve governance particularly for the spaces where the land meets the sea or rather where the sea washes away the land. The important aspect is that of 3D in many of these domains and these can only be useful and integrated when there is interoperability, standards based datasets, within all related domains.

6.2 OGC Land Administration Domain Working Group

The linking of people, business and industry, economy and environment to a place or geographic location can result in a better understanding of social, economic and environmental realities and challenges to support policy formulation, decision making and citizen centric delivery systems. This implies availability of well-maintained links between geospatial datasets, land information and other 'basic' or 'key' or "fundamental" datasets.

The LADM provides an extensible basis for efficient and effective development based on a model driven architecture (MDA), and enables involved parties to communicate based on the shared ontology implied by the model. As it is already difficult within one domain (such as land administration) to agree on the used concepts and their semantics, it will be even more difficult in case of dealing with other and linking to other domains.

However, we cannot avoid this if a meaningful interoperable information infrastructure has to be developed and implemented. It is crucial that the importance of operational standards in land administration is recognised and supported at policy level. Otherwise the standards will not be implemented. Land administration itself is based on standards – which can be sub-national, national or global. It is recognised that there should be options for the inclusion of different types of rights, right-holders and spatial units. But the information infrastructure in which those data becomes available should be similar everywhere. This allows efficient communication between data sets managed by different organisations. This also supports performance measurement, progress monitoring, data protection, etc.

The Open Geospatial Consortium (OGC) has set up a land administration domain working group. This OGC initiative was prepared and discussed during the World Bank Conference on Land and Poverty in 2016. OGC has standing liaisons with major players in the land administration domain, including Technical Committee 211 of the ISO (this committee of the International Standardisation Organisation deals with geographic information), the Royal Institution of Chartered Surveyors, the World Wide Web Consortium, OASIS (Advancing Open Standards for the Information Society), the International Federation of Surveyors, and the Global Land Tool Network. OGC strives to use, build on and complement existing standards. However, while there are some standards describing elements of an administrative system, such as in Party and RRR packages in LADM, there might be gaps in the way that they incorporate geographic descriptions of land records, and/or inadequate rules for defining and describing the quality of the records. The OGC Land Administration Domain Working Group aims to assess the existing standards and address gaps.

Improved interoperability contributes to efficiency and effectiveness, reduce resource consumption through, among others, reduced deployment time, lower system lifecycle costs, improved flexibility and scalability, improved choice from the IT marketplace, and improved ability to share, exchange and integrate information related to land administration.

The domain working group will examine the land administration process from the land survey organisations, up through jurisdictional levels. This will be done with partner organisations across industry, development agencies and others where necessary.

The group will further work to provide a common vocabulary for the locational aspects of land administration databases, and it will also provide a forum for connecting suitable technology for data linkage and quality assessment.

Processes such as initial data acquisition may concern millions of spatial units where people to land relationships have to be determined. The organisation of this process requires location based support in logistics and case management, utilising appropriate geospatial information.

6.3 Data for Measuring and Monitoring

The Global Land Indicator Initiative (GLII) was established under the Global Land Tool Network in 2012 with the purpose to support efforts to harmonize monitoring efforts around land tenure and land governance. The GLII seeks to derive a list of globally comparable harmonized land indicators, using existing monitoring mechanisms and data collection methods as a foundation. This initiative supports on-going global and regional initiatives such as the Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security (officially endorsed by the Committee on World Food Security in 2012) and Africa's Land Policy Initiative, a joint initiative of the African Union Commission, the African Development Bank and the United Nations Economic Commission for Africa, for example.

The World Bank's Land Governance Assessment Framework (LGAF) can be used for identifying and monitoring sound practise in the land sector. The LGAF is motivated by the fact that land policy analyses and interventions are often fragmented.

It is understood that progress needs to be measured. Indicators are available via the Land Governance Assessment Framework and the Global Land Indicators Initiative and these efforts require data as inputs. Standardised (LADM Based) approaches are necessary and can be based on existing tools such as the STDM and also that of the National Tenure Atlases (see 7.2).

6.4 Data for Measuring and Monitoring

The increasing complexity of infrastructures and densely built-up areas requires a proper recording and registration of the legal status (private and public), which can only be provided to a limited extent by the existing 2D cadastral systems. The registration of the legal status in (complex) 3D situations is needed in 3D-Cadastres. This includes the marine environment.

In a recent paper (Sutherland et al, 2016) it is analysed if LADM is applicable to Marine Cadastres. This analyses concerns LADMs ability to:

- accommodate information on stakeholders in marine space,
- accommodate and model complex overlapping marine boundaries,
- incorporate other relevant spatial information components,
- incorporate relevant non-spatial attributes,
- associate marine parcels with complex legal regimes, and the ability to:
- facilitate marine cadastre's data integration in SDIs.

It is concluded that "Publications dealing with the marine cadastre concept were reviewed and criteria defined therefrom so as to support an assessment of whether the LADM standard is as a whole applicable, as published, to marine cadastres.

6.5 A Fiscal Extension Module

Taxation, and specifically taxation on land and immobile property, has recently been related to the process of building effective states and markets. The political aspects of this process are critical, but the following addresses the development of the information systems needed to realize the above-mentioned government tax reforms. A fiscal registry or database is supposed to record legal, physical, geometric, economic, and environmental characteristics of the property units, which are subject to immovable property valuation and taxation. A land administration infrastructure is required to link fiscal registries with other public registries (e.g., cadastre, land registry, building and dwelling registries). The LADM is a conceptual data model which provides a standardized global vocabulary for land administration. There is a proposal from Volkan Çağdaş to extend the scope of LADM with a fiscal perspective to provide a data model that could be used to construct information systems for immovable property valuation and taxation, and offer a data exchange option. The proposal (for inclusion in the second edition of LADM) provides a common basis for governments to direct the development of local and national databases, and for the private sector to develop information technology products. An option could be to include this as informative annex (similar to LPIS or INSPIRE CP annexes). Currently mentioned in informative annex K (External classes: ExtValuation and ExtTaxation) of ISO 19152, Edition I (ISO, 2012).

7. OVERVIEW OF SPATIAL DISTRIBUTION OF TENURES

7.1 Recognition of Legitimate Land Rights (based on the "Voluntary Guidelines")

The Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security (VGGTs) promote secure tenure rights and equitable access to land, fisheries and forests as a means of eradicating hunger and poverty, supporting sustainable development and enhancing the environment. "States should recognize and respect all legitimate tenure right holders and their rights. They should take reasonable measures to identify, record and respect legitimate tenure

right holders and their rights, whether formally recorded or not; to refrain from infringement of tenure rights of others; and to meet the duties associated with tenure rights". The 2030 Agenda for Sustainable Development has as a target the "Proportion of total adult population with secure tenure rights to land, with legally recognized documentation and who perceive their rights to land as secure, by sex and by type of tenure". Also the New Urban Agenda "commit to promote, at the appropriate level of government, including sub-national and local government, increased security of tenure for all, recognizing the plurality of tenure types, and to develop fit-for-purpose, and age, gender, and environment responsive solutions within the continuum of land and property rights, with particular attention to security of land tenure for women as key to their empowerment, including through effective administrative systems". The 'Environmental and Social Performance Standards and Guidance Notes' of the International Finance Cooperation from the World Bank Group, performance standard 5 on 'Land Acquisition and Involuntary Resettlement' also called for a wide range of (recognised) land rights.

Countries need to establish a consultative and participatory process for identifying which rights are legitimate. The VGGTs provide guidance on this process: "Based on an examination of tenure rights in line with national law, states should provide legal recognition for legitimate tenure rights not currently protected by law. Policies and laws that ensure tenure rights should be non-discriminatory and gender sensitive. Consistent with the principles of consultation and participation of these guidelines, states should define, through widely publicized rules, the categories of rights that are considered legitimate. All forms of tenure should provide all persons with a degree of tenure security, which guarantees legal protection against forced evictions that are inconsistent with states' existing obligations under national and international law, and against harassment and other threats".

7.2 Visualisation through a National Tenure Atlas

The end result of this recognition process is expected to be a set of categories of legitimate rights officially agreed within the country, which are legitimate under current legislation or proposed revised legislation. A Fit-For-Purpose approach can record and register all rights across a country and create a truly national land administration solution. This process could be tied to the creation of a national digital atlas of tenure types.

This national tenure atlas should provide a complete, aggregated, overview of the tenure systems and land rights related to the areas affected. All formal and informal tenure categories and sub-categories should be identified, and reference to the location. Also, land-use planning or other planning processes that may apply restrictions or responsibilities to certain areas can be accommodated. Different authorities have different responsibilities in the process of recording, recognising, registering and managing the various tenure types within different areas such as urban and rural.

The national tenure atlas is developed to provide an overview of the spatial distribution of legitimate tenure types across a country, e.g. areas of customary tenure, areas of informal tenure, areas of private ownership, state land, etc. This will help to identify where efforts for further documented land rights may need to be undertaken, or zoning for better natural resources management, or to enable administration and coordination between state and customary authorities through co-management. The limits of these tenure systems can be fuzzy, visible or fixed and all these can be incorporated in the national tenure atlas.

The atlas has a dashboard function and may include a layer for national and administrative boundaries, territories of land administration services, a layer for planned and on-going projects in land administration, a layer for the various types of mapping and scales used for cadastral purposes in the different topographic areas, etc.

8. FIT-FOR-PURPOSE LAND ADMINISTRATION

8.1 Country Specific Strategies

The Fit-For-Purpose approach is directly aligned with country specific needs, is affordable, is flexible to accommodate different types of tenure, and can be upgraded when economic opportunities or social requirements arise. It is highly participatory, can be implemented quickly and will provide security of tenure for all. Most importantly, the FFP approach can start quickly using a low-risk entry point that requires minimal preparatory work. It can be applied to all traditions in land tenure across the globe.
The country specific FFP strategy for land administration will be based on a country context analysis and the baselines of the existing spatial, legal and institutional frameworks. The analysis will involve identifying the conditions and policies within a country that constrain and shape the way that FFP land administration can be implemented.

This will then be used as a set of guiding principles to create the country specific strategy for building the spatial, legal and institutional framework for implementing FFP Land Administration that will also require provision of capacity development measures as well as country specific manuals for capacity, instructions and implementation.

Data maintenance can be 'programme driven' (systematic) or 'sporadic'. Programme driven means a complete and systematic new acquisition after initial data acquisition or an earlier maintenance effort. Sporadic means case by case in a 'transaction driven' way and relates to transactions in the land market (buying/selling, establishment of mortgage etc.). Quality upgrading of data can be part of the maintenance process. This may be required after digitisation of legacy data or in case of urbanisation or urban planning. It is crucial that data collected using survey approaches based on differing accuracies can be integrated together. Quality upgrading of data may also entail integration of 3D cadastral data (this includes integration with standards such as IndoorGML, InfraGML, LandXML, CityGML, BIM/IFC) and marine cadastre.
Enabling standards are also being developed with other domain working groups within OGC, such as LandInfra. Partnerships and liaisons with other associations and standards developing organisations (SDOs) will be developed to address interoperability issues that span the land administration community of practice, geographic information systems and the broader IT environment. Examples include linkages with ISO TC 211 regarding the LADM as well as those standardisation organisations developing IT standards related to topics such as security, the internet and mobile services. The OGC land administration domain working group will be open to participation by any interested organisations and individuals. Participation and commitment from both the developed and developing countries are required.

8.2 Linking New Data Acquisition Methods and Maintenance – Generic Processes

More generic approaches are expected to be possible for:
- Computerising legacy data (indexing and geo locating where possible).
- Determining accuracy labels for all attributes – geometric and administrative.
- Adjudication of existing rights.
- Coding of Rights, Rightholders, Spatial Unit Types etc. See Informative Annex J of (ISO 19152, 2012)
- Inclusion in Tenure Atlas.
- Image based acquisition:
  - selection and composition of cloud free imagery – access to sensors and image libraries;
  - creating cloud free compositions – may be from different sensors;
  - geo referencing based on elevation models (can be in post processing mode);
  - feature extraction;
  - feature classification (optional);
  - fata cleaning and feature visualisation;

  - provision to data collectors (task management, logistics) – this can be paper based or digital, paper based acquisition allows leaving the collected field boundary evidence to the local people. These include participatory approaches, roles, and on line/off line publication. Includes data on people id's, photos, signatures, fingerprints, video, voice recording etc. And right types and restrictions, including disputes;
  - scanning (optional);
  - geo referencing (optional);
  - polygon creation, topology, identification, linking;
  - conversion of rights to legal status.
- Similar as for image based field data acquisition: conventional field surveys (total stations, tape, etc.), UAV based acquisition, Lidar based, Radar Based, Conventional Survey Based, Digital Pen based.
- Coordinate calculations from observations.
- Adjustments of new coordinates to existing coordinates (e.g. least squares adjustments).
- Area management.
- Publication of parties, related rights and spatial units (incl. global services as Google, Virtual Earth, Open Street Map).
- Conflict resolution.
- Integration in LA SDI – incl.:
  - linking rights, restrictions and responsibilities (RRRs) to spatial units;
  - linking (groups of) persons to (shares in) RRRs;
  - maintenance of parties and related rights and related spatial units;
  - inclusion of (legacy) Land Administration Archives and Document Information - Legacy data requires Analogue to Digital conversion and linking to digital data from other sources.

Processes as initial data acquisition may concern millions of spatial units (parcels) where people to land relationships have to be determined. The organisation of this process requires geo-support in logistics and case management based on geo-information. During field work a check on consistency and completeness needs to be performed – in an easy way.

By using orthophotos to produce spatial frameworks the imagery is typically linked to the national geodetic reference frame through the use of GNSS systems on the space/ aircraft and on the ground.

Complementary field surveys may be needed adding to image based acquisition. Today Lidar and Radar technologies can be used. Automated feature extraction can bring support in the production of co-ordinates from identified visible boundaries drawn on top of imagery.

9. CONCLUDING REMARKS

To ensure the wellbeing of humanity including securing land and property rights for all, there need to be concerted efforts to improve the production of data and the generation of information needed to record all forms of people-to-land relationships that will provide for effective and efficient land administration systems that meets the aspirations of all. There will be a need considerably more integration across the various national data and information systems and platforms in order to leverage the most effective data and analysis for evidence-based policy formulation and decision making. Internationally agreed and open standards will be key to unlock the value of data and the wealth of information needed to recognise all forms of people-to-land relationships, which is vital for the wellbeing of all humanity and sustainable development.

With geospatial technologies and sensors coupled with a new professional mindset, the provision of effective and efficient land administration that supports good land governance and secure land and property rights for all appears to be a feasible objective within the current generation. This can only be achieved in joint projects. Good practise as Fit-For-Purpose approaches in land administration are available.

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Annex – Set of definitions

Annex – Nomenclature

III. LADM Related Publications at Workshops, Conferences and in Journals and Magazines

(by LADM developers, but also by others)

2017

Pieter Soffers
Designing an integrated future data model for survey data and cadastral mapping
Master's thesis, Delft University of Technology, 2017, 113 pages
PDF file 31,928 KB

2016

V. Çagdas, A. Kara, P. van Oosterom, C. Lemmen, Ü. Isikdag, R. Kathmann, E. Stubkjær
An Initial Design of ISO 19152:2012 LADM Based Valuation and Taxation Data Model
Chapter in: ISPRS Annals of Photogrammetry, Remote Sensing and Spatial Information Sciences, IV-2/W1, 2016, pages 145-154
PDF file 12,885 KB

S. Zlatanova, P. van Oosterom, J. Lee, K-J. Li, C. Lemmen
LADM and IndoorGML for Support of Indoor Space Identification
Chapter in: ISPRS Annals of Photogrammetry, Remote Sensing and Spatial Information Sciences, IV-2/W1, 2016, pages 257-263
PDF file 1,743 KB

Katerina Athanasiou, Efi Dimopoulou, Christos Kastrisios, Lysandros Tsoulos
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In: Proceedings of the 5th International Workshop on 3D Cadastres (Peter van Oosterom, Efi Dimopoulou, Elfriede M. Fendel, eds.), 2016, pages 81-104
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Mixed 2D and 3D Survey Plans with Topological Encoding
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PDF file 803 KB

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