Sorting through the Backroom Chatter: Reframing Investments in Land Information Systems for Land Administration

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ACRONYMS

CoFLAS	Costing and Financing of Land Administration Systems
ERR	Economic Rate of Return
FAO	Food and Agriculture Organization of the United Nations
FAQ	Frequently Asked Question
FIG.	International Federation of Surveyors
FLOSS	Free/Libre Open Source Software
GIS	Geographic Information System
GLTN	Global Land Tool Network
GPS	Global Positioning System
IADB	Inter-American Development Bank
ICT	Information and Communication Technology
LADM	Land Administration Domain Model
LAMP	Land Administration and Management Programme
LAS	Land Administration System
LIS	Land Information System
LMP	Land Management Program
MCA	Millennium Challenge Account
MNRE	Ministry of Natural Resources and Agriculture
NLA	National Land Agency
RFP	Request for Proposals
SOLA	Solutions for Open Land Administration
STDM	Social Tenure Domain Model
TCO	Total Cost of Ownership
WB	World Bank

FOREWORD

The idea for this paper emerged as we chatted with and listened to conversations among different actors within the land community of practice about investments in registry and cadastral information systems. It is easy to be confused or frustrated by competing conclusions and with 'apples to oranges' comparisons. It occurred to us that a framework that starts with sustainability and enables more consistent consideration of investment alternatives could be useful. In this paper, we propose such a framework, and use a few examples to begin to consider some related issues. Data on projects, investment costs, and returns is very hard to obtain and so our aspiration to do more in-depth analysis was not feasible. This paper, therefore, is a "blue paper" that seeks to motivate more analysis of these and other examples and encourage a more structured debate. It does not pretend to be definitive.

EXECUTIVE SUMMARY

Land administration projects have long been criticized for investing in high-end technologies that are costly and at times, poorly suited to the local needs and capacity to sustain such investments. Practitioners now understand that it is critical to find a balance between land policy, technology solutions, user needs for tenure security, efficient land information systems and good public land management. The marketplace for LIS technology and services for land administration is expanding and dynamic. Inadequate cost data and analysis does not help inform decisions about LIS investments. Moreover, context matters for LIS just as it does for land tenure. Fit-for-purpose cannot become a specific solution but rather implies providing flexibility to tailor the investment package and strategy to a specific context. Like the continuum of tenure and the continuum of technologies available for land administration there is a continuum of purposes for LIS investments. History has created a mosaic of coexisting needs (e.g., basic security of tenure and transactional efficiency), circumstances (e.g., financial and human resource capacity) and valid purposes (e.g., revenue generation, documentation and protection of rights, and efficiency in transfers). In this mosaic, there are multiple justifiable entry points for investing in LIS improvements. Against this backdrop, we propose a framework for more consistent comparison of investment alternatives in context. The framework defines key elements of the policy, technical, operational and results base for sustainable, scalable and secure LIS investments. With this framework in mind, we explored a series of issues that we believe need a more orderly and evidence-based discussion: total cost of ownership; cost in relation to affordability; technology solutions and technology services; enabling and constraining environment; donors and acquisition processes; and entry points and sequencing.

We conclude with 10 preliminary suggestions:

1. It is risky to assume that lower initial investment cost implies lower ongoing operating and maintenance costs; mapping initial investment choices to the specifically implied ongoing costs is necessary. As they say in Latin America "*barato puede salir caro*" or what is inexpensive can end up being costly.
2. Use total cost of ownership (TCO) in analysis of LIS alternatives.
3. Include demand, revenue, and cost projections across the investment life-cycle in business models.
4. Track disaggregated costs and benefits over the investment life-cycle incorporating lessons from pilots and ex-post analysis to improve cost-effectiveness.
5. Pay attention to host agency incentives to keep costs low and provide quality services. Professional leadership with incentives to manage costs and revenues consistent with financial self-sustainability contributes to fit-for-purpose choices.
6. Investigate incentives for people to use the registry and cadaster services that rely on the LIS to avoid a reversion to informality.
7. Analyze fee structures, waivers, and subsidies to ensure both accessibility and sustainability.
8. Invest in LIS when good entry points exist and design the LIS with appropriate safeguards and recognition of other land administration reform areas.
9. Open source, public agency, project-based in-house and, proprietary LIS form a non-linear continuum of approaches.
10. Beyond foundational national land policy reform, more attention is needed for second-tier law and procedural reforms.

1. INTRODUCTION AND BACKGROUND[1]

Complete and reliable information that describes land parcels and the associated tenure relationships supports effective governance of land rights. Land tenure information is also useful for a wide variety of public and private users and uses such as planning an investment in transportation infrastructure or making a decision to purchase a house or lease a farm. Land information systems (LIS)[2] are a compilation and logical organization of land parcel descriptions, corresponding tenure information and changes to these (e.g., via transfers) in a way that supports services for these uses. As shown in Figure 1, LIS is one of four land administration investment areas. The other investment areas include campaigns to achieve first registration, clarification and recordation of land rights, parcel mapping and related infrastructure, and the provision of services like land registration, land valuation, property taxation and land use planning. These are interrelated, but distinct investment areas.

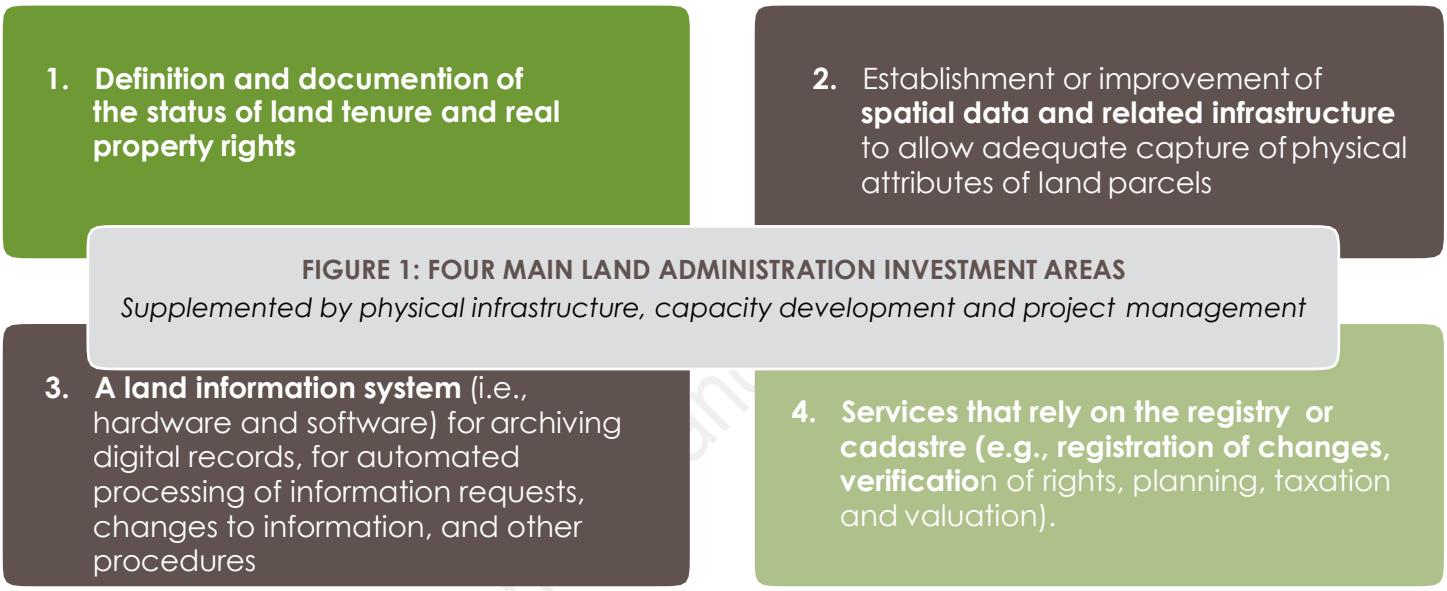


FIGURE 1: FOUR MAIN LAND ADMINISTRATION INVESTMENT AREAS
Supplemented by physical infrastructure, capacity development and project management

1 We appreciate the time of our colleagues Kevin Barthel, Malcolm Childress, Gavin Adlington, Peter Rabley and Grenville Barnes for reviewing this paper and of various people like Elizabeth Stair, Jill Urban-Karr, Andre Teyssier, Tony Burns, Gabriel Arancibia and Christopher Barlow for making time to share information and answer questions. We are thankful for the partial financial support of Thomson Reuters on this project. The views in the paper are ours and do not necessarily reflect the specific views of any of the persons or organization named above.

2 Throughout this paper, reference to LIS is in the context of land administration. It is the software and hardware used to automate processes and archive digital information for land registration and/or for the cadaster. Burns (2014) refers to the same as "ICT for land administration." Sometimes this is referred to as a Land Administration System (LAS). However, in our view and consistent with the cited definition in the text box, LAS encompass the LIS and the upstream processes for recognizing and documenting land rights in the first place and also the downstream services that depend on land information such as valuation.

MCA-CAPE VERDE: PRE-INVESTMENT SUSTAINABILITY AND SCALABILITY ASSESSMENT

Under its second MCC Compact, the Government of Cape Verde commissioned a sustainability study and detailed financial modeling exercise ex-ante that included:

- **Sources of finance and revenue** (projected transactions, tax revenues, sale of GIS products and funding from other government agency users)
- **Operational sustainability** (human resources, licensing, data storage, internet)
- **Usage** sustainability and reliability
- **Legal**, procedural, and technical options to favor sustainable and scalable outcomes

Modernizing the LIS for land administration will create better quality information services that are more accessible, efficient and transparent. In turn, it is expected that the demand for formal services as well as revenues based on land transfers[3] and information services will grow. This theory of change is generally agreed upon (see discussion in Tonchovska and Adlington, 2012). However, there is an active dialogue about what constitutes the best LIS design and investment strategy. This paper speaks to that dialogue.

Perceptions of LIS technologies in land administration are diverse. People might see the symptoms of unsustainable investments — equipment that sits unused or in disrepair, out-of-date parcel records — and attribute these to technology-driven, high cost tools. The tendency is to then extrapolate and assume that technology vendors are pushing inappropriate tools. We believe that these generalizations are misleading in some ways and that other important investment considerations are underappreciated.

Christiaan Lemmen (2014) helpfully uses the model of the continuum of tenure to graphically illustrate that fit-for-purpose means understanding the context and the purpose(s) and then choosing the right mix of investment strategies. In our view, keeping sustainability, scalability, and security criteria in mind will make it easier to find the right mix.

Unbundling LIS investments using these criteria can reveal what underlies fit and unfit decisions. It brings sharper focus on the drivers of total cost and reframes how returns, risks and constraints are considered. While each criteria -- sustainability, scalability, security -- is already in use in land administration work, in practice these rarely get sufficient attention, especially in the process of making and executing a decision to invest in LIS. More complete business modeling prior to investment with explicit consideration of factors that affect sustainability, scalability and security, and especially of projected demand, revenues, and costs over time, will support better outcomes. We hope that this paper motivates further debate about important questions related to LIS investment strategies in order to encourage governments and donors to consider applying sustainability, scalability and security criteria to planned and ongoing investment decisions. We provide a framework for doing so.

3 Transfers can include sales, inheritance, public and private leases among others.

2. CONSIDERING LIS INVESTMENT EXAMPLES

To refine our perspectives, we reviewed project information about more than a dozen LIS investments. We focus on four examples that are less known and for which we had better access to cost information. The four examples are: 1) the Cross River State, Nigeria investment in a fast-track phase of its Cross River geographic information system (GIS); 2) the National Land Agency (NLA) of Jamaica land registry system; 3) the Bogota, Colombia 2009 cadastral upgrade; and, 4) the Belize Land Management Project's Phase 2 and 3 land registration system investments. For each example, tables in the annexes provide context.[4]

The Government of Cross River State Nigeria implemented a state-level land administration project including policy reform, geodetic upgrading, and social impact study. Their progress illustrates how a sub-national government can benefit from implementing LIS technology upgrades that improve records and services for both existing and new users even while national government-led comprehensive land administration reforms are still in planning. The LIS upgrades served immediate needs for efficient services and improved revenue (purposes). Within months of implementation, 12,000 archived property files were being digitized (Edmead et al., 2013). The system was designed to accommodate an expanded volume of records, transactions, and functionality over time. Legal review and policy reform efforts allowed improved work flows and business processes and resulted in a draft bill (the "Cross River Geographic Information Agency Law 2011") that was subsequently signed into law in July 2012. While not an explicit goal, the registry and cadaster infrastructure created will be advantageous for efficiency and sustainability of massive formalization being piloted by the national government when it is implemented in Cross River State. Mass formalization of land rights, in turn, will support the sustainability of the LIS itself while broadening the base of users to all sectors of society. Until then, Cross River has undergone the important task of updating and upgrading the foundations of its deeds registration system by addressing the lack of linkage between the registry and the cadaster, moving from a paper record and improving searches. In the process, the state also modernized its geodetic network. The improved services are bringing new parcels into the system as households use the new Cross River Geographic Information Agency to obtain the first formal record of their rights sporadically

In Jamaica, under an initiative to modernize the public sector, a new institutional structure called the National Land Agency (NLA) was established in order to improve client service by increasing efficiency and accountability for land administration services. The NLA combined into one semi-autonomous, professionally managed agency the functions of property title registration, taxation, land surveying and estate management. The NLA invested in an automated digital land registration system with support from the WB-funded Public Sector Modernization Project (PSMP). With this investment and other measures to establish the agency's operating capacity, the NLA set a new precedent for quality of services and revenue generation. Similar to Cross River State in Nigeria, efficiency and revenue gains were quickly realized and significant. The NLA reported revenue generation of an average of nearly US$9 million per year in the years since it initiated its reforms resulting in relatively short payback periods for the ICT investments. NLA reports that turnaround times improved greatly rising from 56% processed in 25 days to 100% processed in 20 days. The government provides the NLA an operational subsidy of up to 25% of costs annually given that the NLA is not mandated to be independently sustainable. In that context, in some years, operating costs are higher than direct revenue

4 In Annex 1, tables describe the context for the LIS investment (the purpose, the actors involved, key elements of project design, available cost and outcome data), a few points about the strengths and weaknesses, and some comments regarding sustainability, scalability and security. In Annex 2, tables provide detail on costs and revenue in summary financial statement tables (not enough information was available to estimate financial rates of return).

collected, depending on market conditions. The initial system design was extensible to other functions and a second round of investment by the NLA added an estate management systems (property valuation systems are planned). In tandem, the Inter-American Development Bank (IADB)-funded the Land Administration Management Program which is still responsible for facilitating first titling of unregistered land and upgrading the capacity of the survey unit within the NLA; including by modernizing equipment.

The Bogota, Colombia investment is another example of a sub-national effort to improve LIS.[5] The Bogota Cadastral Office is an autonomous agency operating in the national capital. In this example, the investment focus was on cadastral mapping and valuation rather than on property rights records and registration. The cadaster generated significant new revenue (10.2% increase equal to $37 million according to Uribe Sanchez (2010)). Property tax revenues increased from 20% to 40% of local revenue. This stemmed from capturing the rise in property values in the previous decade, which increased the value of the cadastral base by 47% (Ruiz and Vallejo, 2010). The payback period was minimal because of the vast increase in tax revenue. The large revenue increase was due to updated cadastral values, which had lagged far behind rising property values. These results were achieved despite complex national rules and requirements for surveying and valuation that limited the ability to adopt cost saving measures and despite the lack of an effective link between the registry and cadaster systems. The Bogota cadastral reform is viewed as major success because it achieved its immediate objectives and addressed prior concerns about immediate tax liability increases and corruption. Learning from prior failure motivated efforts to professionalize human resources, ensure consistent application of procedures in practice and to adopt special transitional measures to limit the immediate increase in tax burdens. Some outstanding concerns emerge when viewed in light of our framework. An atypical feature of this effort is that all properties, even if unregistered, were subject to the updated valuations. We wonder what implication this has for security of tenure. Tenure security was not a purpose and the reports do not discuss this question. We also wonder how implementing this approach in a region with a smaller gap between market and cadastral values or where property values are lower than in Bogota would affect the payback period.

The Belize example illustrates LIS packaged within long-term, comprehensive land administration modernization. The program addressed land policy at the national level and including significant formalization efforts. Belize achieved relatively comprehensive land rights documentation while modernizing its LIS to serve multiple purposes receiving a positive evaluation (IADB, 2014). Compared to the above examples, the Belize investments were carried out over a much longer period.[6] The biggest cost in the Land Management Program (LMP) —nearly half of resources—was not the LIS technology. Rather, it was the clarification of land rights through parcel surveying and adjudication processes; this is probably common. LIS was not a priority in the first phase in Belize and the existing manual land registry became a bottleneck to the massive formalization efforts. In the third phase of LMP, a disaster recovery plan was created. One risk identified in a recent evaluation is the capacity of staff to maintain the system over time. Even so, Belize land administration has scaled up to the country level. Recent press suggesting corruption in the allocation of land parcels reflects a broader aspect of land policy that is not addressed through LIS; even though a reliable, transparent LIS will make other types of corruption more difficult.[7]

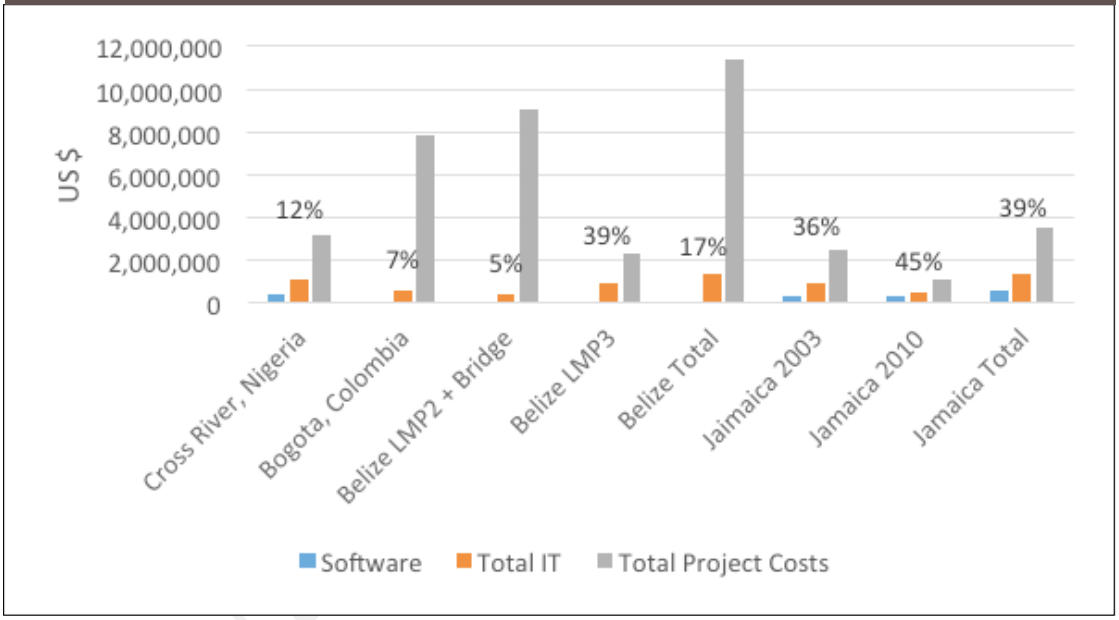
5 The Bogota example differs more significantly from the others in that it is related only to the local fiscal cadaster. We include it because we believe it helps illustrate various points that we make in the paper, including the variety of investments that were suggested to us as LIS investment examples.

6 The first phase of work took place between 1997 and 2002; we have not discussed this phase in detail here.

7 See this 2012 new article on Belize. A 2006 report by USAID discusses how LIS does and does not put a damper on corruption

These examples cast some doubt on the perception that the ICT for LIS is the major driver of land administration project costs.[8] Figure 2 shows technology and software costs, as a percentage of total project cost, for these examples. The ratio of LIS technology costs more then. Also, the number of offices total investment cost vary widely across the examples, which themselves are quite variable in their objectives. The Jamaica NLA ICT investment share of total investment cost was the highest because the NLA made a standalone investment in LIS and did not include elements of the other land administration investment areas as did Belize and Cross River State, Nigeria. At the other extreme, the ratio for Bogota is the lowest because of the focus on improving existing and hiring temporary human resources needed to implement antiquated valuation and surveying procedures that do not use modern statistical techniques or GIS. For three of the examples, we observed that the ICT expenses are not high in relation to revenues either. Cost recovery can be rapid, and financial returns appear to be positive and significant.

FIGURE 2. SOFTWARE AND IT COSTS V. TOTAL PROJECT COSTS



Source: Project data provided by Thomson Reuters and Trimble Land Administration Solutions Group.

8 Another factor to keep in mind, is that in the first phase of the Belize project (and of the Jamaica investments), the cost of basic equipment like PC's, printers, and data storage were very high compared to the latter phases and other more recent examples. A PC that would cost $200 today cost $1,000 or that were equipped in Belize is greater than in the other examples. While there are economies of scale in software and hardware acquisition, the difference in scope would likely increase expenditures

Financial data for the Cross River State, Nigeria example revealed that LIS costs were low in relation to revenues. Revenue for title search and registration increased following the improvement to the LIS. In the first two months of 2013, revenues from fees had already exceeded the amount of these same fees collected between 2006 and 2010 combined. Revenue was projected to climb to $14 million in 2014, and in just one week, revenues reportedly covered the perpetual license fee (Jacobs, 2014).

We found each of these examples to be interesting but also very different. The primary investment objective(s) in the examples just described varied and included one or more of the following: first registration of land rights; improved land valuation; improved quality of land rights information; improved processes to reduce turnaround time and cost, or increased revenue. Accordingly, which of the four areas of land administration (illustrated in Figure 1) were packaged together in these investments varies. These kinds of differences in the investment package and the associated cost and benefits structures make comparing cost-effectiveness across LIS (and broader land administration) investments difficult because the investments are not equivalent. In fact, no two examples shared with us or that we already knew about are comparable. Apples to oranges! Still, each example can help us understand certain points and to raise attention to questions that need more rigorous answers.

Differences in purposes, knowledge, and information about ICT and technology service options; leadership and employee skills; prior investments; and the policy environment further complicate comparison. Comparing investments without taking account of these types of differences can be misleading and feed into bias in favor of one technology strategy over alternatives. For example, at times it is said that proprietary LIS solutions are too expensive. High licensing fees and expensive international expertise are typically mentioned. While high cost and unaffordable services are problems. However, what is 'too expensive" or cost effective needs to be defined relative to context and using parallel comparative information on the alternatives. Variations in context have important implications for both costs and benefits of an LIS investment. And, there can be rational differences in cost and in what is the "best" technology and technology acquisition approach. Moreover, the possible scenarios (defined by client needs, solution design, and investment strategies) are diverse and dynamic. Even with Land Administration Domain Model (LADM) and Social Tenure Domain Model (STDM) standards in use, there is no standardized project or process or product for the diverse approaches to land governance and in the dynamic marketplace for LIS technology. Rather than promote a universal best option, fit-for-purpose decision making requires a well-framed consideration of alternatives in context.

3. A FRAMEWORK FOR LIS INVESTMENT

Arancibia (2014) and Jacobs (2014) use sustainability, scalability and security to describe key features of the approach taken to LIS in Cross River and Plateau States in Nigeria. The framework we propose builds on their use of these terms in combination as criteria of success in relation to land information systems.

The operational definitions of sustainability, scalability, and security for LIS in land administration are the following.

- **Sustainability**: LIS and related services are continued and used over time, especially after initial project funding is withdrawn; records remain up-to-date. Operationally, this requires being able to obtain[9] revenue sufficient to cover or exceed all costs (e.g., for management, human resources, technology and related licenses or user fees) incurred across all phases of the investment life-cycle.
- **Scalability**: the degree to which an LIS can accommodate increased demands and deliver expected results when applied to a significantly expanded volume of records (e.g., due to expanded geographic coverage, increasingly active land markets, or both) and the degree to which it can be adapted to new purposes and technologies.
- **Security**: records accurately reflect land tenure data is protected and the hardware and software systems perform reliably (Byamugisha, 2014). Records are protected from unauthorized transactions, theft, computer viruses, hacking, fire, and natural disasters to ensure that the land tenure rights conferred by the LIS are secure.

In a recent presentation, Burns laid out the scope and early content of a new GLTN tool called Costing and Financing of Land Administration Systems (CoFLAS)[10] and concluded that a key lesson from land administration projects in Eastern Europe and Central Asia is that sustainability should be a top priority in design and implementation. In our view, sustainability is the higher-order criteria as both scalability and security are essential for sustainability to be achieved. The definitions of scalability and sustainability can be applied to each of the investment areas of a land administration system shown in Figure 1. *However, this paper is primarily focused on the LIS investment area (shown in the lower left quadrant of Figure 1), although it recognizes interactions across the areas.*

9 As will be discussed later in the paper, sustainability is promoted by a large degree of financial independence but some revenue (or funding) from government sources could be consistent with a sustainable investment plan.

10 Several international organizations are leading efforts to improve the planning, design, and budgeting of land administration reform and operations. The Global Land Tool Network (GLTN), supported by FIG, the World Bank, UN Habitat, and Land Equity International, is creating a tool to lay out the full spectrum of investments in land administration reforms, from policy to parcel recordation. This planning and budgeting tool includes benchmarking a comprehensive list of unit costs across a range of geographies and offers guidance as to how to extrapolate from unit costs to a project budget and establish project timelines from first registration through to ongoing operational costs. The most recent draft is available at the following link: http://www.gltn.net/index.php/component/jdownloads/finish/3-gltn-documents/2196-framework-for-costing-and-financing-land-administration-services-coflas-eng-2015?Itemid=544 .

THE LIS INVESTMENT FRAMEWORK AND PRO-POOR LAND ADMINISTRATION

The proposed framework, like the views put forward in this paper, is congruent with pro-poor land administration. At a minimum, it stipulates that LIS be designed to allow capture of the range of tenures along a continuum. In addition, an LIS that is designed to support various uses e.g., taxation, can be an enabler for the provision of local services to poor households.

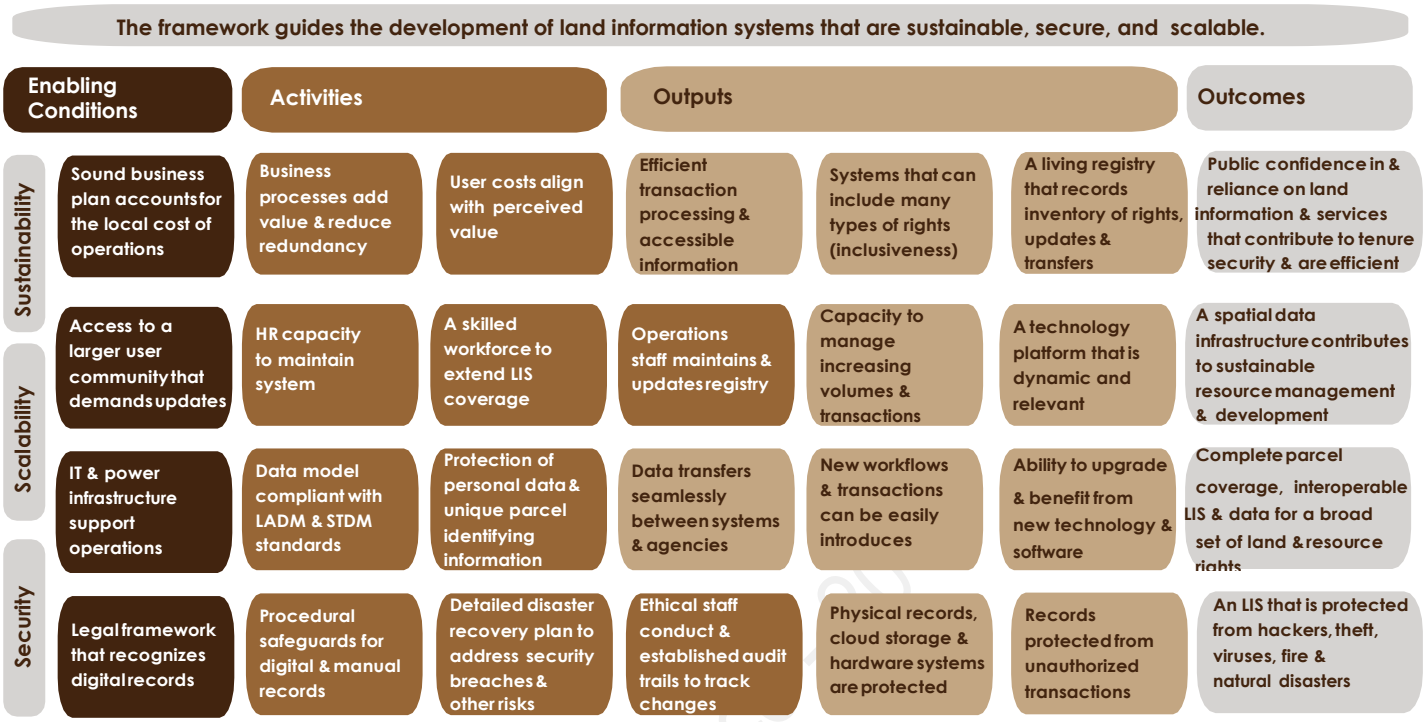
The definition of security is specific to the LIS investment area and does not apply directly to the other land administration investment areas. At the policy level, security is a quality of tenure itself defined by how well and how completely land rights are recognized by others and protected by authorities. While an outcome of an LIS that meets the three criteria is improved tenure security, the quality of records is only one variable that affects the quality of tenure. In the framework we propose, security is defined more narrowly, referring to the physical and virtual security of the equipment and records that comprise the LIS. The three definitions alone are inadequate to guide decision making about investment strategies and system design. They require translation into a logical framework or checklist that disaggregates each element and allows investments to be crosschecked in the design, implementation, and execution. The framework identifies essential enabling conditions, activities, and outputs required to achieve sustainable, scalable and secure investment outcomes.

Figure 3 below[11] provides a succinct description of the multiple elements of the LIS design and implementation approach necessary to achieve sustainable, scalable, and secure LIS. LIS is often thought of as a purely technical solution. Business processes, human resources and other operational elements are also part of the solution. In the framework, both technical and operational elements are organized under four rubrics: enabling conditions, ongoing activities, outputs, and outcomes that characterize an LIS compatible with the definitions above for sustainability, scalability, and security. The outcomes that result are compelling and should motivate consideration of these criteria.

Sustainability encompasses the recording of many types of land and resource rights, the creation of a living registry that documents changes (e.g., transactions) and a system that keeps apace with shifting technologies. The Land Governance Assessment Framework emphasizes that sustainability is associated with cost-effective, financially sound systems and calls for investment sufficient to keep up with demand. If the technology platform erodes or fails or is not scaled to keep up with demands for existing and new services, operational revenue might decline. Scaling up means the system can take on increasing volumes of transactions and land records, is upgradeable and can incorporate new functions (e.g., property tax and valuation). For all users security is important.

11 The elements listed in each bucket are not in any particular sequence and there is no implied correlation among specific elements aligned in a row in Figure 3.

FIGURE 3. A FRAMEWORK FOR LIS INVESTMENT: ENABLING CONDITIONS, ACTIVITIES, OUTPUTS AND OUTCOMES



Adherence to standards, a design that protects confidential information and physically protects digital and manual records, and detailed disaster recovery plans are features that create security.

Investment strategies that comply with the three criteria as operationalized above will result in an efficient LIS that instills agency confidence in the system. With outreach and improved performance by the agency, public confidence is also established. The improved performance and confidence contribute to tenure security, which in turn, generates demand for land administration services. Additional investment in formalization is likely needed for the LIS to have complete parcel coverage. With sufficient coverage and if the system is accessible to and interoperable with other institutions (public and private), the LIS becomes useful for sustainable resource management and a range of development investments such as physical infrastructure. For example, Gahan (2015) reports that a recent investment in Cape Town, South Africa in LIS to improve land valuation and taxation is now used by the transportation department for bus route planning. Other agencies are using the data to broaden access to public utilities in low income communities.

4. SIX TOPICS FOR EVIDENCE-BASED DISCUSSION

4.1 TOTAL COST OF OWNERSHIP

Infrastructure projects (e.g., dams) have long considered both upfront costs of engineering design, equipment and construction, and the ongoing maintenance costs to implement and sustain operations. One motivation for the GLTN CoFLAS tool[12] is that this intuitive logic is not regularly applied in the context of land administration investments. CoFLAS is a budgeting and planning tool proposed to help the public sector ensure that both initial and ongoing costs are understood across all four land administration investment areas shown in Figure 1. In budget execution, understanding TCO is essential for sound evaluation of LIS investment alternatives. Table 1 is a checklist of elements that can be used to ensure TCO[13] is accounted for in costing alternative investment strategies. It includes direct and indirect monetary costs (hard costs) as well as indirect, sometimes non-monetary soft costs.

TABLE 1. TCO CHECKLIST

Hard Costs	Soft Costs
Background studies	Overhead
Development and/or configuration of software	Reporting requirements
Acquisition and installation of hardware and upgrading related system inventory	System depreciation (replacement cost)
Consulting and project management	Opportunity cost of to the inability to innovate and provide new services
Data conversion costs	Customer dissatisfaction, reduced use of system
Data acquisition costs (e.g., base and parcel maps, tenure information)	Wait times for system improvement
Temporary staff	The attributable costs of publicly subsidized software development
System maintenance and upgrades	The relevant portion of the costs of upgrading the geodetic infrastructure
Software for expanded functionality	
Quality assurance and control	
Personnel training	
Anti-virus and security	
Annual costs of software maintenance	

12 See footnote 6 for reference to this tool.

13 These costs include management, human resources, and technology acquisition and ongoing use. The life cycles are design, installment of the LIS, ongoing operations, and upgrading to replace system elements or expand functionality over time.

Costing exercises, whether at the budget and planning or the execution stages, typically rely on unit cost parameters taken from examples of prior investments. In the arenas of land administration investments, finding the right examples to draw from as well as the underlying cost data is challenging. As can be seen from the summary financial tables in Annex 2, it is difficult to identify TCO and disaggregate cost data in ex-post financial information. Multilateral donor project closeout reports typically do not require sufficient disaggregation and cost category definitions vary. The acquisition of technology and related services is bundled into contracts that sometimes go well beyond the LIS itself to include other LAS investment areas. Contract pricing structure and reporting requirements do not typically allow easy validation of actual costs and so budget information gets used instead. Budgets are not always based in specific, detailed and current market information. It would be interesting to look at how successful public private partnership models (e.g., Teranet in Ontario, Canada, HMLR in the United Kingdom and LINZ in New Zealand) create incentives for business models that account for total costs of ownership.

4.2 COST IN RELATION TO AFFORDABILITY

Fit-for-purpose decision making requires consideration of the return on investment and affordability, rather than just cost. To the client or entity making the investment, affordability of an LIS investment depends on revenue trends over time and anticipated budget support. Public budget allocations to support the operation of an LIS in developing countries is often unpredictable and insufficient for financial sustainability. They are not often linked to forecasted revenues from the LIS itself, as they are in Jamaica. Fees and taxes are the main sources of funds for cost recovery for public investment in LIS (Burns et al., 2015). Revenues can be derived from fees for information services that rely on the LIS. Another revenue stream includes property taxes because tax administration officials can use parcel-based LIS to inform valuation and improve property tax collection. Revenues reflect usage (or demand) and also price (fee levels, tax rates). Affordability of the LIS investment, therefore, also has to mean that the fees for LIS-supported services are not set too high in relation to value of land parcels and income of rights holders. High fees dampen demand and put sustainability of LIS investment at risk.

Burns et al. (2015) suggest that in Africa where registration rates are low, a donor or budgetary subsidy may be required rather than expecting cost recovery of an LIS investment through fee income. In

SUSTAINABILITY AND SUBSIDIES

A recent WB study in Madagascar (Teyssier, 2014) argued that independent financial sustainability should not be an objective of the local land registry offices because fees need to be set to be affordable to the poor and because other local agencies use the registry's LIS and are also funded by the public budget. Burns et al (2015) suggest that subsidies might be needed before demand response kicks-in. As service scope and volume expands e.g., with formalization, revenues can expand while keeping fees low. And, national or regional public gap finance such as the Government of Jamaica provides to NLA can be an option that recognizes these points but still encourages cost efficiency in operations. In Jamaica, the NLA needs to earn at least 75% of its costs because the government gap financing does not exceed 25%. The NLA keeps all fee revenue but revenue from sales and leases of public estate land, minus 5%, revert to a national fund. The NLA has an incentive to keep costs low and ensure the services are meeting their private (those with registered property) and public clients' needs.

a static analysis, this could be correct. However, before rendering such a determination, gains in fee revenue from increased demand for improved services should be estimated. Our framework can also be used to inform further analysis of pricing strategy and subsidy requirements. An important consideration is that even with streamlined processes and a revised fee schedule, on-demand registration will be more easily accessed and afforded by better off landholders (Deininger, 2003). In Colombia, a social enterprise, SUYO, is beginning to demonstrate a technology enabled, private sector approach to providing the poor with registration services. Massive formalization initiatives are also a way to address this for first registration. Overtime, services still need to be affordable so that formality is sustained. Technology options today provide means to open access to document rights, with or without government.

This line of thinking does not support the status quo in which many land administration agencies have limited fiscal authority and incentives are weak for cost control resulting in prices and fees that discourage wide use of the services. Resource allocations and service fee structures may be set in high level public budget processes delinked from financial modeling of investments and operations. Another common problem is that revenues revert to the central government widening the gap between investments and operations. The Jamaica and Cross River State, Nigeria cases are two examples that could be used to further consider the question of financial sustainability (the Lesotho Land Administration Authority is another case that could be examined). Better revenue and cost information over time will help determine fee and tax structures and inform budgetary planning that balance efficiency and affordability – to both the investing agency and its users – for sustainability at scale.

4.3 TECHNOLOGY CHOICES AND TECHNOLOGY SERVICES

Embracing fit-for-purpose implies flexibility to choose the best option for a given context. Open source software, cloud storage and processing services, and mobile communications technologies are now tapped to increase access and lower costs in land information management. These options need to be carefully considered from the point of view of customization, maintenance, license payment, system security, and local capacity to operate the system. (Byamugisha, 2014) Beyond better cost accounting in alternatives analysis, some additional topics need some clarification.

In discussions of best practice, the choice of technology seems too comingled with the choice of service providers needed to implement an investment. Services can include development and configuration of software and hardware, installation of the system, and ongoing expert services to support maintenance and upgrades over time. Providers include: public international organizations like the Food and Agriculture Organization (FAO); project-based developers (a project team with outsourced support); national public agencies; private vendors of proprietary software and services; or a combination of these.

One difference among the proprietary, open source, and project or agency in-house software solutions is how development and innovation costs are funded. This is often not considered when comparing costs. Will the donor community continue to make these investments in the FLOSS (Free/Libre and Open Source Software) SOLA (Solutions for Open Source Software Project) and will an active open source developer community evolve that updates the software with such investment? How long will it take for such a developer community to evolve and is the market space for LIS for land administration inherently too small and dispersed for such a community to evolve? If proprietary providers sell services to customize and further develop open source solutions, how will cost comparisons change? Vendors of proprietary software make research and development investments, and have a strong market incentive to do so spreading the costs across customers, in their pricing strategies.

COMPARISON OF COSTS OF SOURCING LIS SOFTWARE

Burns (2014) compares the costs of sourcing LIS software under four modes of acquisition: international procurement processes typical of donor-funded projects; software developed and supported by a central government IT agency; use of open source software; and project-based software development. The cost ranges reported for international procurement processes ranged from $1 million to $10 million, which is significantly higher than the other three modes. An inference is that the difference in cost ranges derives from the private companies that respond and the pricing of their proprietary wares. The examples we considered challenge this conclusion.

In Cross River State, the government used an open tender process and hired an international firm, resulting in software acquisition and customization costs of $382,375. The Jamaica NLA acquired proprietary land registry software and related services via a full and open international tender process under a WB procurement rules; the cost was $595,434. In Belize, proprietary systems were acquired and customized, funded by an IADB supported project using international procurement procedures. The LIS cost in LMP2 was $1,373,179 and in LMP 3 it was $637,920 for additional functionality and updates to original LIS system. The scope of the Belize project was notably bigger, however.

The literature is more nuanced than conversations reveal and practice continues to be diverse. Some land administration projects continue to support "home-grown" LIS software design, private companies continue to evolve proprietary software and services, and private sector services for open source tools are emerging. McLaren and Stanley (2012) provide examples where project-based in-house solution development was seen as better than proprietary products and services, especially from a cost and capacity perspective.[14] The MCA Cape Verde LIS investment is an example in which a government agency was chosen to develop the LIS due to its strong ICT capacity and the existing e-governance platform. A WB closeout report for a recent cadastral-registry upgrade project in Russia discusses a similar choice and appears to have been cost-reasonable and successful (World Bank, 2011).[15] A recent Inter-American Development Bank evaluation of several land administration projects favored proprietary solutions while admitting to limitations and higher-than-expected costs. Currently, countries like Tanzania and Uganda are moving from proprietary products and services to combining open source tools with private consulting services.[16] Lesotho, is considering moving to proprietary software and services suitable to its need to manage on-going transactions after relying on SOLA to create a basic records archive for land leases.[17]

We conclude that the debate on software solutions devoid of context and of better total cost data does not contribute to more informed decision making. Using a structured framework to compare investment strategies among alternatives will reduce the risks of overgeneralizing the virtues or ills of the technology solutions and service providers available.

14 See their review of the El Salvador experience.

15 Tonchovska and Adlington (2012) also discuss the different modes of acquiring technology solutions for LIS, including this and other country examples.

16 Note: the projects evaluated for IADB largely pre-dated the introduction of open source solutions, as did the El Salvador example.

17 Personal interview with the head of the Lesotho Land Administration Authority in April 2015.

4.4 ENABLING ENVIRONMENT, CONSTRAINING ENVIRONMENT

The examples we reviewed show how investment effectiveness -- regardless of the type of LIS investment, system or provider -- will be constrained or enabled by corollary procedural, legal, and institutional realities. Policy, legal, and procedural rules affect sustainability and scalability. At times, sustainability and scalability, or the lack of these, have little to do with the high cost of technology. For example, the Ghanaian SOLA pilot was implemented while important cost-reducing business process reforms had not yet been implemented, whereas in Belize, Jamaica, and Nigeria's Cross River State such process reengineering accompanied the LIS investment contributing to successful outcomes.

A recent article about innovative tools for citizen-driven land registration points to Jamaica's investment in expensive technology for a public sector land agency as the root of limited progress with formalizing the land rights of the poor: "Jamaica's Land Administration and Management Program (LAMP), for instance, was funded by the InterAmerican Development Bank and has installed new computer systems at the National Land Agency, but it has not significantly reduced the large number of informal properties in the country."[18] It is reasonable – even important -- to question the relative prioritization of formalization versus public sector LIS investments. Yet, it is also clear that slow uptake in land titling and registration reflects important policy drivers of high costs and constraints for citizens. Specific constraints to title applications were related to required proofs (of root title and of transactions), records of and requirements for tax payment and lack of subdivision approvals (Koh and Knight (2014)). In addition to also describing these sorts of constraints, Rabley and Samuels (2010) suggest that "LAMP was underfunded and understaffed." Fee structures and the lack of transitional tax strategies are often a source of disincentives for participation in registration initiatives (e.g., Madagascar (World Bank, 2014)). In these contexts, placing the blame for limited formalization on LIS technology investment strategy is an oversimplification.[19] It's worth noting, too, that in both places, remedies for these constraints are being put in place. In Jamaica, the Special Provisions Act introduced fee waivers, recognizes Certificates of Compliance which have easier requirements to meet and are a valid basis for collateral for agricultural loans; they also serve as an acceptable basis of proof for title application.

Gillingham and Buckle (2014) suggest that in Rwanda the low cost of massive formalization was due to community participation (e.g., via para-surveyors) and the use of open source software that could be readily deployed across districts, allowing work to move forward in tandem rather than sequentially across the country. Allowing the use of general boundaries for parcel maps also contributed to low cost and rapid progress in Rwanda. Features like use of para-surveyors and general boundaries are also unrelated to the choice of software for LIS.

18 Schaefer and Schaefer (2014) p. 4.

19 Under LAMP, the Government of Jamaica provides assistance with first registration and updating of titles, this is not mandatory. A USAID report in 2010 suggests that LAMP was never designed as a land titling project, per se (Rabley and Samuels, 2010). It is also worth restating another point made in the paper. Sequencing massive formalization before modernization in a linear strategy will likely hit bottlenecks as the Belize experience shows or limit sustainability as transactions remain informal due to inefficiency in the registration system. As Schaefer and Schaefer (2014) point out today technologies are available that are enabling citizens to proactively improve their land rights documentation regardless of how the government sets its investment priorities.

The Jamaica and Bogota examples also call attention to policy content that directly affects technology options and affects relative costs. Technical requirements are often specified in the regulatory framework for mapping and adjudication, limiting flexibility to opt for lower cost tools and techniques. Analysts sometimes lump these spatial data collection expenses together with assumptions about the costs of proprietary LIS investments. In Jamaica, the longstanding Torrens style land registration requires more diligence, as compared by NLA (interpreted to deeds or hybrid registration systems) because of government guarantee of title quality and this could affect relative costs. The better question to ask is whether costs are as low as possible within a certain context and whether services are affordable. The bottom line is that cost effectiveness is a concern in the business of land administration modernization and formalization but that the panoply of cost drivers do not roll up to a single straw man of "high technology costs."

4.5 DONORS AND ACQUISITION PROCESSES

Anecdotes suggest contract management issues, donor preferences, and specific time and capacity constraints can all influence the technology strategy. Private sector entities have expressed concern for over-specified terms of reference, sometimes seemingly prepared by people whose command of the technology and the market might not have been sufficient. For example, the Millennium Challenge Account (MCA) Mongolia tender for IT equipment and software for property registration in 2011 called on the provider to design and implement, but the request for proposal (RFP) included an extensive list of equipment and detailed software specifications that left little room for respondents to bring fit solutions to the problems at hand, or to use the market to define cost-effectiveness.

Finally, the length of time to tender and the layered reporting requirements that can be associated with donor funded projects have cost implications; defines as soft costs in the TCO checklist in Figure 4. Would costs be lower if donor-funded projects were to use a more flexible approach to the RFP stating purpose, describing key contextual factors, and outlining at a high level the specifications, letting the bidders, then, determine the best approach to the solution? Moving to more flexible TORs, when solutions are procured, will help generate fit-for-purpose choices in our view.

4.6 ENTRY POINTS AND SEQUENCING

Today, national land policy reform discussion is typically grounded in an ideal land administration system rollout plan, which entails a linear sequence of reforms within a comprehensive vision: establishing a comprehensive land policy; addressing first principles by securing tenure for all people via pro-poor formalization; upgrading the LIS that holds land records; and then setting up for downstream purposes such as transactions, taxation, and planning over time. Enemark et al. (2014), Byamugisha (2014), and Burns (2014) all stress a holistic investment approach. Examples of comprehensive programs include the Belize example and other donor-supported reform programs e.g., in Nicaragua and Madagascar. These holistic projects can be effective and if they can be implemented well in a reasonable time, could in fact be the ideal. However, this full package of land administration reforms takes time even where the political will for reform and capacity to implement exists as the Belize example illustrates.

At the same time, under programs to improve the business and investment climate, to develop local government capacity and public housing initiatives, investments to improve elements of the LIS for land administration are supported. The examples of Jamaica's NLA land registry reform, Bogota's cadaster, and Cross River State's land registry reform illustrate

the business case for such entry points that lie outside of comprehensive land administration reform programs. The resulting information systems and services can be consistent with, will benefit from and need to align with a national long-term strategy of land policy reforms, while bringing efficiency gains in the near term. This strategy is not without risks. For example, if informality is still widespread and the government divests of public lands relying on a more efficient estate management system, disputes could emerge. Investing in separate LIS for different agencies without an overall information management plan that is rationalized across agencies, could be less efficient, for example. This is an issue in Colombia. Broad geographic coverage and inclusion of the poor are international standards of good governance and reinforce sustainability of the LIS itself. This is an outstanding issue in all three countries and is the subject of actual or planned land governance reform programs. The question to consider is how to have adequate safeguards in formal transactions while formalization is pursued. Even so, this does not negate the value of the gains from improving efficiency and taxation.

Lemmen (2104) highlights how the various purposes of land administration services span a continuum of complexity. As discussed, the examples used in this paper vary in the specific investment purpose, scope, complexity, and sequencing. These examples illustrate how formalization, record access and updating, taxation, and land management can each provide an entry point for reform. The latter three entry points can contribute to inclusive growth objectives even before formalization is achieved. Municipal development is important for poverty reduction, for example. Investments in LIS to improve taxation and valuation can fund vital transportation infrastructure (as in Bogota) or public services. Transactional efficiency can be a priority for job creating investment.

More broadly, respect of land rights is linked with respect for human rights, livelihood improvements, and resilience—all key ingredients of poverty eradication and inclusive growth. The current trend in the land sector prioritizes formalization or land rights and builds LIS that support that purpose. In that context, sometimes LIS are narrowly designed to a single purpose of archiving the records from formalization. For example, in Madagascar, Lesotho and Rwanda the LIS was not initially designed for recording transactions on formalized parcels. This poses a sustainability risk. In fact, a World Bank Report (World Bank, 2014) suggests that land transactions in Madagascar are not permitted to be registered at the commune level even though the communes were authorized to issue and record land certificates in 2005. Conversely, in the Jamaica NLA land registry system modernization and the Bogota cadaster upgrade examples, expanding parcel coverage (by formalization) was not an objective. In both cases, extending formality to the poor is needed for inclusive growth and sustainability of the registry and cadaster will be enhanced as the client base is expanded. Other programs aim to formalize land rights in these countries. In Madagascar, Lesotho and Rwanda, on the other hand, complementary projects or follow-on strategies are addressing sustainability, scalability, and security gaps in relation to LIS. Our framework can help create an understanding of the value of various entry points. It will also highlight risks of LIS investments when not enough attention is given to upstream or downstream elements of land administration. Endo and Triveno (2015) reinforce the views expressed in this section when assessing Peru's once path-breaking reforms to improve planning for LIS investment. They specifically point out the risk of defining fit-for-purpose from the singular lens of making formalization cheap and accessible. This does not deny the foundational importance of delivering secure tenure for the poor. Rather, it recognizes that LIS investments serve multiple valid purposes creating more than one starting point for reform.

5. CONCLUSIONS

Land administration projects have long been criticized for investing in high-end technologies that are costly and at times, poorly suited to the local needs and capacity to sustain such investments. Practitioners now understand that it is critical to find a balance between land policy, technology solutions, user needs for tenure security, efficient land information systems and good public land management. The marketplace for LIS technology and services for land administration is expanding and dynamic. Inadequate cost data and analysis does not help inform decisions about LIS investments. Moreover, context matters for LIS just as it does for land tenure. Fit-for-purpose cannot become a specific solution but rather implies providing flexibility to tailor the investment package and strategy to a specific context. Like the continuum of tenure and the continuum of technologies available for land administration there is a continuum of purposes for LIS investments. History has created a mosaic of coexisting needs (e.g., basic security of tenure and transactional efficiency), circumstances (e.g., financial and human resource capacity) and valid purposes (e.g., revenue generation, documentation and protection of rights, and efficiency in transfers). In this mosaic, there are multiple justifiable entry points for investing in LIS improvements. Against this backdrop, we have proposed a framework for more consistent comparison of investment alternatives in context. We explored a series of issues that lead us to 10 preliminary suggestions:

1. It is risky to assume that lower initial investment cost implies lower ongoing operating and maintenance costs; mapping initial investment choices to the specifically implied ongoing costs is necessary. As they say in Latin America "*barato puede salir caro*" or what is inexpensive can end up being costly.
2. Use total cost of ownership (TCO) in analysis of LIS alternatives.
3. Include demand, revenue, and cost projections across the investment life-cycle in business models.
4. Track disaggregated costs and benefits over the investment life-cycle incorporating lessons from pilots and ex-post analysis to improve cost-effectiveness.
5. Pay attention to host agency incentives to keep costs low and provide quality services. Professional leadership with incentives to manage costs and revenues consistent with financial self-sustainability contributes to fit-for-purpose choices.
6. Investigate incentives for people to use the registry and cadaster services that rely on the LIS to avoid a reversion to informality.
7. Analyze fee structures, waivers, and subsidies to ensure both accessibility and sustainability.
8. Invest in LIS when good entry points exist and design the LIS with appropriate safeguards and recognition of other land administration reform areas.
9. Open source, public agency, project-based in-house and, proprietary LIS form a non-linear continuum of approaches.
10. Beyond foundational national land policy reform, more attention is needed for second-tier law and procedural reforms.

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ANNEX 1: LIS INVESTMENT EXAMPLES – BRIEF CONTEXT

Example 1: Cross River State, Nigeria	
Context	In Nigeria, state-level government has land governance authority and may take initiative to address land administration issues. Cross River State established a vision to manage its land resources for multiple purposes. Taking leadership to demonstrate rapid results in the context of a longer-term vision, a fast-track phase was defined to improve the documentation underpinning secure tenure and improve the environment for doing business. In addition, Cross River State sought to expand its property tax base, and unlike other states, it lacked any oil revenues (Thomson Reuters, Cross River Revival, 2014). Since the government first began to issue certificates of occupancy in 1978, only 10,000 had been issued. In 2010, confidence in the certificates was so low that the state only received 80 requests. In 2011, it chose to make land policy and institutional reforms necessary to modernize its land information systems (Thomson Reuters, Cross River Revival, 2014).
Host Agency(ies)	Cross River Geographical Information Agency
Funding Source(s)	Cross River State Government
Contracted Parties	Thomson Reuters partnered with Teqbridge Limited, a local GIS service provider, to deliver the four components. Thomson Reuters focused on LIS systems delivery and data acquisition while Teqbridge led the fieldwork to recertify landholdings and the installment of boundary markers (monumentation.)
Supporting Agencies	The LIS modernization effort benefited from the leadership and support of the newly created Cross River Geographic Information Agency and the State Ministry of Lands and Housing, which implemented policy and process recommendations.
LIS Investments	Acquiring ICT (hardware and software) to archive, process, index and search Certificates of Occupancy, customizing the software to ensure performance of the system in context, linked to georeferenced parcel maps. These investments were made over a 6 – 8 month period (estimate) between 2011 and 2012.
Complementary LAS Investments	Creating the Cross River Geospatial Information Agency as a consolidated and independent institution for managing land rights and other geospatial information. Issuing or re-issuing certificates of occupancy to land that already had a formal individual right assigned and validating boundaries including by placing new boundary markers on site. Improving the geodetic reference system infrastructure.
Software costs/Total cost	12.3 percent
IT costs/Total cost	35.6 percent
Results	At the conclusion of the project, Cross River State established a geodetic network, implemented a modern LIS with streamlined workflows, and trained and equipped staff to operate the LIS and provide customer service. Within months of implementation, 12,000 documents had been processed (Edmead et. al, 2013), which included all the previous certificates of occupancy as well as requests for new documents. In addition, the Ministry of Lands and Housing delivered 20,724 property records in 2013 that were also recorded by Cross River State. Revenues have increased significantly from $11 m to $14 m in 2014 (Barlow, 2014).
Sustainability	State-level policy and process improvements were adopted to ensure efficient work flow and business processes. The system is designed to be extensible to include tax and valuation modules. Even with streamlined processes and a revised fee schedule, on-demand registration is more easily accessed and afforded by better off landholders (Deininger, 2003). A campaign to register more landholdings, scaled to include rural areas and poorer districts, will be foundational for inclusive development and contribute to the sustainability of the LIS.
Scalability	The Cross River LIS is designed to be extensible to include tax and valuation modules. It also can accommodate expanded volume. The system is able to support large-scale landholding certification should the government initiate systematic land rights certification.
Security	To date, no security breaches have been reported.

Example 2: Jamaica	
Context	When Jamaica embarked upon land administration reform more than a decade ago, surveys, land titles, estate management, and valuation duties were carried out by four separate government entities. Paper documents dominated, and each public agency had its own system that did not interface with the others, nor adequately support business operations. Based on the 1996 Land Policy, in the early 2000s, two projects supported land administration reform: the WB-Funded Public Sector Modernization Program (PSMP) and the IADB-funded LAMP. In 2001, under the PSMP, the Jamaican government consolidated its four main land administration functions (title registration, estate management, surveying and taxation) into a new executive agency, the National Land Agency, and supported its capacity development and business process reforms. As an executive agency, the NLA had a non-civil service professional management and independent management board. The NLA has progressively improved its LIS and its services with system design and records upgrade investment in 2003 and expansion of functions in 2010. Separately, LAMP was established in 1999. LAMP had multiple objectives including facilitating formalization of urban and rural parcels, modernization of the registry and cadastral systems, improvement in public land management, enabling efficient land information usage for agriculture and rural development. The 3 year pilot under the first IADB loan started in 2000 and focused on cadastral services in support of rural land titling including GIS and base mapping work with the survey department within the newly created NLA. The IADB extended the LAMP for another 5 years in 2004 with a greater focus on first registration; in 2005, a law passed to allow LAMP to facilitate first registration (Rabley and Samuels, 2010). According to its website, the LAMP now provides a one-stop shop for assistance with formalization of untitled or unregistered parcels (parcel surveys, adjudication proceeding, title issuance and first registration). In partnership with the Korean Cadastral Survey Corporation (an official partner of the Korean International Cooperation Agency) and GeoLand Titles LTD, in 2010, LAMP II was launched to expand progress and achieve complete coverage in selected parishes while modernizing the technology of the surveys unit within NLA. In 2011, LAMP in partnership with the Ministry of Water, Housing and Environment, civil society launched the Land Access for National Development land titling project that includes regularizing informal settlements. Under LAMP II, policy and procedural changes that make formalizing land rights more affordable have been instituted. This includes addressing issues relating to what constitutes acceptable legal proofs by providing Certificates of Compliance that validate rights and can be used as a basis for title application and as collateral for agricultural loans. It also includes waiving unaffordable taxes and fees (Koh and Knight, 2014). Under several phases of a Competitiveness Enhancement Program funded by the IADB, support was provided to LAMP in its efforts to strengthen land rights and make titling affordable.
Host Agency(ies)	Jamaica National Land Agency (for the specific LRS investment examples)
Contracted Parties	Fujitsu, International Land Systems (ILS),* ESRI Canada
Supporting Agencies	
Project Design	The investments used as examples in this paper took place at two junctures 2003 and 2010 (the specific duration of investment at each juncture is not known). There were investments prior to, in tandem with and after these investments in other elements of the land administration system. For example, prior to 2003, the NLA had undertaken business process reforms and had also invested in a system to scan and index the paper title records from ILS and Fujitsu. In 2003, these same contractors and ESRI won the PSMP international tender to provide a fully automated land registry system as a turnkey operation. The LRS was customized and capable of integrating with the existing scanned title documents and linking with parcel survey data available in the then separate cadastre-managed GIS. The goals were to further improve customer
Software costs/Total cost	37.1%
IT costs/Total cost	64%
Results	That NLA reported that it generated an average of just under US$ 9 million in revenue per year suggests that the investment (including software licenses) more than paid for itself. The payback period for both the first phase of LIS investments in 2003 and the second phase LIS in 2010 was less than a year. In response to improved quality and accessibility of the land agency, 116,271 titles were issued on-demand. Turnaround times went from 56% processed in 25 days to 100% processed within 20 days. A 2014 Press Release found on the IADB website notes that the inclusion of all parishes under LAMP has decreased the cost of land transfers by 5% and reduced by 2/3 the time to process a title application.
Sustainability	NLA has a business orientation and incentives to keep costs down and ensure client responsive services. While it has seen significant impact from its investments and the payback period was limited, expenditures tend to exceed revenues (on average, by $3.8 million). It is not possible to conclude that the NLA's LIS is independently sustainable because the national government provides a subsidy of up to 20% annually and budgets take this subsidy and market trends into account.
Scalability	Under the second phase of the LAMP, investments in the capacity of the survey unit within NLA and to increase the rate of progress in facilitating formalization were made. All districts have been declared subject to LAMP support and procedural changes were adopted to make land title application more affordable. The formalized parcels are recorded in the NLA Land Registry System adding scale to its operations.
Security	Improved data management resulting in fewer errors and digital records of property rights.

* In 2011, ILS was acquired by Manatron which was then acquired by Thomson Reuters in the same year. ILS' Land Registry System software product, deployed in Jamaica, was repackaged within Thomson Reuter's Aumentum.

Example 3: Bogota, Colombia	
Context	The motive behind Bogota's cadastral information reform was to improve the tax base and increase tax revenue to fund planned investment in public transportation infrastructure and the anticipated construction that would follow it. Analysis indicated that an outdated cadaster cost the city approximately US$235 million between 2004 and 2009 through lost revenue. The procedures for cadastral updating are established by a national agency, and the methodologies are at least two decades old and do not leverage modern technologies or advances in statistical methods (Ruiz and Vallejo, 2010). A prior failed effort to improve the Bogota cadaster was studied and the learning was used to make important changes in design and implementation of the investment. Uribe (2010) labels this the "first successful effort since 2004."
Host Agency	Bogota Cadastral Office
Contracted Parties	Staff and consultants under the supervision of Bogota's cadastral office.
Supporting Agencies	The National Geographic Institute Agustin Codazzi (IGAC) and the Property Registry
Project Design	The investments were implemented over a two year period in 2009 and 2010, according to Ruiz-Vallejo (2010). The assessed value of 1.2 million properties were updated, regardless of whether the rights were registered or not. The project, under national rules, was required to visit all parcels rather than visiting only parcels with known changes. Also, even though the registry information is readily accessible, the interface is inadequate and data had to be manually crosschecked with the registry. Both constraints limited the ability to streamline the process. Learning from an earlier failed effort to update the cadaster, the project invested in the professionalization of human resources, ensuring that procedures were consistently applied across locations and adopting then new technologies such as a PDA for field data entry and a web portal for citizen review. These both helped address prior concerns of corruption. A policy choice was made to limit the increase in tax rates for a period so that the
Software costs/Total cost	NA
IT costs/Total cost	7.2%
Results	The cadaster generated significant new revenue (10.2% increase equal to $37 million according to Uribe [2010]). Property tax revenues increased from 20% to 40% of local revenue. This stemmed from capturing the rise in property values in the previous decade, which increased the value of the cadastral base by 47% (Ruiz and Vallejo, 2010). In the process, Bogota modernized its LIS, with investments in hardware and software that are contributing to better land use planning (Uribe, 2010).
Sustainability	The procedures to update the cadaster require periodic updating initiatives rather than continual updates (e.g., through linkage with the registry), which undermines the sustainability of this program. This further reinforces a pattern of reporting the lower dated cadastral values rather than the actual sales price in registering transactions which reduces tax revenues. Even though the cadastral update encompassed all properties in the jurisdiction, services to update land tenure records remain costly for property owners, which might dissuade some parties from updating tenure. The procedures Bogota employed to update its cadaster are a second best approach—steps to make future updates more frequent and less costly require reengineering of IGAC-imposed procedures that limit the scope for improvements and cost savings.
Scalability	Only a few other cities and one department have independent cadasters that could adopt Bogota's approach.
Security	The interface between cadastral records and the property registry is inadequate, and manual review of records was required during the project.

* Fees for land titling on private land and building recognition can exceed US$1,250 and uncontested successions can cost $500 – 600, with more than half the costs going for legally mandated fees and taxes paid to government or quasi-governmental institutions such as notaries (Alexander, personal communication 2015).

Example 4: Belize	
Context	In 1997, land governance in Belize was marked by tenuous land tenure security and informality coupled with a lack of effective tax collection and a weak public sector that created a poor environment for investment. Belize has both freehold and leasehold land tenure. Privately held land accounted for 54 percent of the territory (public land accounts for the remainder). Urban parcels that occupied only 0.1 percent of land accounted for most land transactions. At the time Belize launched its reform program, the country had three separate ownership registration systems: a deeds registry, title registry and lease estate registry. Collectively, they failed to provide effective management of land records. The country also had to address a backlog of transaction requests that resulted from inefficiencies generated by poor land registration processes and a reliance on physical folios (IBD, 2008).
Host Agency(ies)	Ministry of Natural Resources and Agriculture (MNRA) (Previously names: MNR and MNRE)
Contracted Parties	Stewart (now Trimble Land Administration Solutions Group) was contracted in the second phase, a bridge activity and the third phase.
Supporting Agencies	Various (details unclear in information available)
Project Design	The Belize reforms took place between 1997 and 2013. There were three rounds of work: The **Land Management Project (LMP)*** and two successor projects, LMP II and LMPIII). The objective of the LMP (1997-2001), which was funded by the Government of Belize, the IADB and the Danish Cooperation, were to establish reliable land records management system to improve tax collections and to give individuals tenure security. Of its three components, the LIS element was focused on installing a computerized land revenue system and reconciliation of existing records for improved valuation, revenue collection, financial control and automated billing. The other two components focused on broader LAS elements including land tenure adjudication, dispute resolution, parcel surveying, creation of a cadastral database as part of a broader GIS and work on land policy reform. In the second round of work, **LMPII from 2007-2009**, the cadastral data base infrastructure created in phase 1 was extended to all units within the MNRA, a computerized land registry was established, a one-stop shop for customer service integrated the components of the LIS into the Land Information Center, and parcel surveying continued. The third round of work, **LMPIII (2011-2013)** consolidated progress to fully establish a well-functioning land information system and put emphasis on urban area coverage. In this phase and in a small bridge activity was implemented to make needed geospatial adjustments and carry out additional training of staff. More importantly, the parcel-based information system was expanded to cover the remaining sections of the Department of Lands and Surveys (Estates, Valuation and Planning). A new system was designed and installed to handle land revenue data extending the functionality of the LIS. The expansion of the system was accompanied by technical assistance, training and the development of operational manuals.
Software costs/Total cost**	LMP2 and Bridge: 14.4% ; LMP3: 29.8%; LMP 1 – 3 Overall: 13.8%
IT costs/Total cost	LMP2 + Bridge: 15.2%; LMP3: 38.6%; LMP 1-3 Overall: 21.8%
Results	Belize now has a fully functional LIS. In the LMP, 1.6 million private and public land records were entered into the new system. Tax revenues and rents increased significantly (IADB, 2008).). Under LMP 2 and 3, services for processing land transactions were made more efficient and the tax base expanded significantly. Additionally, under LMP local surveyors introduced a technology component to foster the use of GPS methodology to reduce costs of surveying land parcels by 60%. Approximately 9,600 rural parcels, representing about 40% of agricultural land were adjudicated. Under LMP II, the targeted rural land holders of over 16,000 parcels received secure titles for land they occupied and an additional 7,000 rural parcels were surveyed and declared as registration sections (areas where it is mandatory to register land transactions). Activities in urban areas were somewhat less successful and very few urban parcels were formalized. A side benefit to the LIS work was the production of community land use plans, the delineation of village boundaries, and public consultations on key policy areas (land acquisition, the allocation of national lands and the establishment of a Land Distribution Authority) useful to the broader reform agenda.
Sustainability	The comprehensive design and adaptations made to address bottlenecks and reduce costs favor sustainability. One risk identified in a recent evaluation (IADB, 2014) is the capacity of staff to operate the system over time. As early as LAP, institutional capacity development was identified. The evaluation finding illustrates the need for continued human resource development as technology investments and personnel change overtime.
Scalability	Initially, surveyors had to slow down the field work for adjudication because the lack of an automated, digital land information system for registry and cadastre was a bottleneck to issuing and registering titles and leases. This was addressed in LMP II, allowing broad geographic coverage and an LIS that is serving all of the sections within the MNRA and then from MNRA headquarters in the capital to district offices throughout the country.
Security	The LIS system design has information security built in.

* This was originally called the Land Administration Project (LAP).
** For these cost ratios, LMP 2 plus the small bridge investment are the most relevant. Even within this project, the way cost data is disaggregated varies by phase of operation.

ANNEX 2: LIS INVESTMENT SUMMARY FINANCIAL TABLES[1]

TABLE 1: SUMMARY FINANCIAL STATEMENT FOR THE CROSS RIVER STATE EXAMPLE	
	Cross River US$ 2011
Revenue (taxes, fees, sales of maps/data)	
Recurrent Costs (personnel, software maintenance, tech support)	
Outlays	
Project Management and Staff	65,352
Temp Staff	
Infrastructure	61,290 *
Policy and Legal Framework	
Background Studies	332,076 **
Dispute Resolution	
LIS Technology Investment (Subtotal)	**1,106,504**
Hardware	621,017 +
Software acquisition	274,850
Software customization and implementation & other ICT consultants	107,425
Capacity development to support IT	23,708
Web development and hosting	66,228
Cloud/data storage	13,276
Geodetic Control	466,716
Mapping	
Data Conversion and Issuance of New Documents	425,956 ++
First Registration Costs (not included above)	
Communications and Public Outreach	
Capacity Development (not linked to IT)	134,805
Travel, per diem	
Other Project Costs	225,838 ^
Taxes	282,520
Total Outlays	**3,107,718**

1 Thomson Reuters provided data for both Cross River State in addition to information from Edmead et al. (2013). Information for Jamaica was provided by the NLA. Trimble Land Administration Solutions Group provided us with cost data for Belize which was used together with the IADB Evaluation Report (IADB, 2013). Bogota source material includes Ruiz and Vallejo (2010).

* Workstations

** Includes data, products, and structure and workflows items within the institutional framework.

+ Includes periphery valued at 227,012.

++ Includes data, functions, products and structure and workflows in Recertification of Occupancy category.

^ Includes diesel, maintenance, stationeries, vehicles and housing.

TABLE 2: SUMMARY FINANCIAL STATEMENT FOR THE BOGOTA, COLOMBIA EXAMPLE	
	Bogota US$2009
Revenue (taxes, fees, sales of maps/data)	**Not Available**
Recurrent Costs (personnel, software maintenance, tech support)	**Not available**
Outlays	
Project Management and Staff	557,827
Temp Staff	4,330,346*
Infrastructure	
Policy and Legal Framework	
Background Studies	958,147 **
Dispute Resolution	
LIS Technology Investment (Subtotal)	**560,486**
Hardware	
Software acquisition	
Software customization and implementation & other ICT consultants	
Capacity development to support IT	
Web development and hosting	
Cloud/data storage	
Geodetic Control	
Mapping	392,225
Data Conversion and Issuance of New Documents	
First Registration Costs (not included above)	
Communications and Public Outreach	79,093
Capacity Development (not linked to IT)	
Travel, per diem	
Other Project Costs	954,778 +
Taxes	
Total Outlays	**7,832,902**

* This cost reflects a legally mandated methodology for updating valuation rolls that involves physically visiting all properties to identify changes that affect value (e.g., built area, type of use); requiring significant employment of temporary manpower. Ruiz and Vallejo (2010) suggest that in 2009, the costs associated with the fieldwork to canvas properties, prior to any survey work, added to 47% of total cost. After the canvasing, surveyors are deployed to parcels with changes and use modern PDA to intake data. It is unclear whether the costs of survey staff time is or is not bundled into this figure.
** These studies were for economic support for valuation/assessment.
+ Bogota includes some administrative staff in this category, but it mostly consists of offices, vehicles, and uniforms.

TABLE 3: SUMMARY FINANCIAL STATEMENT FOR THE BELIZE EXAMPLE (US$2010 DOLLARS)*			
	LMP2 + Bridge Funds 2007-2009	Belize LMP3 2011-2013	Totals 2007-2013
Revenue (taxes, fees, sales of maps/data)			
Recurrent Costs (personnel, software maintenance, tech support)		$35,000/yr	
Outlays			
Project Management and Staff		53,295	53,295
Temp Staff			
Infrastructure			
Policy and Legal Framework			
Background Studies		126,642 **	126,642
Dispute Resolution			
LIS Technology Investment (Subtotal)	**410,908**	**896,712**	**1,307,620**
Hardware	85,559	54,785 +	144,345
Software acquisition			
Software customization and implementation & other ICT consultants	321,349 ++	693,816	1,015,165
Capacity development to support IT		88,228	88,228
Web development and hosting		59,873	59,973
Cloud/data storage			
Geodetic Control		25,194	25,194
Mapping	348,112		348,112
Data Conversion and Issuance of New Documents			
First Registration Costs (not included above)			
Communications and Public Outreach			
Capacity Development (not linked to IT)			
Travel, per diem			
Other Project Costs	8,266,303	1,223,767	9,490,069
Taxes			
Total Outlays	**9,025,324**	**2,325,600**	**11,350,924**

* We obtained aggregated project budgets. This figure includes multiple components related to LIS, IT Capacity building and database development. In addition, it includes the costs of surveying activities, a review of tax assessment policy and process improvements. It does not include costs of adjudication and records management that were completed in Phase 1 (LMP 1997 – 2003) under which 9600 rural parcels were surveyed and registered. However, in LMP2, an additional 7000 parcels were surveyed and registered and this likely figures into the "Other Project Costs" line; costs that were not part of the contract to Trimble Navigation for LIS elements.

** Business process and data analysis

+ Validation and hardware compliance verification. Does not include all software and hardware expenses (Jill Urban-Karr, personal communication).

++ This figure includes scanning of existing records, system test, IT capacity, consultants and LIS implementation.

TABLE 4: SUMMARY FINANCIAL STATEMENT FOR THE JAMAICA EXAMPLE			
	2010 Upgrade US$	2003 LRS (US$ 2010)	US$ 2010
Revenue (taxes, fees, sales of maps/data)	7,814,220	Not Available	88,152,569*
Recurrent Costs (personnel, software maintenance, tech support)	18,000**	54,514	72,514
Up-Front Outlays			
Project Management and Staff	50,820	97,408	148,228
Temp Staff		133,446	133,446
Infrastructure		261,504	261,504
Policy and Legal Framework			
Background Studies		78,867	78,867
Dispute Resolution			
LIS Technology Investment (Subtotal)	**478,990**	**891,137**	**1,370,127**
Hardware	289,474	261,504	550,977
Software acquisition	80,932	479,721	560,653
Software customization and implementation & other ICT consultants	108,584	125,713	234,298
Capacity development to support IT	-	24,199	24,199
Web development and hosting	-		
Cloud/data storage	-		
Geodetic Control	-		
Mapping	-		
Data Conversion and Issuance of New Documents	-		
First Registration Costs (not included above)	-		
Communications and Public Outreach	-		
Capacity Development (not linked to IT)	24,593	46,171	70,764
Travel, per diem	5,999		5,999
Other Project Costs			
Taxes			
Total Outlays	**578,401**	**1,563,047**	**2,141,448**

* This figure aggregates revenue from 2004 through 2010 from NLA reports; it captures the flow of revenues from the 2003 investment and does not reflect just the revenue resulting from the 2010 investment in the Estate Management System.
** Composed entirely of software licenses.