

How Geospatial Surveying Is Driving Land Administration



Special and General Administrative Data Regulation									
What is it?	Location	Material	Regulating Authority	Level of Authority	Accession	Sign Authority	Rights	Prohibition	Storage
Document or Fingerprint	In the field	Original	OKZ Police	OKZ Police	Basic	Individual Administrative Authority	Registered Police	Public Inspection	Chief
Classification Document		Handwritten	OKZ Police	OKZ Police	Classification Document	Matched Administrative Authority	Class Document	Public Inspection	Chief
Document Material		Handwritten	OKZ Police	OKZ Police	Classification Document	Matched Administrative Authority	Class Document	Public Inspection	Chief
Document Material		Handwritten	OKZ Police	OKZ Police	Classification Document	Matched Administrative Authority	Class Document	Public Inspection	Chief
Document Material		Handwritten	OKZ Police	OKZ Police	Classification Document	Matched Administrative Authority	Class Document	Public Inspection	Chief
Document Material		Handwritten	OKZ Police	OKZ Police	Classification Document	Matched Administrative Authority	Class Document	Public Inspection	Chief
Document Material		Handwritten	OKZ Police	OKZ Police	Classification Document	Matched Administrative Authority	Class Document	Public Inspection	Chief
Document Material		Handwritten	OKZ Police	OKZ Police	Classification Document	Matched Administrative Authority	Class Document	Public Inspection	Chief
Document Material		Handwritten	OKZ Police	OKZ Police	Classification Document	Matched Administrative Authority	Class Document	Public Inspection	Chief
Document Material		Handwritten	OKZ Police	OKZ Police	Classification Document	Matched Administrative Authority	Class Document	Public Inspection	Chief
Document Material		Handwritten	OKZ Police	OKZ Police	Classification Document	Matched Administrative Authority	Class Document	Public Inspection	Chief
Document Material		Handwritten	OKZ Police	OKZ Police	Classification Document	Matched Administrative Authority	Class Document	Public Inspection	Chief
Document Material		Handwritten	OKZ Police	OKZ Police	Classification Document	Matched Administrative Authority	Class Document	Public Inspection	Chief

[illegible]

The national cadastral and topographic mapping agencies from UN member states are represented in the United Nations Committee of Experts on Global Geospatial Information Management (UN-GGIM). The geospatial industry is involved as an observer. UN-GGIM's Expert Group on Land Administration and Management has developed a reference document for developing, reforming, renewing, strengthening or modernizing land administration and management systems. It is called the [Framework for Effective Land Administration](#) (FELA) and is currently under global consultation. The document calls for recognition of land tenure, land use, land value and land development data – including elements relating to gender, conflict and disaster – as fundamental geospatial data themes



Figure 1: Sustainable development and land administration. (Courtesy: UN-GGIM)

Member	Description
Chair	Esri is the LEADER of international organizations that are involved in the LADM.
Members	The following organizations are members of the LADM: Esri, IGN FI, GEOTIT, and Innova Solutions. They are responsible for the overall development of the LADM, including the design and development of implementation standards. Close cooperation between OGC and the International Organization for Standardization's ISO/TC 211 on Geographic Information is expected to accelerate these developments.
Observers	Observers are organizations that are not members of the LADM but are interested in the LADM. They can participate in the LADM Working Group (DWG) and provide input to the LADM. They can also participate in the LADM Working Group (DWG) and provide input to the LADM. They can also participate in the LADM Working Group (DWG) and provide input to the LADM.
Advisors	Advisors are organizations that provide advice and support to the LADM. They can provide input to the LADM Working Group (DWG) and provide input to the LADM. They can also provide input to the LADM Working Group (DWG) and provide input to the LADM.
Partners	Partners are organizations that are working with the LADM. They can provide input to the LADM Working Group (DWG) and provide input to the LADM. They can also provide input to the LADM Working Group (DWG) and provide input to the LADM.
Collaborators	Collaborators are organizations that are collaborating with the LADM. They can provide input to the LADM Working Group (DWG) and provide input to the LADM. They can also provide input to the LADM Working Group (DWG) and provide input to the LADM.
Supporters	Supporters are organizations that are supporting the LADM. They can provide input to the LADM Working Group (DWG) and provide input to the LADM. They can also provide input to the LADM Working Group (DWG) and provide input to the LADM.
Advisors	Advisors are organizations that provide advice and support to the LADM. They can provide input to the LADM Working Group (DWG) and provide input to the LADM. They can also provide input to the LADM Working Group (DWG) and provide input to the LADM.
Partners	Partners are organizations that are working with the LADM. They can provide input to the LADM Working Group (DWG) and provide input to the LADM. They can also provide input to the LADM Working Group (DWG) and provide input to the LADM.
Collaborators	Collaborators are organizations that are collaborating with the LADM. They can provide input to the LADM Working Group (DWG) and provide input to the LADM. They can also provide input to the LADM Working Group (DWG) and provide input to the LADM.
Supporters	Supporters are organizations that are supporting the LADM. They can provide input to the LADM Working Group (DWG) and provide input to the LADM. They can also provide input to the LADM Working Group (DWG) and provide input to the LADM.

Interoperability and OGC

In parallel, the Open Geospatial Consortium (OGC) published a white paper on land administration, providing an overview of the land administration domain and proposing actions needed for the design and development of implementation standards. Close cooperation between OGC and the International Organization for Standardization's ISO/TC 211 on Geographic Information is expected to accelerate these developments. The charter members (see Figure 2) of the OGC Land Administration Domain Working Group (DWG) seek to identify enabling standards and best practices to guide countries in a programmatic way to establish more cost-effective, efficient and interoperable land administration capabilities. The aim is to support the upgrading of current manual

processes to semi-automated ones, and to suggest solutions that are more automated and open to new data sources and technologies. Interoperability is imperative in the field-to-cloud and field-to-office activities.

Figure 2: Overview of charter members of the OGC Land Administration Domain Working Group. (Courtesy: OGC)

Standardization and LADM

The Land Administration Domain Model (LADM) has been an ISO standard for seven years and is currently undergoing a review towards a second edition. A road map is under development. The scope of LADM will be extended to include valuation and fiscal representations, which will have an impact on data acquisition methods. Spatial planning and zoning inclusion, with legal implications, is another extension of the scope. Moreover, it is planned to include process models and workflows. Esri continues to invest in LADM for the ArcGIS platform. It has been configured to leverage LADM to meet land administration system needs across the globe. IGNFI/GEOTIT and Innova Solutions already provide proven national-scale, enterprise-level, LADM-compliant configurabilities, rule-driven systems, based on BPMN workflows. Those open solutions can integrate external services and sources using exposed web services/API (including GIS systems).

Quality and FFPLA

Data capture should fit the purpose of its intended use. In cases where value of land is higher or an intensive level of land use exists, conventional field surveys – using high-precision methods such as high-precision GNSS, total stations or terrestrial laser scanners – can be deployed. [Trimble](#), [Leica](#), [Topcon](#) and emerging players offer a wide range of such options. Areas with lower land values can use other approaches including use of aerial imagery, aerial Lidar and even radar. All these approaches are suggested in the [Fit for Purpose Land Administration](#) (FFPLA) approach. FFPLA urges cost-effective, time-efficient, transparent, inclusive, scalable and participatory data collection and management, including participatory surveying and volunteered and crowd-sourced land information. This means integrated acquisition of spatial and legal/administrative data. Many options and approaches should be available (see Figure 3). The user interface should be as simple as possible and the kind of measurement used should be recorded. In many situations, it is sufficient to identify visual boundaries in the field using easily understood imagery. By following FFPLA guidelines, land administration systems start from a simple basis and can be incrementally improved over time, whenever necessary or relevant. It is a dynamic process involving adaptation to different contexts, availability of technology and existing administrative approaches. In summary: less accurate measurements can serve the purpose for initial measurements. Higher precision can/should be used for incremental improvement (where needed).

Figure 3: Integrated acquisition of spatial and legal/administrative data. Many options and approaches should be available in a flexible way.

Productivity and the Private Sector

The International Federation of Surveyors (FIG) published a report on crowdsourcing (see Figure 4) recognizing that geographic data collection via authoritative professionals only – characterized as the ‘top-down’ scheme – has been challenged over the past few years. There is now a move towards more bottom-up approaches in which people generate data that is subsequently used as information in various land-related applications and services. This is in line with the FFPLA concept. Esri, [IGN FI](#)/GEOTIT and [Innova Solutions](#), [Meridia](#), [Trimble](#) and [Cadasta](#) now all offer solutions in support of participation. Meridia states that the Meridia°Collect is designed to enable local community members to use advanced spatial and textual surveying features for initial land registration. It scales well (as proven in 50,000+ parcel projects) and is focused on usability and data consistency. Cadasta says that solutions must be adapted to the local context, but at the heart of their work they focus on ensuring data collection and management is done in concert, if not directly, by community members. Trimble states that, if input is required from non-professionals (via crowd-sourcing, for example), tools such as Trimble TerraFlex – a flexible and easy-to-use cloud-based solution for field data collection – also enable attribution. Leica's FFPLA solution, [Leica Zeno](#), provides a very easy-to-use GNSS field data collection tool offering scalable accuracy to meet all land administration requirements. Zeno can be used on consumer-grade smartphones or tablets with the high accuracy and precision demanded in land administration.

Company's visions on how to support land administration (cadastre and land registry) processes and services in the future.

Innovation and 3D Cadastres

Another relevant development is that of 3D cadastres. A comprehensive study recently published by FIG (see Figure 4) concluded that ongoing urbanization, increasing complexity of infrastructure and densely built-up areas require better recordation and registration of the legal status. This can only be provided to a limited extent by existing 2D cadastral systems. 3D, including indoor modelling, is required to capture the whole legal and spatial dimension, which further includes the marine environment. A dedicated ‘vertical’ land administration stream is without any doubt the trend which is requested and fully supported by suppliers. The support may range from assistance during initial registration and documentation of land rights, to deliverance of the full ‘vertical’ spectrum of land administration services – from field

data acquisition, data conversion and data migration, to LADM-compliant data integration and transactional workflow-driven data management and dissemination.



Figure 4: FIG has published reports on crowdsourcing and 3D land administration.

Automated Feature Extraction

Automated feature extraction (AFE) is under development in various domains, including the land administration domain (see Figure 5). The most notable developments are in infrastructure management in urban areas (e.g. transport, buildings) and agriculture (land use). The application to land administration is more recent and should be considered at R&D and pilot level. It is argued that a large number of cadastral boundaries are visible and coincide with natural or human-made physical object boundaries. Imagery-based approaches have been proved as usable for land titling and recordation of all people-to-land relationships in countries such as Ethiopia and Rwanda. Nevertheless, even in ideal cases, not all visible cadastral boundaries can be automatically detected; certain boundaries require a semi-automated approach, especially in urban areas where the morphology of cadastral boundaries is complex. AFE cannot deliver complete matching; some tenure boundaries are also defined socially or are covered by thick canopy and thus are not visible in imagery. AFE is a good method for updating a cadastral map or for initial working-draft land recordation. AFE is perhaps on the cusp of going beyond R&D, as all the big vendors are working on it. Linking with those providers for pilots will reveal many lessons, including the viability of the approach in different parts of the landscape. AFE will not be suitable everywhere, but – like UAVs – it will have a niche role to play in both initial capture and updating/maintenance.



Figure 5: Automated feature extraction (AFE) is under development in various domains.

Disaster Readiness

There has been increasing focus on ensuring land administration systems are better able to adapt and respond to both natural disasters and disputes. It is crucial to gain an overview of areas where disasters have an impact on land rights. Land administration systems (LASs) are typically built to operate in relatively stable environments. Disaster risk management (DRM) generally assumes a dynamic, if not chaotic, environment. After a disaster occurs, the aim is to quickly assess and triage damage, injury and loss of life, and respond with medicine, food, water, housing and basic infrastructure. New conceptual thinking has established a link between the key LAS constructs of land, people and rights, and the core DRM concepts of hazard, vulnerability and exposure. This theoretical link has been converted into a practical data model by embedding new attributes into the ISO 19152 LADM standard (see Figure 6).



Figure 6: What happens when disaster risk management meets land administration? Special edition of the newsletter *Kadaster Abroad*.

Concluding remarks

New-era land administration is being embraced by surveyors, the private sector, policymakers, governments and communities alike. Underpinned by emerging policies such as UN-GGIM's FELA and principles of interoperability (OGC), standardization (LADM) and pragmatism (FFPLA), a range of sustainable and scalable private-sector products and services are emerging. These are enabling innovations and automation in national land administration sectors. Importantly, these technical developments are supplemented – if not enabled – by simple legal procedures and streamlining institutional processes.



What are the latest land administration innovations that companies would like to share?

Further reading

- FIG, 2019, [New Trends in Geospatial Information: The Land Surveyors Role in the Era of Crowdsourcing and VGI](#), International Federation of Surveyors, FIG Publication No 73
- FIG, 2018, [FIG publication on Best Practices 3D Cadastres](#)- Extended version, International Federation of Surveyors, November 2018
- Kadaster, 2019. *Kadaster Abroad*, Special Edition – Theme: LAS meets DRM, Kadaster, September 2019
- OGC, 2018, Open Geospatial Consortium White Paper on Land Administration, OGC, February 2019
- UN GGIM, 2019, Framework for Effective Land Administration. Expert Group on Land Administration and Management United Nations Committee of Experts on Global Geospatial Information Management (UN-GGIM), July 2019 – Under Consultation