Increasing Cadastral Survey Productivity to Tackle Undocumented Land Rights Worldwide: A Case Study

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SUMMARY

This paper will introduce a vision for transforming cadastral workflows by leveraging a broad spectrum of geospatial technologies in a way that will provide surveyors with greater productivity in both the field and the office. A holistic system approach will be analyzed, with key factors identified to address customer challenges in the context of a real-world case study. Finally, the customer benefits identified in the case study will be extrapolated to identify potential applicability to developing countries in order to enhance productivity to tackle undocumented land rights worldwide.

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1. INTRODUCTION

This presentation will introduce a vision for transforming cadastral workflows by leveraging a broad spectrum of geospatial technologies in a way that will provide surveyors with greater productivity in both the field and the office. A holistic system approach will be analyzed, with key factors identified to address customer challenges in the context of a real-world case study. Finally, the customer benefits identified in the case study will be extrapolated to identify potential applicability to developing countries in order to enhance productivity to tackle undocumented land rights worldwide.

Cadastral surveying has evolved significantly over the past 25 years, with the introduction of faster, lighter, and more accurate hardware technology to serve more traditional operations. Field and office software has also evolved to handle large volumes of data in smaller packages and in formats readily accessible worldwide. However, with all of these advancements, there still remain challenges in the transition phases of cadastral projects and, even with all the available technology at a project's disposal, the volume of undocumented land parcels worldwide is estimated in the billions. In Uganda alone there are currently an estimated 15 million unregistered land parcels that current cadastral government authorities estimate will take Ugandan surveyors 1,000 years to legally register (Cadasta.org, 2018). Improvements to cadastral workflows, when considered at such scale, can decrease the time it will take to do this work and thus grant land tenure to rights-owners more expediently.

2. CHALLENGES IN ESTABLISHING LAND RIGHTS

Therefore, it is important to not only assess the introduction of technology, but to understand the workflows and processes that can introduce delays and challenges in the establishment of land rights:

- **Getting the right data/equipment to the right people at the right time.** Organization of field crews, their equipment, their schedule, and their data is still a largely manual process in most projects, and often requires significant prep time and strong communication to be executed efficiently.

- **Mixed fleet of hardware and software equipment.** Most cadastral projects require more than one piece of equipment, software, and/or format in order to get the job done. This introduces data management challenges as well as equipment compatibility hurdles between manufacturers. This is in addition to the training required for each crew member to operate at full capacity.

- **Time-consuming process to update changes in the field.** In traditional form-based data collection software, it is often difficult to visualize the data being captured, and limited attribution is collected about the geospatial element. If errors are made in data collection, it can be difficult to identify in the field.

- **Multiple iterations required between field and office.** Most cadastral survey crews will work an entire day in the field before receiving any feedback from the office, and communicating changes is often manual or fraught with errors. In some cases, multiple trips are required in order to finish a job correctly and to specification.

- **Manual deliverable production and processing.** Once all the data has been captured and verified, production or drafting of deliverables often involves the use of many softwares and various export/import formats and mediums to prepare data for final approval.

3. KEY TECHNOLOGY INTEGRATION COMPONENTS

Given these cadastral workflow challenges, several key technology integration components can be identified to streamline these processes:

- **Map-based data collection tools.** Combining cadastral field surveying techniques and high-accuracy GIS data collection in one intuitive, easy-to-use, map-based interface is essential for increased productivity, limiting manual entry errors, and providing real-time feedback in the field.

- **Data validation and verification in the field.** Designing a data validation wizard that is compatible with the project and database model allows for better attribution, verification, and completeness of data while crews are active in the field, and limits the iterations between field and office.

- **Streamlined deliverable process.** By automating common drafting and post processing activities, and standardizing on a common data model, manual work and prep for production is significantly reduced.

4. ORDNANCE SURVEY NORTHERN IRELAND: A CASE STUDY

A good example of this type of cadastral workflow system integration is a project Trimble performed for the Land & Property Services (LPS) division of Ordnance Survey Northern Ireland (OSNI). LPS collects, processes, and manages land and property information, which underpins the collection of rates, in support of the government's commitment to economic and social development in Northern Ireland.

In early 2017, the Trimble team began working in Northern Ireland to develop and implement a customized solution with map-based data collection software, adding enhanced editing,

query, validation, and deliverable workflows to the existing platform to increase productivity in the field across 35 crews.

In addition to the key challenges already identified in cadastral workflows, LPS also faced challenges of implementing a new data model for both GIS and Survey style methodologies, incorporating third-party task management software and legacy hardware equipment.

Trimble worked collaboratively with LPS's existing team to understand the processes and workflows currently implemented, and to define the technology recommendations based on the objectives outlined within the project. By developing a customized deliverable format designed to work specifically with LPS' new data model, integrating the field software with task management software, and implementing a validation wizard for both survey and GIS, Trimble was able to reduce LPS' time spent in the field.

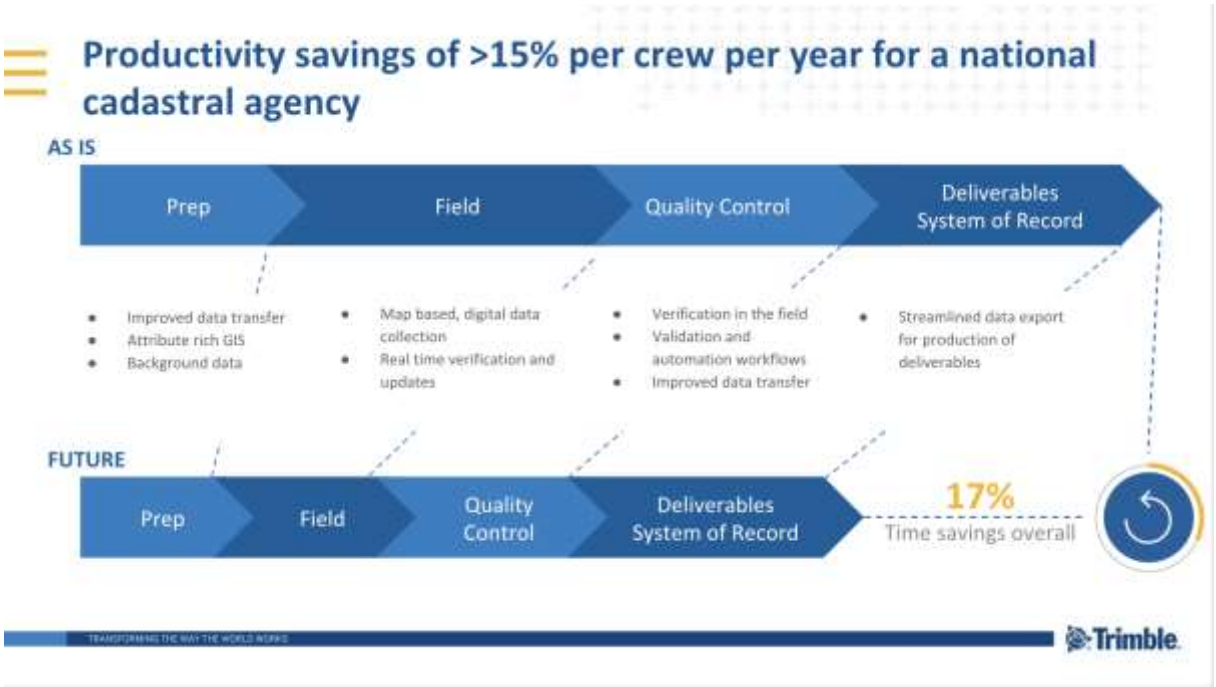

Figure 1: Modeled LPS Project Productivity Savings by Workflow Component

In order to leverage the vast amount of field data already collected by LPS, the Trimble team developed a unique layer-view functionality that allowed for datasets to be manipulated and displayed according to the individual task at hand. Additionally, GIS query and validation engines were designed to search this data in an efficient and concise way to gather the appropriate information on field devices in real time. This system integration reduced the average number of trips required for job completion from 3 to 1.

Overall, by addressing the identified cadastral workflow challenges from an entire system perspective and modeling the initial results from implementation, Trimble modeled a 24% cost savings for the project based on the typical time and dollar spend of each crew member per workflow component. Though the LPS team is still working with 35 survey crews, they

are now able to work more productively and expediently document changes in land management.

5. APPLICABILITY TO OTHER PROJECTS

Just as the cadastral workflow challenges can be extrapolated to other projects, it is also possible to infer that the benefits can be realized as well, especially when referring to process improvement. Though the LPS case study is based in a developed country where access to connectivity, technology infrastructure and qualified personnel are prevalent; the workflow components identified 1) organization of field crews/equipment, 2) mixed fleet of hardware and software, 3) time-consuming process to update in the field, 4) multiple iterations between field and office, and 5) manual deliverable processing and production; are still all relevant challenges experienced in developing countries. It is possible that in future case studies in developing countries, productivity improvements could be realized through conducting more parcel surveys with fewer crews (or crews of a smaller size), instead of expediting the amount of work done by the same number of crews, as identified in the LPS case study. When considering the scale of undocumented land parcels worldwide, these improvements have the potential to be material to the organizations undergoing land reform efforts.

In societies were land rights are largely undocumented, formal property rights establishment is often being conducted for the first time. Existing data is sparse, the collection process is inherently more difficult, and both legal and survey expertise is required on the ground. With missing or low-quality base data, no connectivity, and poor transportation infrastructure, the challenges faced from inaccurate and inefficient field operations are known to be significant. Resultant impacts are either slow to materialize or are not "positive", and can further complicate the tenure environment. Therefore, for the rights holders, "immediate" validation in the field is absolutely critical to ensure community acceptance, verification, and finalization of rights (boundary and attribute). For the field crews, they benefit from intuitive, self-correcting software that helps prevent technical errors and provides immediate feedback on the collected data.

6. CONCLUSION

Leveraging the power of data is essential to making informed decisions in the field and, though challenging, the results of doing so yield significant productivity gains. Additionally, the business process analysis and requirements gathering is not just about implementing new technology and software workflows, but about understanding what the true intent and purpose of a project is. By assessing the system and workflows holistically, and constantly iterating with feedback from both field and office components, cadastral workflows can truly be transformed to a new level of productivity to tackle undocumented land rights worldwide.

REFERENCES

1. Cadasta.org (2018) https://cadasta.org/resources/infographics/surveying-the-landscape-to-reduce-poverty/

BIOGRAPHICAL NOTES

Stephanie Michaud, P.Eng. is a professional geomatics engineer responsible for the application of geomatics engineering principles and techniques to coordinate the definition, development, testing, and delivery of custom land development solutions within the Land Administration division and Trimble Inc organizations. Mrs. Michaud holds a degree in geomatics engineering from the University of Calgary in Canada.

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