GIS in Land Administration
Can Help You Implement the FELA
and Support the SDG's

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SUMMARY

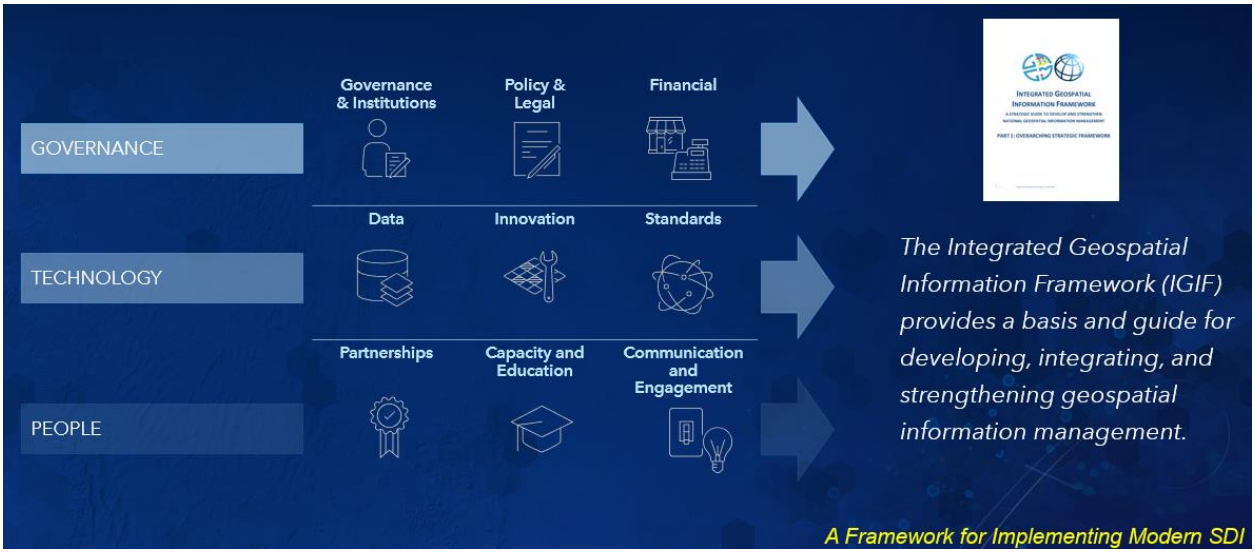
The UN-GGIM's Framework for Effective Land Administration (FELA) is an excellent conceptual framework providing guidance on best practices, and it proves to be extremely useful in the coming years. While there is consensus on the value of such a framework, a key question is how a cadastral agency can put this into daily operations leveraging scalable, cyber-secure and sustainable technology without costly custom software development. Geographic information system (GIS) technology exists today that supports several of the FELA Strategic Pathways. Effective land administration supports at least five of Sustainable Development Goals (SDG) and the same GIS technology that supports FELA supports the SDGs. This presentation will illustrate how configuring existing and software tools can provide key support on operationalizing FELA and the SDG's.

GIS in Land Administration Can Help You Implement the FELA and Support the SDG's

Brandon Tourtelotte

Organizations like FIG, the World Bank, and numerous UN Agencies have taken the lead in developing standards, data models, and frameworks for how best to go about modernizing Land Administration. These include Fit for Purpose, the Land Administration Domain Model, the Continuum of Rights concept, the IGIF, the Framework for Effective Land Administration, and of course the SDG's for the 2030 development objectives. You've probably heard many presentations on these topics in conferences like FIG, and if so you know these frameworks have been refined and tailored over time.

You could think of these frameworks and standards as a 'cookbook' for how to do Land Administration. The need to pursue such modernization is a clear priority. Yet we want a way to measure if our developments are being done according to an agreed upon standard. How is everyone else doing this? Are we doing this right? Of course the real benefit of the standards is working through them to complete impactful projects. Our topic here asks if GIS technology is ready to operationalize this?



As a framework for implementing modern SDI, the UN and World Bank developed the Integrated Geospatial Information Framework or IGIF. Many of you are no doubt familiar with this. It was adopted by the UN GGIM in 2018. Thus it has been in effect for about 4 years now. It aims to provide a basis and guide for lower to middle income countries to reference when modernizing their approach to geospatial information management. It does this through 9 strategic pathways (depicted in the above diagram). These 9 strategic pathways can be conceptualized into three overarching themes related to governance, technology, and

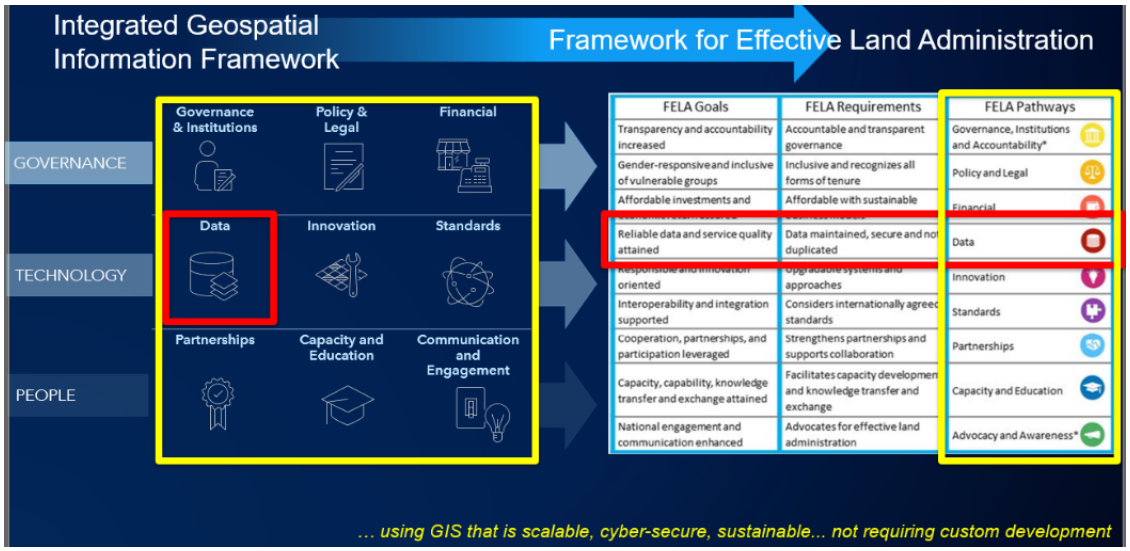
people. As you can imagine, GIS provides a host of resources to help countries implement the IGIF.

Operationalizing, which means dynamically putting the framework into practice, calls attention to this quote from the IGIF. As it says, the framework is intended to ask as a catalyst for opportunities, and translating your agency's priorities into tangible value. This is why it's

- The IGIF acts as a catalyst for economic growth and opportunity, and to provide understanding and benefit from a country's national development priorities and the SDGs.

a meaningful and relevant topic.

IGIF has been specifically applied to Land Administration in the form of a guidance document called the Framework for Effective Land Administration (FELA). The graphic below conveys the direct connection between the contents of the FELA and the 9 pathways of the IGIF. You'll note that the FELA pathways on the right are the 9 pathways of the IGIF. From there each pathway states goals and requirements pertaining to Land Administration.



The guidance lies in the combination of all 3.

If we take one example, in the Data pathway, it states the FELA goal as *reliable data and service quality attained*, and a requirement of *data maintained, secure and not duplicated*. What we'll do next is step through each of the pathways and illustrate the various ways that GIS can enable you as a Cadastral Agency to put these requirements into action. This is all possible by leveraging scalable, cyber-secure, and sustainable technology that doesn't require custom software development.

The first theme is *governance*, and we'll discuss the first 3 pathways.

Pathway 1: Accountable and transparent governance. This is not so relevant for software, but what this identifies is a need for consultation. A Cadastral Agency needs to develop and update their organizational strategies in several areas. Modernization implies change and a strategy to manage that change. We know that it's key to have a Data Governance strategy (who manages and owns what data). In many cases projects fail because they don't have exec sponsorship, so it's important to consider consulting around how to engage your leadership in what your agency wants to accomplish. More and more Geospatial firms provide consulting in these areas, and can help you develop your overall geospatial strategy. You should seek them out. The same goes for Spatial Data Infrastructure consulting. Data sharing agreements and regional geospatial portals also play a role.

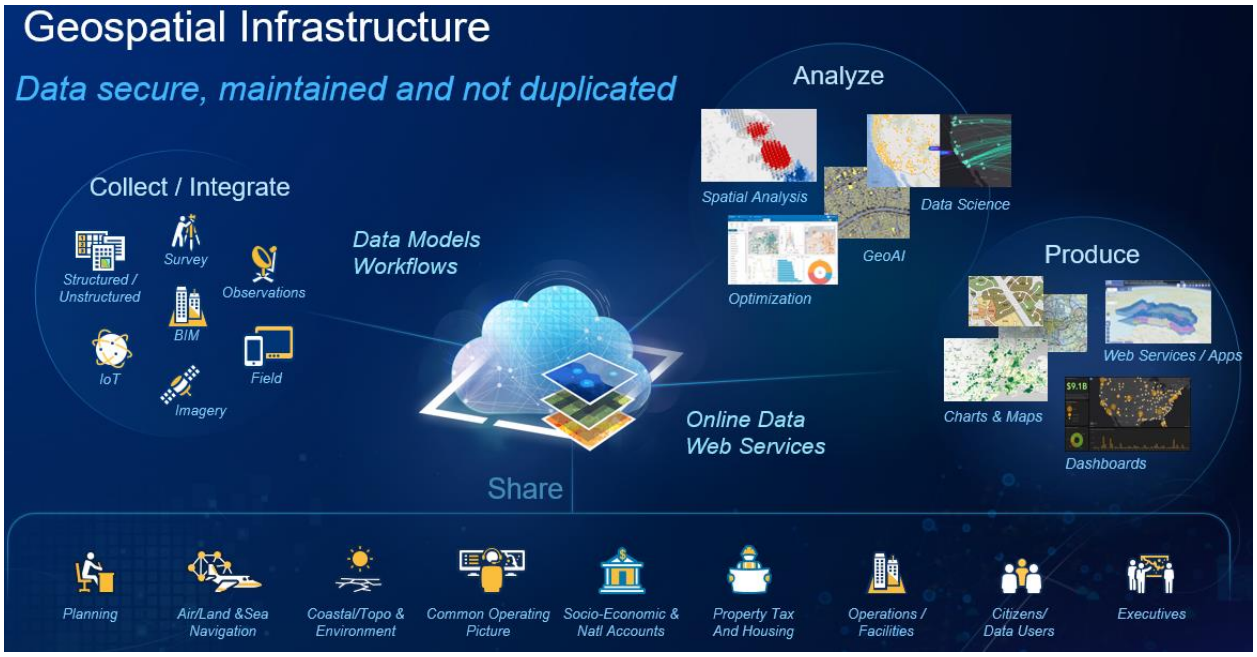
Pathway 2: Inclusive and recognizes all forms of tenure. As we'll see in a later example by the Cadasta foundation, GIS enables us to quickly deploy configured apps to the field to perform first registration activities, collecting ownership information and mapping parcels in a Fit for Purpose methodology. Informal tenure is recognized and captured. This work can be undertaken by anyone with a smart phone and a GPS device, and we have projects that have been **completed** with participants from the communities involved, and a methodology that worked.

Pathway 3: Affordable with sustainable business models. These are very logical and reasonable goals. GIS does give us the option of starting small with the SaaS model, where you purchase a single user account, hosted on the cloud, and you're operational. As your needs grow, you have options. You can purchase more user accounts, or options for on-premise are available where you deploy GIS on your own infrastructure. This is a sustainable model, which we'll touch on later.

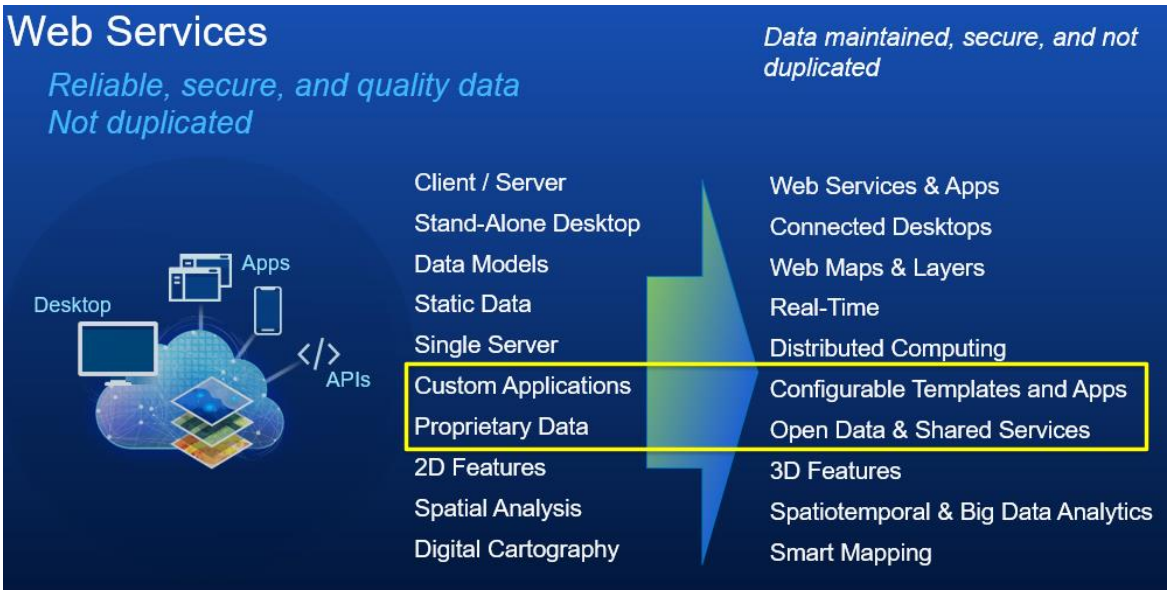
In terms of the costs, for developing countries you might want to explore what sorts of discounts or bundle approaches are available from your vendor. You might be surprised what you find, as many such programs are available particularly for developing countries.

Next we'll review the *technology* theme and it's 3 pathways.

Pathway 4: Reliable data and service quality attained. Data secure, maintained, and not duplicated. Modern GIS is data agnostic, with multiple ways to collect data, store it, use templates, maintain it, publish it was a service, and leverage basemaps that are available to you. The key point of the graphic below is that modern Geospatial Infrastructure provides the ability to collect data, maintain it, analyze it, produce information products with it, and share those with all stakeholders.



One way GIS ensures reliable data with no duplication is that you publish your data as a web service, so there is a single authoritative source and services which come from it. If you've ever listened to an online music stream you've connected to a web service. No longer are we connecting from a desktop application directly to a database, but instead we are consuming a published web service into desktop, or web maps, or any manner of applications.



In the above graphic, the purpose of the 2 lists is to show the massive implications of using web services. To touch on 2 examples: (1) instead of everyone using custom applications, web services can be used in configurable templates that don't require software development, (2) instead of proprietary or siloed data, this enables open shared data that is accessible widely, using open standards.

There are many sources of global basemaps and data, as you may know. In addition to many content providers that can acquire new imagery, or lidar, or other sensors, there are many data layers that you can consume published as a web service (see graphic above). Many content providers already have these data layers as services, either free or low cost, that you can consume into your applications and use. Most organizations will use a combination of these; meaning some datasets that are created in house or by a contractor, and other datasets from public data services. The good news is that GIS has no problem integrating all those disparate data sources into your Geospatial Infrastructure. Tabular data, big data, BIM, 3D, imagery, terrain, and so on. In Land Administration we focus on maintaining many different types of datasets; land parcels, ownership, property values, land use and planning, and 3D data for urban modelling. The Living Atlas includes Petabytes of data.

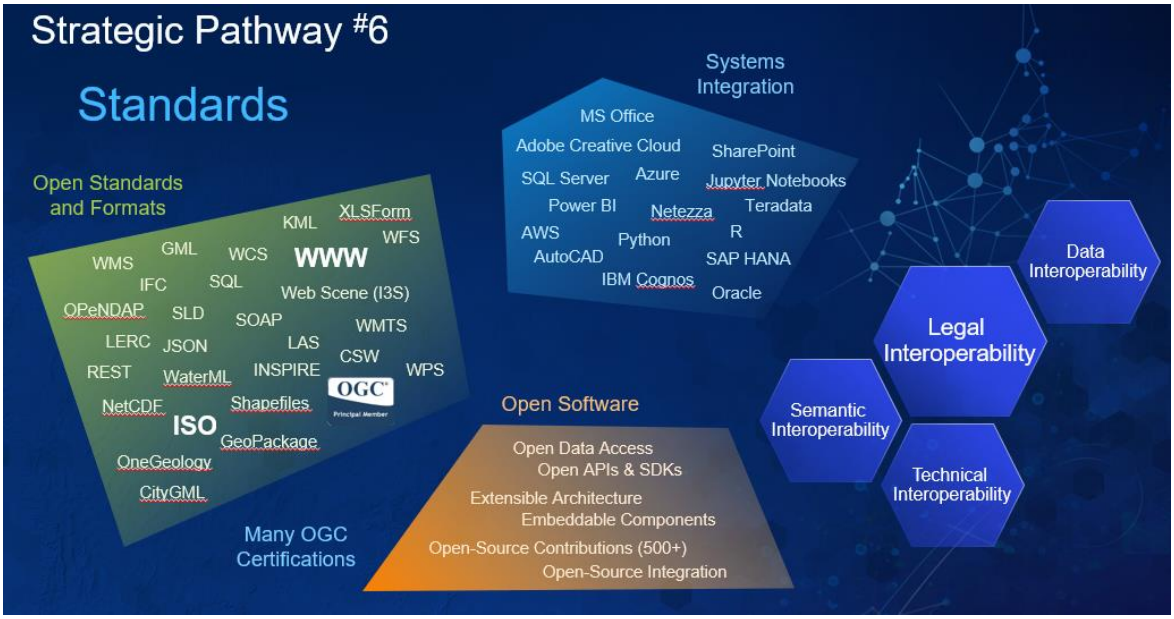
The full value of GIS is realized when those web services feed into various apps that extend the reach of GIS to everyone, across organizations and beyond. Not just into desktop software, but also mobile apps, public viewers, and dashboards.

Pathway 5: Responsible and innovation oriented. Upgradeable systems and approaches. GIS enables many innovations and incorporates all types of technological advancements. This helps us all to scale up our collective efforts. Cloud computing is advancing, as are configurable apps. Imagery and remote sensing technology offers more all the time, including machine learning that enables software to identify and extract features from your imagery. More and more of what we see is modeled in 3D, with strong GIS visualization and associated analysis.

GIS is trusted by IT managers because it keeps pace with other technology advancements in the broader IT industry. They don't have to worry about GIS becoming outdated or no longer supported. IT managers think about Kubernetes and Big Data and so on, and they can see GIS taking advantage of these.

GIS also offers an upgradeable path. You can begin with a single desktop, and then upgrade to an implementation of GIS in your Enterprise or Organization. The basics would be SaaS, which is the hosted model where you purchase user accounts. As you grow you can either purchase more users or if you're at that point, you can bring the software in house and implement it on your own IT infrastructure, or cloud infrastructure if your IT policies lean that way. Ultimately when your organizations' GIS is connected to that of others we see Integrated Geospatial Infrastructure at work. The upgrade path is why we stated earlier that GIS offers a *sustainable business model*.

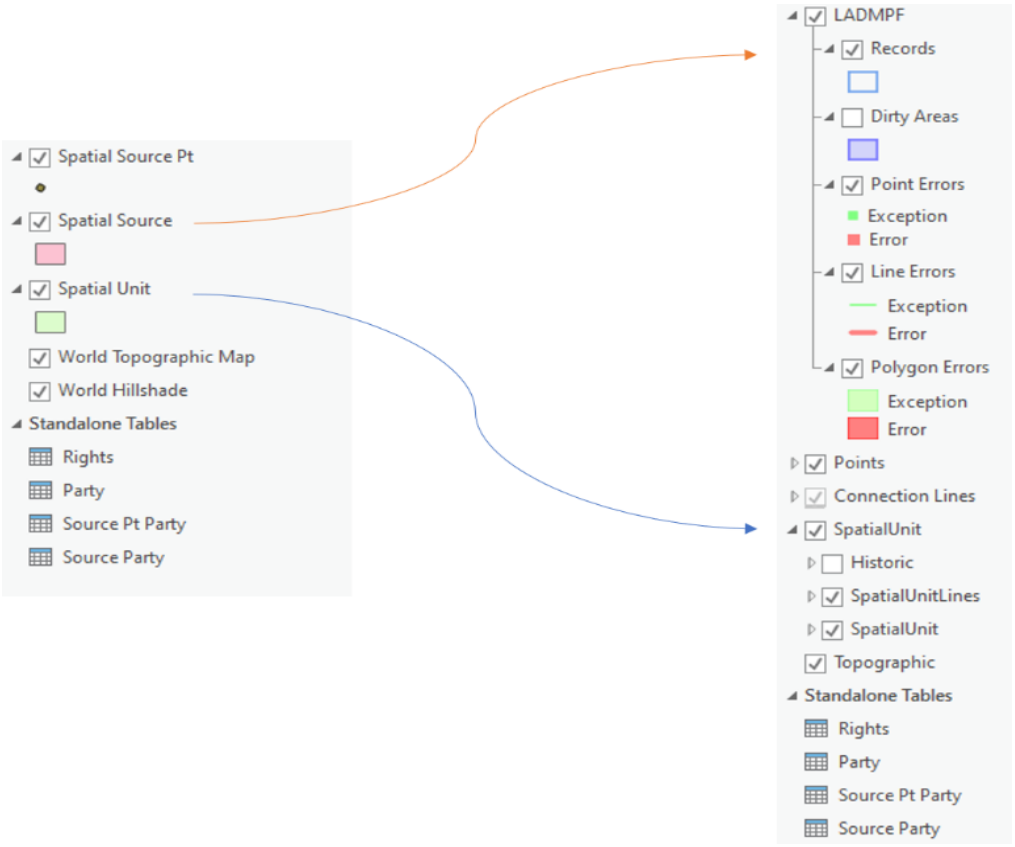
Pathway 6: Interoperability and integration supported. Considered internationally agreed standards. GIS software is fully committed to international standards. This includes open standards and data formats such as OGC, and all the examples in the graphic below. But it



also includes an open extensible architecture, with open API's and SDK's that enable integration with open source applications. In terms of standard IT systems such as SQL Server, MS Office, or Oracle, there's likely a native system integration already available.

When it comes to integrating with other software systems, or technical interoperability, the key point is that *GIS is an excellent integration environment*. This is all made possible through adherence to those standards we just considered, both by the GIS and by 3rd party systems. In our space in Land, we mainly focus on our registry systems, although you may also have a few others in mind. This is also made possible by one of our earlier topics; while you can use Extract Transform and Load (ETL) procedures, those web services can also enable system integrations like this. It's been great to see that many of the vendors in the Registry space have built their systems to work through the common language of web services and data standards. This enables changes to a parcel in GIS then being reflected in Registry, and vice versa.

A configurable platform has no problem fully aligning with industry-specific frameworks. In the Land space we have the Land Administration Domain Model. The LADM facilitates interoperability on many levels.



Next we'll review the *people* theme and the final 3 pathways.

Pathway 7: Strengthens partnerships and supports collaboration. There's many partnership, development, and advancement opportunities out there. We at Esri have many of our own and others have similar offerings. There are numerous GIS conferences that enable great collaboration with our peers. You are encouraged to look into the various modernization programs that enable Land and other agencies to access technology in discounted bundles. There are similar offerings for non-profits and NGO's that offer great value. There are regional geospatial portals that enable data sharing to solve regional problems.

In support of strengthening partnerships and supporting collaboration, when properly implemented, GIS creates a technology environment in which all the key stakeholders can benefit from, and in many cases use the technology and contribute. In any country/context it would be some combination of these types of groups that would define success of the Land Administration project, and all can play a role. See figure below.

Pathway 8: Facilitates capacity development and knowledge transfer. In terms of opportunities for education and skills development there are many in the GIS community. Over 10,000 Universities around the world include GIS in their standard curriculum, including the vast majority of the top 100 ranked Universities. There are many Massive Open Online Courses, or MOOC's, and countless online courses around specific skill development. Most GIS vendors offer access to some sort of online training academy and those also teach you skills, not just how to use their particular software.

The technology itself impacts educational needs; if you put pre-configured simple maps and apps in the hands of novice users, very little if any training is required before they can start operationalizing the FELA. Thus, a certificate is not always needed. To simply benefit from GIS tools doesn't require that you learn GIS conceptually first.

Pathway 9: Advocates for effective Land Administration. GIS offers a system of engagement which is an ideal way to promote the value of Land Administration. This is done via a set of public facing web maps and apps that make land and property information available to the stakeholders. Below are some examples. These show to the public well maintained land information, with parcel viewers, looking at comparable values, tax distribution, as well as mobile apps which turn any mobile device into an information kiosk, and integrating it all into information HUBs.

Colombia

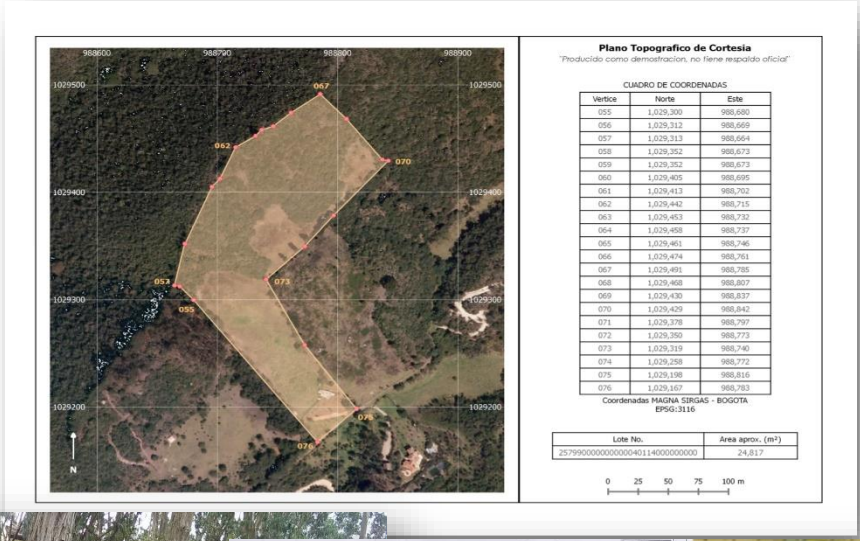
Is there a vision for how this all comes together? What does it look like when technology is aligned with everything we've been talking about in this study? For an example we'll look at Colombia. A peace treaty there signed in 2016 ended a 52 year Civil War. There's many examples from history that show that Cadastre is a necessary precondition to a sustainable peace. The challenge in Colombia was that there are 15 Million parcels that had to be regularized and ownership rights reinstated that were all lost during the war. Doing so with traditional surveying methods would take forever, so what to do?

As a project, there were many requirements set forth by the Government. It needed to be quickly deployable, and low-cost. It needed to be standards based and thus interoperable. They needed high accuracy, in this case defined by GNSS level accuracy. No software development would be required, and of course this is important data that had to be secure. They wanted to use data from external systems, and to use any smart phone. It needed to be future-proof meaning a method that didn't need to be re-developed every few years, and scalable, with the ability to work offline.

The project response was a collaboration between IGAC (the National Mapping Agency), Kadaster International (which is part of the Dutch Kadaster), Trimble, Esri, and Esri-Colombia. The ISO standard of the LADM was chosen, as well as various security protocols.

The Trimble R1 was used, connected to smart phones via Bluetooth. The Esri mobile app was used on Android and iOS devices, as were basemaps from the Living Atlas. Data services configured with the LADM were utilized in the Esri Geospatial Cloud. This formed a complete solution that met the requirements we just listed.

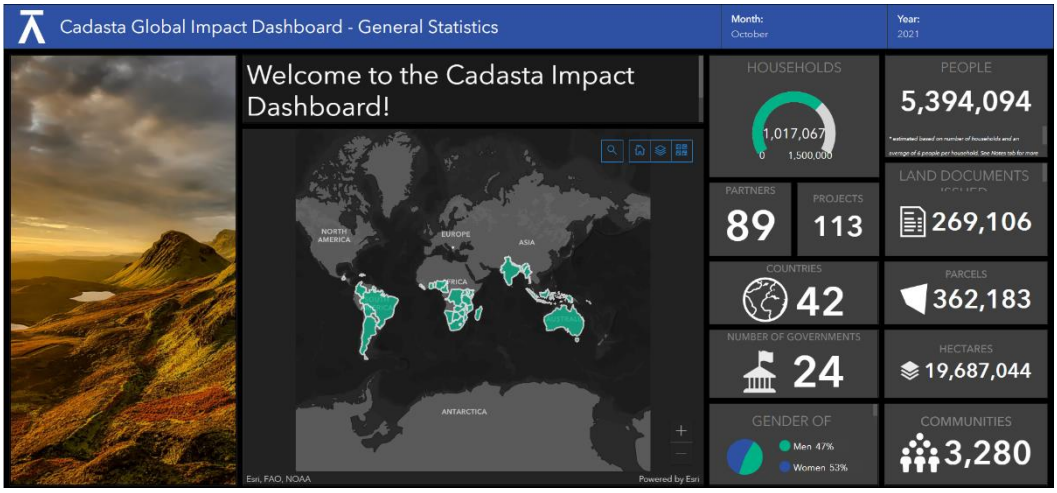
Here are a few pictures of the process. Volunteers and project members deployed to the field and began collecting parcels and ownership info. The project was participatory, not just by volunteers but by the partners listed above. Kadaster International and ITC The University of Twente helped with the configuration a great deal.



This Colombia project embodies all aspects of the FELA: see figure below.

On the final point of advocating for effective Land Administration, the publicity the project received would indicate that it also achieved that objective.

There are other projects where FELA is being put into action. They're all a little different, but use the same core GIS technology. In Zambia, MEDEEM is a social impact and land documentation company that supports councils facing the challenges of unplanned settlements and seeks to bridge the gap in tenure documentation. In Odisha India, the Cadasta Foundation, along with their Partner the Tata Trust, supported the state government with a large-scale slum upgrading program. Each step of the way, the teams used GIS technology, configured by Cadasta, for capturing land information. Workflows include handheld applications set up for the survey task, a claim review process, steps to transfer the formalized land records to the government, and the delivery of four formal certificates of occupancy to the occupants. In fact, Cadasta has put together a dashboard that shows the impact of these kinds of projects, and these are just the projects they have been involved with.



Supporting the SDG's with Land Administration and GIS

Given that our topic is about aligning GIS technology to help you support standards, and to put them into practice, clearly another key standard that Land Agencies have to consider is

the UN's Sustainable Development Goals. Our current focus is on Land Administration, and through that lens, we can see that Land plays a key role in at least 5 SDG's, as shown below

Goal 1: No Poverty.

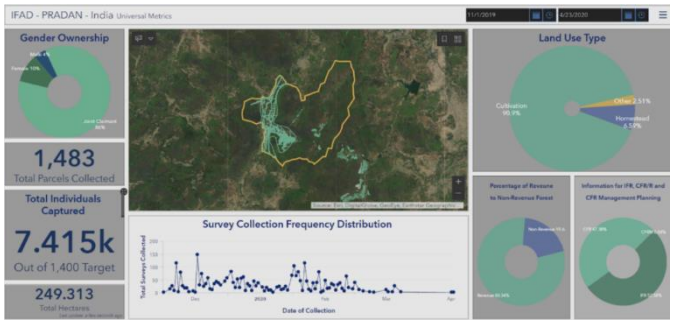
On Goal 1 of No Poverty, we see that in Target 1.4 it mentions *ensuring that all men and women have access to ownership and control over land and other forms of property*. Indicator 1.4.2 includes the *proportion of total adult population with secure tenure rights to land, with legally recognized documentation and who perceive their rights to land as secure, by sex and type of tenure*

This obviously illustrates how connected secure land rights and poverty are. Of course, in the Cadasta Global Impact Dashboard above, we've seen how GIS is impacting registration and tenure security in many places.

Goal 2: Zero Hunger.

Target 2.3 reads as *By 2030, double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists and fishers, including through secure and equal access to land*. This target falls squarely within first registration and tenure security, with the connection being small scale food producers which need to double their productivity.

Indicator 2.4.1 reads as *Proportion of agricultural area under productive and sustainable agriculture*. That involves land management, and this indicator could be closely tracked and measured with GIS, likely in the form of a dashboard.



Goal 5: Gender Equality.

In Goal 5, we have target 5.a *Undertake reforms to give women equal rights to economic resources, as well as access to ownership and control over land and other forms of property..*

Next, indicator 5.a.1 reads as *Proportion of total agricultural population with ownership or secure rights over agricultural land, by sex; (b) share of women among owners or rights-bearers of agricultural land, by type of tenure*. That is something can be tracked in GIS as a first registration initiative. It would be tracked in a mature Registry, and can be represented spatially.

Goal 11: Sustainable Cities and Communities.

Goal 11 has several relevant targets but let's just consider the first. Target 11.1 reads as …*ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums*.

Indicator 11.1 naturally says *Proportion of urban population living in slums, informal settlements or inadequate housing*. We can use GIS to visualize that. To measure that it pre-supposes that you have land parcels mapped in your GIS, including informal settlements and housing info. A land information system would be a pre-requisite here.

Goal 15: Life on Land.

Goal 15 is about conservation of natural resources, which is a key area of Land Administration as a Land Management function.

Target 15.2.1 seeks to … *promote the implementation of sustainable management of all types of forests, halt deforestation…* and so on.

Indicator 15.2.1 is *Progress towards sustainable forest management*. This is a vague indicator. Still, data can be captured in the field on sustainably managed stands of forests, managed in desktop, and published in web apps.

Sometimes, the hardest thing to recognize is when the old tools have become the new tools. The compass is now your phone. Similarly, the GIS tools to put FELA into action are readily available. We have seen how GIS can support the 9 pathways of the FELA including their goals and requirements. The tools are configure-first. They support standards and interoperability. They are upgradeable. They are secure, with reliable data. They are affordable, via sustainable business models. They are collaborative and participatory. As we have seen, they have already been applied to many real-world projects and have enabled agencies to achieve the value and results that FELA was designed for. The reader is highly encouraged to put current GIS tools and the FELA into practice in your current projects. Doing so will also enable you to support many of the SDG's.

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Resources/Citations:

IGIF https://ggim.un.org/IGIF/

FELA: https://ggim.un.org/meetings/GGIM-committee/10th-Session/documents/E-C.20-2020-29-Add_2-Framework-for-Effective-Land-Administration.pdf