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BLOCKCHAIN FOR LAND ADMINISTRATION: SMART LAND REGISTRIES - A TANGIBLE MODEL SEEKING VALUE FOR ALL PARTIES

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Abstract

There has been much media excitement about blockchain's potential to revolutionize commerce, trade, supply chains, and, indeed, Land Administration. But, is it real, and where is the value to our citizens, economy and society?

Trimble, Ordnance Survey of Great Britain, and IBM have come together to provide insight into the upsides, and into the risks associated with this technology-lead transformation. This partnership combines land administration domain experience, government technology and guardianship, and technology leadership to bring a measured perspective to the topic.

This paper will give decision-makers insight to 1) assist with understanding the value of blockchain for their particular jurisdiction, 2) place blockchain among the arsenal of other potential technical approaches that could be leveraged, and 3) put these technologies, a.k.a. Smart Land Registries, into the context of the problems that society and government need to solve.

Furthermore, we will propose a value-focused and achievable roadmap to their adoption.

Key Words:

Blockchain, Data Integration, Distributed Ledgers, Fit-for-Purpose, Land Administration, Technology



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Blockchain for Land Administration: Smart Land Registries - a tangible model seeking value for all parties

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Trimble, Ordnance Survey of Great Britain, and IBM have come together, combining land administration domain experience, government technology and guardianship, and technology leadership to bring a measured perspective to the discussion about the value of blockchain¹ for land administration.

In this paper we will outline the significant strategic steps required to truly leverage value from blockchain as the basis for land registration. Value is there to be had, but only as part of a long-term adoption strategy, starting with the decision to move to the Smart Land Registry – something discussed in more detail below.

And we note that while blockchain has found utility in a number of processes that surround the land authority's role of registering tenure on land (such as the conveyancing process, leasing, etc.), here we will focus on land registration and the enablement of land transactions - the fundamental duties of the land authority.

Blockchain – cutting out the middleman?

There is a widely held and unvalidated belief that blockchain is a means to “cut out the middleman” almost magically.

This belief has led to proposal that a country's land authority will be made obsolete by blockchain-based land registration, and transactions with smart contracts will carry-out the operation of the land authority via software, with blockchain safely holding the details of land ownership.

¹ We use the term “blockchain” here as the catch-all term for distributed ledger technologies, including the blockchain itself, smart contracts, distributed off-chain storage and the ecosystem of supporting technologies. For this paper we assume a permissioned blockchain as the most appropriate model.



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Such a claim ignores the true reality of land registration and land transactions - both as a legal process and as a transaction over data that is typically not structured to enable such automation. It also ignores the need for the realization of the legal process in software (whether Smart Contract or not) and the operation of the technology that underpins a land authority.

Though there is value to be found in moving to the use of blockchain technologies, the barriers are manifold: Are the citizens digitally enabled and able to use digital identities successfully? How will the legal system of the jurisdiction need to change? Is the technology actually up to the job? Is the data in the registry in a fit state?

These barriers are not insurmountable for a suitable determined jurisdiction, but not without collaboration across numerous government departments and significant investment.

Gaining true value - steps on the journey

As a jurisdiction journeys along a path of increasing maturity and technical sophistication, it will do so in a manner that addresses the reality of the challenges faced and not simply add technology for technology's sake.

Some of these challenges are listed in the table below, and within this paper the authors contend that the majority of these challenges can be addressed by moving towards something the authors term the "Smart Land Registry".

To define this term, the "Smart Land Registry" is one where the land authority has taken two key strategic decisions: 1) to transform the way the register is structured: digitizing and codifying the rights, restrictions and responsibilities detailed in the registry such that they can be queried and understood by software; and 2) to transform the services offered by the land authority to enable smoother, more automated transactions.

To be clear, the Smart Land Registry does not mean "blockchain based", it means a move towards an environment (legal, technical, cultural) that enables "software driven" land transactions. Moving to the Smart Land Registry may well be a sufficient maturation in the land authority. It is certainly a precursor to being able to leverage true value from a future leveraging of blockchain.



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Challenges faced by a classic land authority	
Immediate challenges	<ul style="list-style-type: none"> ● Exclusion of groups of peoples from formal land registration processes ● Low quality and heavily siloed data ● Manual paper based processes, or early computerizations of paper processes ● Unsustainable custom built technology ● Financial constraints ● Organization constraints: poor integration across government departments and efficient processes ● Lack of trust in the land authority ● Low levels of market liquidity
Longer term challenges	<ul style="list-style-type: none"> ● Inability to enable foreign investment in the local land market

Table 1 - Challenges faced by the classic land authority

Of these challenges, the majority are addressed by the move to the Smart Land Registry, with only the last few items on the list - in particular the issue of trust - representing the opportunities where blockchain technologies can provide value. Indeed it could be argued that the issue of trust is the *only* place where blockchain is the only real answer, and even here only some aspects of that trust issue can be addressed.

To better clarify what we mean by the Smart Land Registry, the table below outlines some of the differentiating characteristics of the Classic registry and the Smart Land Registry; and the Smart Land Registry that is leveraging true value from adoption of blockchain technology.

This has to be seen as a journey: moving to adopt blockchain in a manner that generates real value is precursored by a move to the Smart Land Registry, which itself addresses the majority of the challenges above.



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	Classic registry <i>land transactions require significant human input and are typically slow. Paper and early electronic systems</i>	The “Smart Land Registry” <i>faster, more reliable land transactions with automation enabled</i>	Leveraging true value from blockchain <i>high levels of trust enabled by moving land transactions to be mostly software driven and carried out using Smart Contracts with the results recorded on a blockchain</i>
Registry data	Text based titles describing rights, restrictions and responsibilities in natural language - even if held on computer.	Codified titles - ownership, rights, restrictions and responsibilities codified and semantically modelled into a register that is machine-readable.	Transaction results are recorded on a blockchain with the “state of the register” recreatable and validatable by anyone with access to the chain.
Citizen identity	Citizen identity is verified by classic means such as town meetings or government issued paper documents (e.g. passports)	Citizen identity is held digitally, enabling a citizen to access government services by “logging in”.	Citizen identity is not only digital, but carries a digital signature that only that citizen can use.
Citizen digital enablement	Citizens do not require digital enablement to be able to access government services	Citizens receive a “better” (smoother, faster) result by using the digital services on offer.	Citizens interact with government services digitally by default with exceptions managed by digitally enabled citizen



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			representation (e.g. notaries).
Legal position	The law and regulation describes the structure of the register and the forms and processes used to make changes Paper forms and wet signatures are the norm	The law and regulation moves to a position that enables innovation rather than constraining it by prescriptive definition of the existing process. Digital data is acceptable without a physical copy or wet signature.	Digital signatures are legally enforceable. Contracts written in code (Smart Contracts) are legally enforceable. Processes are in place that enable the courts to step in and enforce changes to the register where a problem has occurred.
Technology position	Classic technology solutions applied to the land administration domain - computerization of paper processes.	New digital services provide better experience for those using them - newer technology patterns such as APIs and mobile applications utilized.	Blockchain technologies sufficiently mature to be usable for this critical dataset. Problems of running the chain and handling off-chain data resolved.

Table 2 - Characteristics of different types of land authorities

Moving to the Smart Land Registry

As described above, a prerequisite to leveraging value from blockchain is to move to the Smart Land Registry.



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The enabling of software-driven land transactions brings significant economic benefits at both a macro-economic level in a more energized economy; and also in the land authority itself as it is freed from handling simple and rote transactions – freeing them to apply their long-honed skills to the more complex and higher value cases that cannot be automated.

However, in many jurisdictions, the extant land administration legal process, from first registration to subsequent sales transactions, and the registry data itself are not well suited to be being devolved entirely into software algorithms.

The complexity and unstructured nature of title documentation is such that human interpretation is usually required to reach an understanding (legal and/or technical) that is acceptable to all parties. Furthermore, the structure of the register is frequently enshrined in law, and change to that structure is not to be undertaken lightly. Crucially - the establishment of root of title based on a history of paper deeds is intrinsically a human task; trusted experts - not algorithms - are required.

The migration of the data from the current processes and systems to the ones envisaged within the Smart Land Registry has traditionally been a high risk and long term activity. When planning such a move the experience of the authors is that it is vital to avoid a “big bang” of data migration.

Migration from “old” to “new” data models should take place in a manner where both old and new data and processes can co-exist for a significant period of time, with transition from the old data model to the new one being triggered on a case-by-case basis - updating the data in response to the demand of a land transaction - rather than attempting some mass upgrade and migrate process that is fraught with high risk and cost while generating little actual value.

Beyond the data and technology, there are further strategic changes to the environment within which land administration sits, and it is worth considering these.

Truly enabling software-driven transactions requires the implementation of a suitable identity scheme for legal entities and citizens who may wish to register ownership in land and property, and the digital enablement of citizens to allow them to take advantage of this identity. This is a critical element of making any new land registration system participatory (a key element of a fit-for-purpose land



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administration approach, as per the FIG-World Bank Declaration on Fit-For-Purpose Land Administration).

Alongside this, the legislative situation within a jurisdiction is also something that will need careful consideration. It is not uncommon for the structure of the register and the processes that surround its change to be specified in law – a paper form with a wet signature is still a common requirement, and moves to making digital data with a digital signature legally enforceable have been seen in many places over the last few years.

Understanding the above, a key design principle of the Trimble and Ordnance Survey Land Administration Services is the ability to embrace change and enable transition has been architected in from the ground up within the technology platform; and this platform is augmented with specialist services to support the transition process: readying the environment from legal and policy framework definition to enterprise change management to enable the move the Smart Land Registry.

Moving towards using blockchain - where is the value to be had?

Having made the move to the Smart Land Registry many of challenges outlined earlier will have been addressed. If challenges remain present where utilization of blockchain is perceived as a potential answer, then an evaluation of the value it can create should be undertaken.

When looking at how blockchain can present value in this environment it is worth remembering that as a technology, blockchain's primary value is in enabling multiple parties to carry out a transaction, where it is not acceptable to those parties to have a centralized authority enact the transaction for them.

This key use-case for blockchain suggests that true value in use of blockchain technologies is in creating an environment of highly trusted land transactions. This has value in all jurisdictions, and in particular where trust in the land authority has been traditionally problematic.

Making this a reality involves a move of the land transaction from taking place behind the closed doors of the land authority to taking place on a blockchain in a visible manner, where multiple parties can confirm that the transaction took place according to the rules. Doing this creates significant value in raising trust in the land transaction process.

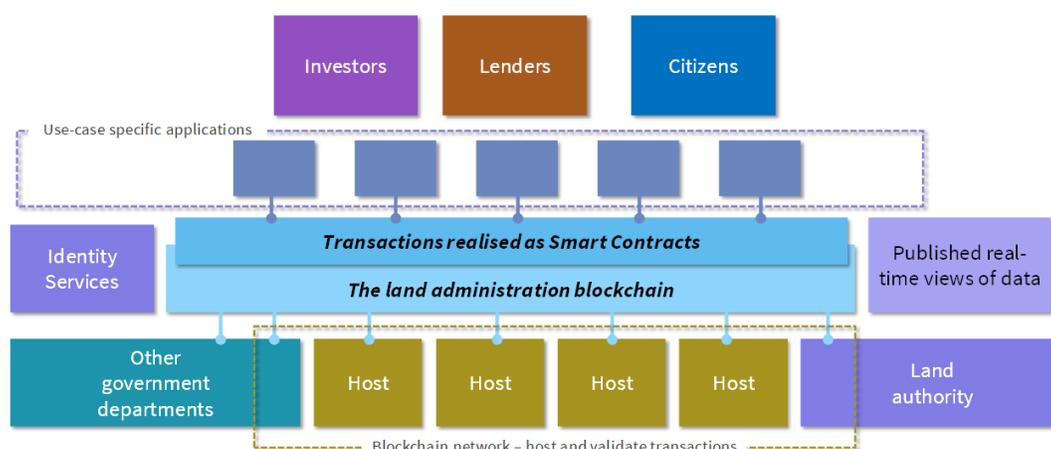


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This can be achieved by using the Smart Contract technology inherent in blockchain - the contract describing the transaction is written in software, and executed across multiple hosts of the blockchain enabling those hosts reach a consensus on the outcome. The Smart Contract can be seen as the *governance engine* of the transaction.



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Diagram 1 - outline architecture for a blockchain based land authority

However, changes beyond those involved in making the move to being a Smart Land Registry, as described above, need to be taken in order to enable the adoption of blockchain in this manner.

Identity management need to mature to be fully digital, where the legal entities that can own land and property are able to successfully use digital signatures as part of the transaction process. The legislative environment will need to enable the adoption of new models of engagement between citizens and their land authority, and recognize the legal enforceability of digital signatures and of Smart Contracts, written in software.

Actually running blockchain technology remains a challenge. “Well established” technology in this domain have life-spans measured in months rather than years. Though advancing rapidly, there are still



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many hurdles to overcome in running blockchain technologies at all, and realizing legal process successfully as smart contracts requires expertise that is rare and expensive.

Alongside this technology immaturity, the question of a public vs private blockchain needs to be answered. The position of the authors is that though the maturity of public blockchain platforms such as Ethereum is improving, at present the control and governance surrounding them is substantially inadequate to allow them to be a viable platform to trust one of a nation's most valuable and critical datasets to. The authors expect that the use of a government operated, private blockchain is the most likely way forward for a real blockchain based land authority to be established.

Further, in its essence, a blockchain enabled system for transacting land must be distributed - hosted by a network of participants. It might be expected that these participants are mandated by the jurisdiction, and would include not only the land authority itself, but other government and non-government bodies, professional authorities, banks and real-estate traders. This network could also be extended to include third-party and NGO oversight authorities (for example, the World Bank) to host the chain. This requires these parties to all agree on and adopt a standardized approach.

The role of the land authority

In this proposed structure for a blockchain based land authority, the role of the land authority itself will change, but will certainly not be obsoleted by the injection of the technology.

Depending on the relevant land law, the Land Administrator is responsible for ensuring indefeasibility of title, and sometimes, guarantee of title, and hence, takes responsibility for veracity of the current state of the register before any transaction.

The land authority is well placed to define the data models that over time will enable an increasingly efficient and effective land market within a jurisdiction. Their role will include the governance of the migration of data from legacy to newer data models, and the provision of suitable digital services that will enable the land market to function. The balance between what services are offered by the land authority and what are left to the private sector will need to be made - and will no doubt vary from jurisdiction to jurisdiction.



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Alongside this, the governance of a marketplace of applications that utilize the services offered may well fall to the land authority - ensuring that applications that are used by citizens and businesses are correctly using the digital services offered.

As the arbiter of the land market, the land authority will ultimately exercise governance over the validity of a contract that describes a land transaction. This will remain the case even if the contract is a Smart Contract written in software rather than natural language. It is likely that the Smart Contracts actually used to transact land will originate from the land authority, though how a contract will be instantiated for a particular transaction is not yet clear.

The land authority has a role to play as the technical authority on the hosting of the blockchain that will govern the land transactions - both as a host of the chain, and as part of the decision making and governance process around other hosts joining and leaving the hosting network.

Finally, as the ultimate expert witness, the land authority will clearly still have a part to play in the legal process - both in its execution in court as part of settling disputes and in the definition of future legislation that can support progress.

Smoothing the information flow

A side-effect of implementing blockchain as the technology by which land transactions take place is that the information flow across government departments can be smoothed. Though unwelcome, it is a reality that departments are protective of the data they consider they own. Thus, having in place a means by which they can all exchange and update data without having to give up that ownership of “their” data to another party is valuable in making better and more joined-up government.

Having put blockchain technology in place as the register of land and property ownership, there is opportunity to leverage this further as part of a wider government data sharing initiative.

Better liquidity and fractional and foreign investment

Making the move the Smart Land Registry opens up a number of interesting opportunities in a land market where an increase in market liquidity is desirable (it is debatable whether, and to what level, increasing liquidity in the land market is advantageous to an economy, but this is a matter for local



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jurisdictional decision making). Traditionally market liquidity is low: transactions are slow and typically at a level of granularity that is a single piece property or piece of land.

The Smart Land Registry has as one of its benefits the opportunity to improve market liquidity in terms of land transaction time: the opportunity is there to improve transaction speed by application of substantial levels of automation and this is generally regarded enabling of an economy.

Though requiring of a suitable legislative environment, there is also an opportunity to improve the position with regard to granularity in the land market. Here the adoption of blockchain presents some further interesting opportunities as the tokenization of property ownership suggests that moving to a fractional investment model becomes supportable in jurisdictions that would traditionally struggle with the concept of registering a large number (e.g. many thousands) of owners of a single piece of land or property.

Where foreign investment in land and property is desirable, then moving to a blockchain based model of transacting and recording of legal rights in property can provide higher levels of trust in the land authority from investors outside the jurisdiction who may traditionally have seen investment as carrying too much risk due to the lack of transparency in the process.

Risks and fitness for purpose

In any complex system design, the selection of each technical element must be made with a view to the efficacy, risk, cost and benefits of that element in the context of the social, economic, societal, cultural and legal context in which the system operates. This is very much the case when considering land administration modernization, so crucial to the nation's economic and societal stability and wealth.

Consider first, as in the discussion above, the challenges faced by a jurisdiction with a "classic", non-digital registry. Foremost is the regularization and codifying (digitization) of ownership records, and the transformation of required land transaction processes into software supported and enforced workflow. This is a significant task, yet it can be entirely achieved through the application of well designed, stable, ledger technology, without the use of blockchain. This society has then achieved regularization and efficiency of process supporting robust auditing and legal indefeasibility of title.



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For a country already possessing a classic digital registry, the transition to a Smart Land Registry is simpler (as data quality and consistency issues have already been addressed, and processes are already formalized); having done so, that society has achieved significant further efficiency gains, and has prepared the registry to accommodate future changes going forward, once again , without the use of blockchain.

Once significant maturation of underlying blockchain technologies, ubiquitous digital enablement of citizens, and modernization legal frameworks have made it possible, only then would a subsequent transformation to a blockchain hosted registry be considered, and would indeed be far simpler.

Should jurisdictions moving from a classic registry context consider leap-frogging directly to a blockchain based solution? The authors imply that at this time, before technology maturation and crucial standards have been established, the risks are considerable, and the benefit, if any, slight. This is the pain currently being seen in the cryptocurrency sector; in land administration, neither putative efficiency gains nor speculative windfalls justify such risk.

Summary and a roadmap to value

Within this paper the authors hope to have provided a balanced view of how a move to the Smart Land Registry can be advantageous to a jurisdiction, and how this is precursor to a step into leveraging true value from adoption of blockchain technologies.

Jumping directly to use of blockchain carries substantial risk - even given the immaturity of the technology, the ability to actually gain any value from it is severely constrained for any jurisdiction that has not already made the move to the Smart Land Registry. The authors would counsel that moving to a Smart Land Registry of well codified and modelled data together with appropriate digital services to smooth the path of land transactions is in itself highly valuable and necessary prior to considering a further move to using blockchain.

Furthermore, any such move is not merely an improvement in technology and data - the environment of legislation and digital readiness of the citizens is equally in need of transformation.



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A value-focused roadmap

Moving to the Smart Land Registry and beyond is a significant strategic decision, and one where the roadmap should focus on value unlocked for the economy and the well-being of the citizens. The authors contend that the identification of a technology platform to support the future Smart Land Registry should be done on the basis of ensuring smooth and progressive migration from current systems (paper or electronic) and the ability to respond to change in the future.

Ensuring the continued operation of the land authority is crucial - avoiding “big bang” style of change by allowing data migration to take place in response to land transactions rather than through high-risk/high-cost one-off migration releases value early and reduces risk.

Value is released as a steadily increasing proportion of data is moved to a newer, machine-readable and semantically modelled structure, with a modern technology platform able to offer automation and digital services that can be leveraged by an ecosystem of innovation building applications that can take advantage of these new services.

In parallel to this activity, a ramping up of digital enablement of citizens should take place - rolling out digital identity schemes that may start with a simple government identity in the form of a login, but are fit to be extended later to include digital signatures, PKI management, and biometric authentication.

Update to legislation is typically slow, so should start early with a focus on moving legislation away from defining the process and registry structure to allow for future innovation; and to enable digital signatures and smart contracts to be legally enforceable, and to be surrounded by an appropriate legislative environment that enables the courts to resolve matters when things go wrong.

As established above, significant benefits across the ranges of challenges in the Land Administration realm are achieved by the implementation of Smart Land Registries, with digitally secured, and machine executed representations of land rights and responsibilities. All this can be achieved today with well-engineered systems and proven technologies.

The further benefits promised by the application of Blockchain and Smart Contracts - and we note that these are limited to some improvements around establishment of trust, and to the potential to establish decentralized, cross-border tradable land asset classes for instance - are only achievable once standards



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have been agreed, and technologies have stabilized. At this point, when a jurisdiction is ready, the transformation from a semantically accurate digital store to a blockchain store is simply achieved; the hard work is already done.

Alongside all these actions which enable economic value to be realized, there is value in carrying out trials and pilots of using blockchain technologies. These aid learning and lay a foundation of expertise that will be needed for a later adoption and effective use. Private blockchain technologies are most mature with the greatest levels of enterprise grade support and support - they are the clear winner at this early stage when it comes to selecting a suitable platform. However it is well worth keeping a watching brief on the evolution of the public blockchain platforms.

Only having reached a point where the land authority and the supporting legal and policy frameworks enable the Smart Land Registry should a real production grade blockchain based implementation be considered.

There is value to be had - in economic value and citizen enablement; but actually realizing that value means putting in place the right foundations first.

END



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