



Blockchain-Based Systems in Land Registry, A Survey of Their Use and Economic Implications

Yeray Mezquita¹(✉) , Javier Parra¹ , Eugenia Perez¹ , Javier Prieto^{1,2} ,
and Juan Manuel Corchado^{1,2}

¹ BISITE Digital Innovation Hub, University of Salamanca, Salamanca, Spain
{yeraymm,javierparra,eugenia.perez,javierp,corchado}@usal.es

² AIR Institute, IoT Digital Innovation Hub, Salamanca, Spain

Abstract. In recent years it has been demonstrated that the use of the traditional property registry models involves the risk of corruption along with long waiting times. This paper points out the main problems of conventional models and makes a survey on new ones, based on blockchain technology, already being developed as proof of concepts by different countries. With the use of this technology in land registry systems, it is possible to improve the transparency of the processes as well as optimizing costs and time in the realization of these. To show the theoretic results of this study, it has been taken the Spanish land registry as a use case to compare them.

Keywords: Blockchain · Land registry · E-government · Review · Survey

1 Introduction

One of the concerns of governments today, is the optimization of the bureaucratic processes carried out in property registry systems. This optimization is understood as the improvement in the profitability of their management, the increase in the speed at which those processes are carried out and the reduction of the ambiguities that occur in the processing of data [23].

Based on the precepts of optimization and reduction of ambiguities mentioned above, e-government has established itself as a concept on which bureaucracy is beginning to develop. Through internet it is possible to provide to the different governments with features such as standardization, departmentalization, operational profitability, construction of coordination networks, collaboration with external entities and citizen services [27, 29, 31].

In today's industry, several models are being applied to allow the automation and distribution of their processes, obtaining very good results [8, 10]. In order to achieve the automation and distribution of processes in the registry field, it

is necessary for e-governments to make use of a technology that provides the system with a unique and immutable registry, the blockchain [19].

The study of the use of blockchain technology has been extended to many areas, beyond those underlying the economy of the so-called cryptocurrencies (Bitcoin, Ethereum, EOS, Tron) [30], especially for the areas that use some type of record, such as in the identification of objects in a unique way [18, 24], for the traceability of assets [21], for the audit of insured goods [9, 26] or in the creation of data markets between machines [5, 20, 32].

One of the main aspects by which the use of blockchain technology is spreading to so many different areas is the possibility of implementing smart contracts, which can be enforced by themselves in an automatic way, while being able to eliminate the human factor as an intermediary [22]. Since the code of these contracts is stored in the blockchain in an immutable way and each one of its executions is verified by the set of nodes that make up the blockchain network, it becomes feasible to automate processes that involve actors with different interests and who do not trust each other.

With all of the above, the studies developed to date in e-government have in common that they provide a sufficiently powerful tool for local governments to reinvent themselves, deepening, in this case, the e-government paradigm.

Thanks to the supportive structure that blockchain technology offers, e-governments are able to provide the citizens with the automation of processes, like the management of digital identification and the safe handling of documents [33].

It is precisely in the latter where, as a platform for various applications in e-government, blockchain technology shows great potential to authenticate different types of documents, properly stored and typically understood such as property records, birth and marriage certificates, vehicle registration, (business) licenses, educational certificates, student loans, social benefits and votes cast in any election process [25].

Specifically, the current work focuses on the advantages of applying the blockchain to the property registry process, mainly following the strategic precepts of transparency, understood as the democratization of the access to different data and the reduction of corruption through distributed storage; economic cost reduction, due to the realization and validation of a transaction without human intervention; and the technological precepts of resilience and security of the data.

This introduction is followed by the studied works that have been done around the world with blockchain-based systems on different land registries, Sect. 2. Then it is established the development of the work, where current times and costs are detailed, in Sect. 3. Finally, the discussion is shown in Sect. 4 and we proceed to the conclusion in Sect. 5.

2 Blockchain and Land Registry Around the World

Each country has its own property registry system, and this section will address property registration cases that use Blockchain technology or are in the

process of adapting this system. Blockchain technology can be applied in many legal fields [1], and although it will not be discussed in this paper, blockchain technology has also been proposed as a tool to solve legal issues with displaced persons or refugees, not only as a regulatory agency for countries but also to solve transaction costs for displaced persons or for receiving aid for refugees and cross-border collaborations.

By 2017, more than half of all households in developing countries have access to the Internet, so they can make a model based on blockchain technology viable [17]. In Africa, for example, we find the case of Ghana. In countries like this, which are less developed and where the political situation is quite unstable, it is not strange that there are cases of corruption in terms of citizens' property. In this kind of situations, where the government's own corruption rates are very high, government officials alter titles to registered properties by assigning them to others or to themselves.

In the case of developing countries, another factor that reinforces this problem is the fact that citizens do not have easy access to information. Although it is not only a question of access to information but it is also a challenge for the African country since around 90% of the land is not officially registered [12].

Ghana is one of the countries that has promoted and joined the blockchain project together with multinationals that have been working for years in the sector, along local startups that know the area and the possible disadvantages that may exist. In the case of Ghana, they working hand in hand with IBM and Bitland [2] to modernize and make the land registry immutable. They use *OpenLedger* to create a distributed public blockchain, which more companies are expected to connect to over time.

Blockchain technology is also beginning to be applied at the government level in Asia. In particular, Japan is also seeing the feasibility and implications of using this technology. The government of Japan is developing projects on uses of blockchain technology for property registration and for the management and unification of all procedures related to property [16].

The intention of using blockchain technology in Japan is to unify all data on empty or unowned properties, land and unproductive spaces, unknown owners and unidentified tenants or users before agencies. The consolidation of these data and their availability to all relevant agencies through the blockchain pursues several objectives identified at the country level, such as: encouraging land reuse, promoting sale and purchase, controlling redevelopment, optimizing tax collection and designing plans related to the environment. Although there is no more information about the trials carried out in different Japanese cities since summer of 2018, it is expected to cover all japan in 2022 [7].

Sweden is an European country that aims at the benefits of blockchain. However, to be able to carry out the implementation in the legal fields in which it wants to be applied, it must reorient its legislation to be able to implement blockchain technology in the registration of all its properties in an integrated way in the system [13], something for which there must be a legal modification.

In June 2016, the Swedish property regulator published a report under the title “The Land Registry Blockchain”. It was part of a project on the possibilities of using blockchain as a technical solution for real estate transactions. The project focuses on the contracting process because currently, and according to its legal system, it consists of two steps: a contract sale and a deed of sale (the former can be registered as a pending sale and the latter as the final sale).

The process from the signing of a contract to the registration of the deed of sale takes between three and six months. Even so, in the signing process, many documents are signed on paper and sent by ordinary mail, so digital signatures and identification will be a component of the project (which requires investment in time and money). Updates in the Land Registry must be checked by the regulatory authority and, in a long-term solution, the Land Registry will remain in charge of enforcing the law.

The aim is that, with the use of a permissioned blockchain in its proof of concept, the process of adding information is centralised while still offering a high level of transparency. In this case, the blockchain is called *permissioned* because only a limited number of actors, from the registration agency, are able to approve the blocks of data that are going to be stored in the blockchain. In addition, this blockchain is open because all Swedish citizens have access to the information stored in it. The Swedish project is an example of Blockchain as a technology adapted to registration, not as new category of property registration, but as modernisation and adaptation of new technologies towards legal efficiency.

On the other hand, Georgia is a country that have begun a project to create a private blockchain in 2016 and, since then, the National Public Registry Agency continues to act as a third party enforcer [28]. Today, titles can be issued in digital format and recorded using blockchain technology. A blockchain property registry has been proposed as a solution for those states with an institutional deficit, as it is believed that a low cost “property” certificate can be issued from a computer. But a “real right”, effective against all, needs an institutional infrastructure to protect. Without legal institutions there is no “real right” or property, but rather expectations, social norms, facts or possession. If the owner cannot go to court to claim or defend his right, its existence is doubtful.

As mentioned in the previous cases, each country finds different incentives that lead them to opt for the use of blockchain technology. This technology has different purposes but they converge in the fact of the need of a more immutable and effective property registry, and use blockchain technologies as a lever for it.

The land registry and legal entities in general, ensure maximum security in the documents, as well as possible cases of corruption. The daily market transaction sequence rule [15], in relation to the rights over individual land or title registries has been a feature of title registry systems as opposed to the original deed systems where this rule was unknown.

This new rule improves the security status of the land registry by limiting access to persons who can consult or extract information. According to this rule, the property registry cannot be entered if the person concerned is not registered

as the authorized person. The land registrar must check that the registered person has given his consent or has been part of a legal procedure.

To summarize, to make use of blockchain technology as a storage system, in which the information generated and the smart contracts containing the logic of the platform, are stored in a distributed database, allows governments to create a public transaction book that is transparent to all citizens and a proven anti-corruption mechanism.

In addition, the use of digital signatures in the communication protocol and a time-stamped fingerprint of the data, obtained with a hashing algorithm, as a mechanism for validating the information, are very powerful tools for preserving the kind of files generated in land registry systems and, the use of a network of nodes as the keeper of the information, facilitates its retrieval under any circumstances.

3 Benefits of Blockchain Technology in Land Registry

This paper focuses on the benefits and contributions that the use of blockchain technology in land registries would have if used in the case of the Spanish land registry system. One of the possibilities of how blockchain technology can be theoretically used in the Spanish land registry is to make use of an external public blockchain as a service. In those kinds of blockchains, it is not restricted access to the networks, therefore they are prone to attacks and need strong consensus algorithms to gain resilience against them.

To add new blocks of transactions, in the case of the Ethereum and Bitcoin public networks, it is being used the Proof of Work (PoW) consensus algorithm. Thorough the solve of a cryptographic problem that is more computationally expensive to solve it than to verify it, the PoW algorithm avoids the spamming of false data inside the blockchain. The main problem of PoW consensus algorithms is that they spent a great amount of energy, so alternatives like Proof of Stake (PoS) and Delegated Proof of Stake (DPoS) have arisen in other public blockchains [30]. Either way, in the case that the low latency of these networks don't allow the deployment of a platform of this scale, it could be possible to create a public blockchain with the nodes of the Spanish estate and the individuals and companies that want to take part in the process.

Another possibility is to use a permissioned blockchain network, in which the nodes that manage it are identified and have well-defined roles inside the network. Thanks to this approach it is not necessary the use of energy eager and low latency consensus algorithms, because the nodes of the network are trustful. On the other hand, the system will be more centralized, but as the case of Ghana, it can be expected that the network will grow as time passes with the addition of nodes managed from different sources.

In every technological scenario, because data protection laws, it must be taken into account that the private data of a person cannot be stored publicly, restricting its access to only the ones that have permission to. Therefore, the Spanish estate have to continue manage and store that information in its private servers.

For our study, we have selected 3 variables that have a direct and immediate effect in the case that the blockchain technology is applied to the Spanish land registry. The current situation is then compared with what is expected.

3.1 Time

This point details the time needed to be able to carry out a query or make a record. We have based ourselves on the minimum formal times excluding any anomaly that might occur. At present there are some special dispatch periods such as for the legalisation of the minutes books of Communities of Owners, set at five working days if there is no incidence, or for the issue of certificates, set at four working days per property, in the same circumstance of lack of incidence.

In addition to the 15 working days for the formalisation of the said register, the time for consultation or request may vary and may also be extended in the event that it is or is not accepted or modifications have to be made. In the case that blockchain technology is used, the registration or consultation is immediate. In a matter of seconds the transactions can be carried out.

3.2 Economic Resources

In this point we detail only the part of economic resources at the level of fees or direct cost of register a property. It is taken into account the costs derived from waiting times, travel, or other indirect costs that occur with legal processes in Spain today.

Currently, in any case, the price of registration will never be less than 24.04 euros or more than 2,181.67 euros. The cost per transaction is in the order of cents, as it does not require either labour or printed certificates.

3.3 Inconsistencies and Corruption

This point details some inconsistencies that may emerge in the registration process due to the human factor, in addition to corruption and possible advantageous movements of properties associated with changes of government. With blockchain, any change or alteration is recorded so that you can always check and see if any discordance has occurred.

Another inconsistency that may exist is the differences between the property registry and the cadastre. There have been many political cases of corruption that appear every year with the property registry [3, 4, 6, 11].

4 Discussion

The evolution of society and new technologies makes it clear that there is a need for government systems that, although they have different characteristics, all see the light under the paradigm of incorporating new forms of governance, e-government.

One of the supports of the new paradigm is the blockchain technology, where the fight against corruption and cost reduction are conformed as guarantees of this technology, but it is precisely in its conjunction with the different governments where both fields have to be properly adapted.

In the first place, in the development of blockchain technology linked to the property registry, it is important to know about the existence of a certain flexibility that requires precisely a solid governance. These types of governments also need to be able to adapt to changes in functions such as data management and the responsibility of governments themselves.

Secondly, it is important to note that more research is needed to create trust, disintermediation, organizational transformation and governance models under new e-government designs.

Thirdly, it should be borne in mind that the incorporation and adaptation to this type of technology, which is still under development, requires periodic audits so that the evolving technology and the forms of government that in turn adapt to it are aligned, mitigating possible undesirable consequences for society.

Finally, and in addition to the above, it is worth noting the evolution towards distribution and decentralization that computer systems are following over the years. In this evolution three well differentiated stages can be observed.

The first and traditional stage of these systems consists of the use of a centralized data system in which a single owner is in charge of adding, modifying and deleting the data generated within a platform. The rest of the users are exposed to the decisions that this owner has with his data. These systems include the vast majority of current applications, such as Google Drive or Facebook.

The next, and logical, evolutionary step for computer systems is when user data is not exposed to the discretion of an owner. It occurs when blockchain technology is used in a computer system to maintain records in which users need to have confidence that they have not been manipulated after their creation. However, their governance, which depends on the proper functioning of the smart contracts that underlie the functionality of these systems, is generally in the hands of a single organization. Examples of these systems are in the area of decentralized applications created in Ethereum or Tron.

This step is also taken by governments that want to make use of blockchain technology for the implementation of automated land registration. This is because, although the data generated is controlled in a decentralized and distributed way within a network of independent nodes controlled by different entities, the way to govern such an application, and therefore how users can interact with it, is decided by a single organization.

The last stage identified is where the governance of a system is given by the users themselves. They can interact with each other directly without the need for intermediaries. Besides, the control of the data generated in the platform is decentralized and distributed in the same way as in the previous step. These systems are achieved through the use of smart contracts that allow users to be part of the government when some condition is met and how this government can change the way applications work. But in order for such a system to be adopted by a state, it is necessary that this kind of technological advances are taken into account by the legislation of the countries.

For these reasons the European Directive on Information Society and Electronic Commerce [14] has established in its article 34 that every member state of the European Union must adjust its legislation on contracts that are executed by electronic means. This should enable corporate governance through this type of system and the use of intelligent contracts.

5 Conclusions

Although the concern of the different governors has always been to comply with the appropriate criteria of efficiency, these criteria are helped by the monitoring and compliance with certain protocols linked, some of them, to the rise of new technologies.

The so-called e-government paradigm includes different protocols that go deeper into the idea of approaching services and bringing them closer to citizens, and blockchain technology is part of this. It is at this point that this work highlights the importance of this technology in the proper development of certain public policies. Specifically, this study focuses on the process of property registration.

Aware that there are already different countries that apply blockchain technology to the tracking of property-related records, we have observed that it has been possible for property registration organizations to reduce their intermediary role and to focus on the development, maintenance and governance of the application of blockchain technology to the platforms and applications that serve citizens.

Understanding the previous results as positive for public governance, the involvement in the progress towards transparency, among other characteristics that support good governments, is more than clear and determined if they start applying the most disruptive technologies.

Acknowledgements. The research of Yeray Mezquita is supported by the pre-doctoral fellowship from the University of Salamanca and Banco Santander. Also, this work has been partially supported by the Interreg Spain-Portugal V-A Program (PocTep) under grant 0677_DISRUPTIVE_2_E (Intensifying the activity of Digital Innovation Hubs within the PocTep region to boost the development of disruptive and last generation ICTs through cross-border cooperation).

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