Decision support for the practical implementation of land administration systems

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KEY WORDS

Decision support, land administration, implementation, IT solutions, cadastre, ICT, GIS, geographic information systems, LADM, land information systems

SUMMARY

We live in an insecure era with climate change, conflicts, dense populations, and increasing poverty and inequity. Good land administration is a basic requirement for governments and societies to address these challenges (de Zeeuw *et al.*, 2019).

Many guidelines, tools and frameworks have been developed, and are freely available to guide decision makers and professionals towards good land administration. Still, the practical implementations by Land Administration Authorities demand good decision support for making the best choices in IT, capacity development and financial investment.

In this paper a discussion is started on the choices that must be made when a land administration IT system is designed or further developed, and a required framework for making good decisions. In addition to the challenges with existing registers and cadastral maps, an interoperable futureproof system requires strategic planning and design in order to not get anchored in old technology. Sustainable system development is challenging. The procurement, design and maintenance of IT solutions should always fit the long-term budget of the Land Administration Authority and be evolvable with new requirements, expectations, and technology.

In practice, this means planning holistically in the design phase that can be translated into an architecture, infrastructure, and daily approach. With Land Administration Authorities in the lead, this is where choices and priorities are set. In this paper we will explore how IT decision-making has evolved and provide practical ideas for Land Administration Authorities around the world. We will detail a framework that can be adapted to your organization to help make good IT decisions to deliver a secure, sustainable, and well-functioning land administration system.

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1. LAND ADMINISTRATION AND SUSTAINABLE DEVELOPMENT

Opinions and emotions about a livable world are developing and changing rapidly. With a global Covid pandemic, noticeable climate change everywhere and unpredictable human behavior we have entered a new era. This effects sustainable development in all its aspects (people, profit, planet, peace, and partnership).

A well-informed society is essential to address these challenges. This includes information on people-land relationships and its correct documentation and registration. Therefore, Land Administration and the existence of a Land Administration Authority in any form, is a prerequisite for - and good investment in - sustainable development.

The global differences in land administration systems are vast. From first time registrations to upgrading existing registration systems, to aligning systems to the changes society continues to demand. But all systems have the common denominator that they link the past, present and future of land tenure within society. To do so, a system of record, a system of insight and a system of engagement must be interconnected and aligned with the legal, geospatial and institutional context. The level of technology chosen is context-specific and can range from simple paper-based systems to enterprise digital systems, including cloud solutions and artificial intelligence, and everything in between.

2. DECISION SUPPORT IN LAND ADMINISTRATION

It requires a secure national or local system to get the legal certainty on land in place. Figure 1 gives on overview of the aspects influencing the implementations of these systems.

There are a vast number of guidelines, frameworks, standards, methods, and approaches. The IGIF (https://ggim.un.org/igif) and FELA (EG LAM, 2020) from UN-GGIM provide globally recognized guidelines for both the development of Spatial Data Infrastructures and an Effective Land Administration system. Methods like Fit-for-Purpose Land Administration (FIG/WORLDBANK, 2014; UN Habitat/GLTN/Kadaster, 2016) and the Land Administration Domain Model (LADM, Lemmen *et al.*, 2015) help define a required approach for land administration authorities. However, this context is strongly influenced by external factors that differ from place-to-place. In Figure 1, this is represented by the arrows, varying from political commitment to available capacity, and software and tools. And then, without the proper options for innovation and upscaling, risk exists for stranded investments in non-sustainable systems and implementing systems that are not future proof, risking the success of projects and programs.
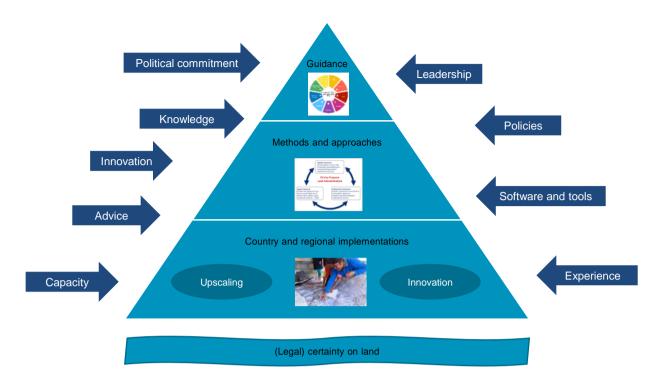
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Figure 1. The relationships between guidance, methods and approaches, and country implementations, and the issues effecting these relationships.

This is where the practical decision support in system design and implementation is extremely valuable. Apart from the design and IT requirements for the registry and cadastre, aspects like workflow management and the possibility of incremental development introduces complications. The solution should be scalable, both in size as in capabilities. At any stage of the development the recording, analysis and data sharing the Rights, Restrictions, Responsibilities (RRR's) should be guaranteed to the users of the system and citizens, and society.

3. IT SOLUTIONS IN PRACTICE

Well-developed administration authorities tend to be in the position to have all relevant domain expertise and assets available to design and develop systems by themselves. The very specific domain expertise and a good understanding of the national context is available in house. Land administration authorities with less capacity and means, often need to rely on external advisory and development services, providing less specific context and domain knowledge. This brings in the risk of following unsuccessful strategies, using outdated technology, and making poor investment decisions.

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In all cases, the IT solutions that are developed, customized, configured or acquired, must be evaluated on various aspects:

- The use of standards
- Out of the box functionality
- Security and privacy
- Scalability (hardware and software)
- Market share and support (internally or externally)
- Capacity and training requirements
- Cost for purchase and design
- Total cost of ownership
- Sustainability and expandability of the chosen solution

Practice shows that it is very difficult to do this from a 'Fit-for-Purpose' development perspective. Very often the initial requirements are assessment and system design. This approach requires high-end solutions that are hard to realize and finance from the start (the classical Rolls Royce design for a family car). Alternatively, simple solutions that cannot be further developed, expanded, and scaled up are doomed to fail as well, as they require unnecessary re-investments in the (near) future.

4. THE RIGHT ARCHITECTURE AND INFRASTRUCTURE

In practice, land administration information systems are rarely isolated systems. They most often need to exchange data and integrate with other systems, departments, and users. And with ongoing digitalization of societies and expanding citizen expectations, this demand will only increase.

This requires that the digital infrastructure of land administration information systems meet the following capabilities and functions:

- Integrated registries and maps
- Scalable (performance, number of records and capabilities)
- Use of open standards (OGC, ISO, LADM)
- ETL (Extract, Transform and Load) capabilities
- Interoperability
- Security and privacy
- Evolvable
- A multipurpose cadaster
- A National Spatial Data Infrastructure

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5. LAND ADMINISTRATION AUTHORITIES' APPROACH IN THE 21ST CENTURY

There are very few (if any) green field development opportunities in the land administration systems domain. Although the completeness of land records is very low in many parts of the world, often there are registrations that cannot be denied or neglected. In some areas of the world, multiple – different – land information systems co-exist, with different accuracies, time frames or approaches. For example, some areas have a mixture of deed and title systems. It is the land administration authority's responsibility to connect the past, present, and future tenure security based on the archiving, collection, analysis, and distribution of land records.

This does not alter the fact that all land administration practices should always be purpose driven. It is the societal demand of today and tomorrow that defines the design and implementation, considering the appropriate technological and financial possibilities.

When designing your system, the main key take-aways are:

- Sustainable (operations, technique, and finance)
- Use a business model
- Be innovative and current
- Make it futureproof (e.g., Artificial Intelligence and 3D) but not futuristic
- Evolvable and expandable
- Learn to and from others
- Cooperate and share

6. THE USE OF GIS

Geographic Information Systems (GIS) support the system of records, the system of insight and the system of engagement for land administration. GIS can be the starting point in a project beginning very simply, evolving into a system, bringing information into the cloud and – finally – contribute to a system of systems.

It is critical to always understand that land administration is about people-to-land relationships, and there is legal and non-spatial data. This means that platforms, communities, software, and hardware should be interoperable and configurable. The use of open standards, proven technology, and long-lasting professional communities support this.

The ArcGIS parcel fabric is a good example of this. This Commercial-off-the-shelf (COTS) software has been developed, considering requirements and best practices of land administration authorities worldwide. It is configurable, scalable and can be applied using the LADM standard. There is a global user community allowing new users to share, learn and to give feedback on lessons learned and desired additional functionality. Also, it is part of the Land Administration Modernization program (LAMP) supporting over 80 eligible developing

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countries in starting-up a GIS land parcel management system, More information to be found at: https://www.esri.com/en-us/industries/government/departments/land-administration/modernization-overview.
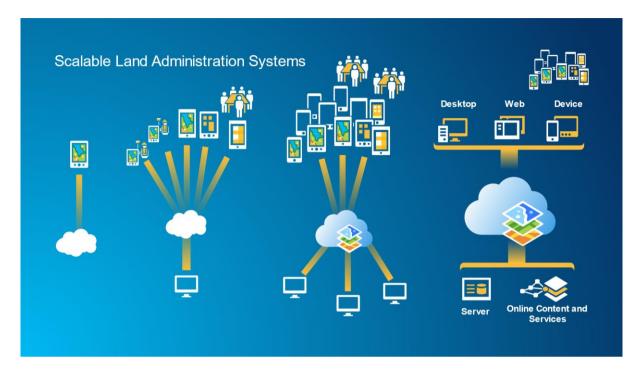

Figure 2. Scalable Land Administration Systems.

7. CONCLUSIONS

Land administration is prerequisite and a required investment for sustainability.

A system of record, a system of insight and a system of engagement must be integrated and aligned with the legal, geospatial, and institutional context.

Practical decision support in IT design (hardware and software architecture) and infrastructure design will help land administration authorities in a Fit-for-Purpose approach applying existing (international) guidelines, principles, approaches, methods, and standards.

Three important success factors for land administration implementations are: Sustainability, scalability, and affordability.

GIS adds value in parcel management, enterprise systems and workflow management.

It is hoped that this paper can be used as an inspiration by all technology providers and communities to make a contribution to "land rights for all".

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BIOGRAPHICAL NOTES

Kees de Zeeuw is Principal Consultant at Esri inc. Since 2022 he is the Practice Lead on Land Administration at the Geospatial Authorities department of Professional Services. He holds an MSc degree in land and water management (1989). After long term assignments in Rwanda and Bolivia he has been working more than 10 years in environmental and geo-information sciences at Wageningen University and Research Centre in The Netherlands. At Cadastre, Land Registry and Mapping Agency in The Netherlands (2007 – 2022), he has been for 12 years the director of Kadaster International. His expertise is on Land administration and NSDI. He made contributions to Fit for Purpose, LADM, IGIF and FELA.

Brent Jones oversees Esri's worldwide strategic planning, business development, and marketing activities for land records, cadastre, surveying, and land administration. As a recognized innovator, Jones specializes in modernizing existing land administration systems and designing new GIS-based cadastral management systems for small and large governments globally. He is president-elect of URISA; past president of the Geospatial Information and Technology Association; and a current member of the United Nations Committee of Experts on Global Geospatial Information Management, sitting on the Expert Group on Land Administration and Management. Esri creates systems that drive all components of land and cadastral administration.

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