

Blockchain and the Land Register – a new “trust machine”?

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Introduction

Blockchain is said to be a “Trust machine”. The technology is predicted to be an invention as important as the personal computer and the Internet.¹ The interest is high and followers and believers come with it. Even in the quite traditional and sometimes conservative sector of Land Administration the blockchain technology has become an object for both curiosity and innovative start-ups.

Sweden has a very secure and reliable system for Land Administration. The trust and confidence is strong. The citizens, banks and other stakeholders have confidence in the system and the state guaranteed information about real properties, its owners and rights and about geography; and rightly so since it rests on undisturbed development for hundreds of years.

A stable land registry, Cadaster and Land Formation has not meant that everything has remained the same over the years. Over the long period of time of public held mapping and land registration several big steps of development and invention of new technology has been taken. The digitized real property register was invented in the 1970s. Mortgages and its certificates (in paper form) was digitized in the 1990s. The latest years has meant rapid and extensive development of a number of IT-systems and the land registration process is close to a complete digitized workflow with automated decisions published in the real property register in real time.

Many of the digitized businesses have evolved from an operation based on handling information in paper form. Today the use of paper is reduced or even extinguished in parts of the process but we still need to change our way of thinking and try not to handle “documents” in the digital world. This and the fact that it is hard to find adequate solutions to secure transactions in the digital world makes it still a need for papers. For example, real estate purchase contracts, IOUs (I owe you), bill of sales, and many signatures are still made on paper. However, the technical development rushes fast forward and the possibilities to manage information are many.

One of the new technologies that earns a lot of interest is the blockchain technology. Today it is mostly known for hosting the digital currency “Bitcoin”. After some years of practical use several other use areas within the financial services sector has been explored. Apart from financial services other areas are thought to provide great benefits from the blockchain technology; land registries being one of the most talked about.

Lantmäteriet, the Swedish mapping, Cadaster and Land Registration Authority is involved in a project together with some partners in order to explore and investigate if the blockchain may be an alternative to support the process of a real property transactions; sale and

¹ <https://dealbook.nytimes.com/2014/01/21/why-bitcoin-matters/>

purchase, finance and mortgage, apply and register title/ownership; instead of having the traditional technical database and web application solutions. The work is acted out on the assumption that the digitized business of land registration actually sees the IT as a part of the business and not just a tool used in the process of handling cases. With that perspective the project and the discussions from it can illustrate possibilities, issues to elaborate, problems or even show stoppers.

Take a moment to think of this description of a future state of trust and service delivery.

” Imagine the next generation of real property owners; being the generation of gaming, social media and masters of how to manage information; caring for property boundaries together with other property owners according to their wishes and demands. Imagine them making transactions like purchases, gifts and sharing. Think about how they may give out rights to use, set up businesses and finance housing. All actions are taken in the best possible way and according to a natural digital process with regard to integrity. Transactions will be acted out without any involvement from the public businesses and officials beside the given guarantee of secured quality in the public held information distributed in an open and always available manner whenever it is needed and with no risk of fraud, manipulation or corruption of the transactions and the data.”

Some would say that we may be close to the situation but in most parts of the world it may be a far stretched and probably unreachable vision. It is easy to agree on that Land Information Systems are important for any kind of legal and economic system. Many developing countries have gotten promises from donors and aid that implementation of IT-system this and that may solve everything but most of them may witness of not so successful implementations.

Suppose something like the Blockchain actually would give you the promised solution and give a kick-start to something close to the described state? That would mean a lot to parts of our world. It would give an opportunity to move from distrust to confidence.

Well-established democracies and economies must be a model for countries in development and stand out as good examples and share best practices. If we don't move ahead and stay on the frontline regarding technical development, we won't be able to help any more.

Therefore, the knowledge and experiences based on blockchain activities gives all good conditions to move forward in a much greater speed in order to reach much higher levels of trust, security and transparency in Land administration in both working systems and in those that does not work as well. This is reason for Swedish state agency Lantmäteriet to innovate and be in the frontline to explore the opportunities with blockchain.

Two aspects of the new technology are important to highlight in order to understand why it is so interesting.

1. Digital units impossible to copy

If we look at a central bank that is about to issue money in the form cash, i.e. physical bills, to the market we can think of their concerns. It is quite obvious that one concern is of outmost importance; the bills must be very difficult to copy. If everyone could take a home printer and make thousands of copies of their bills they will soon be worthless.

The same would be true for digital cash. If a central bank would like to issue money in the

form of cash that would be digital it is still crucial that it cannot be copied. However, such a solution in the digital world hasn't existed. We didn't know a technology that can make digital units impossible to copy. Until Bitcoin was launched. A lot of central banks, and commercial banks, have during the past year communicated that they are looking at the opportunity to issue digital cash on the blockchain. None of them has done so with the blockchain yet, but none has even said they are looking at doing it with another technology. The blockchain is the only known solution this growing group of central banks and commercial banks is looking into as far as we know. Perhaps the main reason for this is the possibility to create transferrable digital units, which are more or less impossible to copy. If you want to create a digital entity of a mortgage deed, a land title, or an IOU (I owe you), and be sure that there are no copies of this IOU, and that any notifications on this digital property is kept with it, the blockchain is the only known solution.

2. Digital files that can't be manipulated

While digitization has come far in many respects there is another challenge, except for being impossible to copy, that traditional IT has not solved yet. It is very difficult to know if a digital file, photo, contract etc. has been manipulated. As an example the Swedish law states that any changes in the bookkeeping of a company has to be registered with a notification of who made the change, why was it made, and when was it made. The problem with this law is that it is impossible to audit. A savvy IT-person can make the changes in the registry of the bookkeeping anyhow. There is no practical way for a manager or the organization, an accountant or the tax authority to know who made these changes and when they were made, or to notice at all that any change has been made.² Even with signatures, a signed copy may exist in different versions, with confusions as to which one is authoritative.

With the blockchain it is now possible to make sure that a digital file, register, patent, video etc. is still the same as it was when it was first registered in the blockchain. Similarly, with digital signatures on these contracts we don't want them to exist in conflicting versions. The blockchain is the only known technology that can do this. If we want to make digital files representing purchasing contracts of real estate we are very keen on knowing that these are not easily manipulated. The blockchain is the most trustworthy solution for this as far as we know.

Solutions

Interest from the financial services sector primarily comes from the first of the two described aspects of the blockchain i.e. the possibility to put digital assets on a blockchain and being able to transfer them without the risk of fraudulent copies. Some of the interest for Land Registries are built on this idea as well. The idea is to make a transferrable land title deed, with little or no control of the transactions for a central authority. However, there is a major difference between land and financial assets, land cannot leave the country. In some countries the land title deed is a physical document that has an important role. Making the use of the blockchain could therefore make digital units representing land title

² Modern technologies have made it possible to monitor all updates, for example in a cloud solution, so a person who wants to manipulate the data have to be able to manipulate the external environment as well, which makes it more complicated but possible.

deeds that can be traded. However, this solution also puts risk for the possible loss or theft of the title deeds. If you lose your private keys or if they are stolen they cannot be retrieved. The protection from a corrupt or unfair public authority can also be questionable. As land rests in the country the government or similar public authority can always confiscate it. The Swedish project working on a pilot with blockchain to support the process of a real property transaction focus on providing a proof of ownership that is impossible to challenge. This is made by registering the contracts and the digital signatures in the blockchain. The blockchain stores the verifications of the contracts, rather than the details. Since the blockchain is transparent to the public, proof of the ownership and transactions cannot be challenged. On the other hand, if someone has taken a property through fraud or if the property is confiscated the right owner can publicly show this and the property returned to that person.

We still believe in the value of a public authority making the judgment of which the right owner is – we just make any judgment easily auditable for outsiders.

The value of the solution

The transparency and security provided by this solution may be very valuable to society. Bank of England has for example claimed that the creation of a blockchain based currency, “a Bitcoin”, could permanently increase British GDP by as much as 3% of GDP.³ Several Central banks, including the Swedish central bank is looking into the opportunity with a blockchain-based currency backed by the central bank.

While the value of migrating from the current platform for real estate transactions and mortgage deeds in Sweden primarily is easier to overview and understand we believe the value to countries with less trusted land registries may be gigantic and also provide trust to the society. Looking at the world as a whole the value of creating a transparent and easy to prove real estate ownership and transaction system is beyond imagination if you consider the importance for social and economic prosperity.

The size of the global lending against real estate as collateral i.e. mortgages is overwhelming. In the US alone mortgages are valued at more than 14 000 billion⁴. If the lenders of this money can be more secure that the ownership of the real estate is true and easy to prove the risk gets lower and interests can be lower. Lowering interest rates by 0.1% per year on the debt would mean 14 billion dollars per year in value.

A report by the World Bank has made clear that the values traded on the mortgage market are much higher in developed countries. “Mortgage markets seem to develop only at relatively high levels of gross domestic product per capita.”⁵.

Having a trustworthy record and possibility to secure land ownership may be a necessary condition for becoming a country with high GDP per capita. A financial market may be difficult to develop without mortgages, and a mortgage market will be difficult to develop without trustworthy and enforceable real estate ownership.

³ <https://www.finextra.com/finextra-downloads/newsdocs/swp605.pdf>

⁴ <https://www.federalreserve.gov/econresdata/releases/mortoutstand/current.htm>

⁵ <http://documents.worldbank.org/curated/en/697351468165251669/pdf/WPS6756.pdf>

Uncertainty of land ownership is also a major hindrance for agriculture to develop in many countries. Farmers don't dare to invest in the land, and may actually deplete land since the harvest may get lost to an unknown landowner. A trusted land registry is fundamental for increased food production and reduced deforestation in many countries. High GDP per capita is therefore only possible with a trusted land registry.

Seminal works by people like Robert Putnam⁶ And Douglas North⁷ have proven the importance of interpersonal trust and informal institutions for the prosperity in a society. North pointed to the lower monitoring and transaction costs in economies with strong institutions. Interestingly, the blockchain was described by The Economist as the Trust machine. We believe this metaphor is very accurate. Since trust lowers monitoring and transaction costs countries with less developed institutions can get a more positive development using the blockchain. A solution with land registration in the blockchain similar to the one elaborated in Sweden may provide a value similar to informal institutions and create positive dynamics within an economy.

It is possible that a country with a global average GDP per capita can increase their GDP by more than one percent per year permanently, but, more importantly, it may be an increasing growth rate for at least ten years. The cumulative effect of increasing GDP from 4% to 5% per year will after ten years translate to a 63% increase in GDP compared to a 48% increase.

Implementing a solution similar to the one described might be the fastest, easiest, and most cost efficient way to make a medium GDP per capita country into a high GDP per capita country.

[Are there any questions or challenges with blockchain solutions?](#)

The result so far is that we see no major obstacles to a solution similar to the Swedish example. The only major concern in Sweden is the legal uncertainty of when digital signatures on a digital real estate contract become valid. The process of accepting digital signatures is ongoing within the EU, in Sweden and in many forums, but it may delay the implementation and full potential of the solution if it takes time and if the digital contracts do not get accepted.

From a technology perspective there will be problems, but considering large technological implementations in general we think this will be easier than many other national IT-projects. And considering the value for the world, we think it's hard to identify better investments in the future for society, people and planet.

Other issues to consider are for example the radical change of concept, role, storage and distribution of data. The blockchain changes the game plan regarding information systems and the way we are used to see how we handle, manage and take responsibility over

⁶ Putnam, Robert D (with Robert Leonardi and Raffaella Y. Nanetti) (1993). *Making Democracy Work: Civic Traditions in Modern Italy*, 1993, Princeton University Press.

⁷ North, Douglass (1992). *Transaction costs, institutions, and economic performance*. San Francisco, CA: ICS Press

information. In the following a couple of issues regarding challenges will be discussed.

The first question is if it is possible to build a new trust machine to replace one we feel so confident with? The Land Registration stands for a critical infrastructure for society, real property and finance market and to replace such is not like buying a new car.

The other question is if the principles and the technology behind the blockchain are applicable to the legal framework, or vice versa, and the area of Land Administration. Is it even a way to improve and develop security, quality and efficiency to Land Administration if blockchain technology is used? In the legal aspect also lies the interest to see whether the principles for integrity, personal data processing, public information, open data etc. can be handled in new and improved ways.

There will not be presented any solutions or answers to these questions because it is still too early to tell; there is not yet enough experience and knowledge on the field; but the presentation may still give the reader a better understanding of challenges and opportunities.

Possible to build a new trust machine to replace the old one

Even if Sweden was late to start to read and write compared with other many other countries and cultures in the world; good working public administration was soon elaborated with the written word as a base. Also mapping was an important pillar developed in order to support taxation and the building of an early smart public infrastructure. These public administration systems have thereafter been developed under rather stable conditions with few wars and conflicts and continuous democratic development.

In the land administration sector Land Registration of ownership and rights was within the courts administration from the late 16th century. Mapping of Sweden started out early in the 17th century. When computing technology became available the Swedish Land and Real Property Register was implemented in a mainframe platform in the 1970iesromt moment [22]. From that moment a period of collecting and transferring data from real property books to the so-called ADB-system⁸ went on. Almost all of the data was already collected and registered in the books but some data that was missing was completed during the registration in databases. It took about 30 years to complete the work even if the data was fairly good from the start. The reform then went in to the computerization with further steps.

It is easy to see that a well-trusted paper based system was replaced by a modern technical system, which in turn continued to maintain and improve trust in the land administration system. So regarding the given question the answer would be “yes”; it is possible to change a system of trust to a new system of trust. The ADB systems were a rather progressive development from paper and pen at that time.

Was it different back then? Did the citizens understand? How could that happen with no disbeliefs? Probably citizens did not notice any threats. It was probably pretty unknown

⁸ ADB was a Swedish abbreviation for electronic data processing

territory and quite hard to know what it was. Also all progress was made without any major disturbances.

Is it possible to implement blockchain solution according to given legislative framework?

In the Swedish example it was soon noticed that in order to support all parts of a digital real property transaction process there might be some problems regarding the interpretation of the Swedish law. The blockchain in itself is just a type of technical solution, which often is independent of the regulations. What may be a problem in many legislative systems is that they may be formed on the condition of paper as bearer of information and that signing documents and the contract in itself are understood as signatures on paper with pen. This is the situation in Sweden where the Land Code gives that a transfer of ownership of real property must be done by a hand signed contract. According to the given legal interpretation of the wording "in writing" it is to be understood as a signed paper. Now this may be changed if a new interpretation is made in the context of modern digitization but as far as it is right now it is not possible to deal with digital contracts for the purpose of real property transfers. Therefore, some sort of change in the legal framework must be in order to have a complete process supported by the blockchain; where the use of digital identification in some form is an important part of the solution.

The background for such legislative regulations like the Swedish one is that one must be certain of that it is a valid contract. It is completely about security and verification. Therefore it is; as far as we know now; interesting to reflect over the fact that the security of the blockchain should make it more attractive than ever to allow for digital contracts and signatures since manipulation of the signatures and the contracts becomes much harder than with traditional IT.

There are also still some regulations concerning the banks documentation in a transaction involving financing by loans. In order to verify the customer's loan and mortgage the customer need to sign contracts, an IOU, regarding that. For the bank to be fully safe in reclaiming the debt and the real estate as collateral these IOUs are still not possible to have in digital form since the document has to be unique. So the same reasoning regarding using the blockchain technology could be used here. We now have a solution to make the IOUs digital and still be unique and impossible to copy.

Now these circumstances are not really a legal showstopper for the use of blockchain. But the use of smart contracts⁹ (the application) needs the digital signatures and the blockchain and therefore the lack of legal ground makes it hard to get the best effect from an implementation. It would be possible to use the blockchain solution for parts of the process and continue with other parts later when the legislation comes to a change. The mortgage registration done by the Land Registry in Sweden is such an example where it is already stated that all the process and signatures may be handled completely digital and then the use of the blockchain would just be a change of technology¹⁰.

⁹ Smart contract is an often used name of the application layer in a blockchain solution. However the notion of "smart" is often misinterpreted and exaggerated.

¹⁰ Today Mortgage registration is done in a "mortgage deed system" built in the early 1990ies in a mainframe environment. The Law about a Mortgage Deed Register from 1994

Another concern regarding the legal aspects of using blockchain are integrity, treatment of personal information and responsibility for information. A blockchain is stronger and more secure with a larger number of peers or nodes participating in the chain. That makes it necessary to have some sort of access for many and transparency. The idea with blockchain is to distribute and allow access to information for many. That may collide with legal demands regarding some of the purposes stated for registers like the real property register in Sweden. However, it is important to know that the information in the blockchain database is verifications of transactions and it must not be the exact information. It is a choice for the organizations and the users of the solution what information should be public and in what cases only the verifications are public. This makes it possible to publish less information and not the most personal if it is not needed. The new thing with the blockchain is that deleting information is not possible. Therefore, again, the lawmaker should be positive to see this as the replacement for the paper and pen solutions.

When many actors distribute and share information in a community or a so-called Eco-system of information systems; like the blockchain may be; it may be of importance to know exactly what information comes from whom in order to trace liability. The Swedish Lantmäteriet is today responsible and liable for the correctness of information in the Real Property register and other registers. In order to give the citizen and property owners reason to trust the system such liability must be transparent in a blockchain too. This may be a challenge because it might be difficult to have information stamped as “owned” by someone. One may see example of this today when different Internet sites use information from different sources without telling where the information comes from and if there are some guarantee regarding it. This is an issue to work with. Some thoughts have come up if it will be possible to add some sort of mark on information in the Swedish property transaction blockchain.

Blockchain Use Cases for Land Administration

The Blockchain technology seem to promise a lot and the contribution to give trust to IT and digital solutions may be greater than any other such technology so far. From the writers view it is a challenge to the old be-trusted technology of keeping registers and information in databases protected from corruption legally, physically and by technology. To a developing nation in transition who may not have the traditional technology and system solutions in place it might be a challenge to choose the right technology to start with. In times like these there are a lot of initiatives from donors’ organizations in all the developed regions of the world ready to support and help out to working infrastructure and state administration systems. A working land administration comes high at the priority list and to set up Land Information Systems is an early and crucial need to attend.

If a nation like that is in the early or middle stage of that development today the obvious choice for any donor would be to recommend the traditional solution you have the best experience from. But if you see another probable solution that has a lower cost of

was one of the earliest legislations regarding digitizing a former paper and manual process of mortgaging.

implementation and higher transparency and trust, it may be relevant to look for new but promising technology like the blockchain. It could be similar to a country using mobile payments before they have bank accounts. There are not many examples to refer to but here two interesting parallel and linked use cases can illustrate a possible short cut to a new era of trust regarding technology.

The case from Sweden this paper rests on is a development of a blockchain to support the complete process of the selling and purchasing of a real property with financing from a bank, e-ID, mortgaging and land registration. It's set up first as a test bed to increase knowledge and experience in order to take on the next step of development of production system. This work is done with a quite long perspective where each step is taken with careful analyzes and parallel legal development and lobbying. A lot of issues must be considered due to the fact that the awareness and experience of existing technology is broad and reach even laymen at all levels. Earlier lawyers and other academics were not involved at all when it came to choose IT-system. Now everyone knows and trusts central database solutions and when a "new" technology comes up many tend to be skeptic. Remember the reactions to Internet when that became everyone's interest. The pilot blockchain is based on the principle to move slowly and keep the level of trust with a hybrid blockchain based on nodes kept by trusted peers like government agencies and banks maybe. Later on a more distributed public blockchain may be considered. Also the blockchain is developed as a dedicated blockchain that may stand for itself as well as being connected to an echo-system of blockchains. The system management and financing will be a challenge as well as the legal framework regarding liability for the information of different kinds and status.

In another country, Georgia, the development of state and land administration has been going on for about 10 years. One could say that Georgia is in the middle of the development. One has come quite far in many aspects. For an instance Georgia has been in top of the World Bank Ranking in Doing Business the last years. Georgia has been supported by different initiatives and by different donors over the years. One donor organization that has been around since over 10 years is the Swedish Mapping, Cadaster and Land Registration Authority Lantmäteriet finances by Sweden aid program through Sida, The Swedish International Development Cooperation Agency. Based on its long and vast experiences of working land administration advice and support has led to many both innovative and reliable solutions. The long-term support has also meant a lot to the contribution of trust for the system, which is shown in the increasing number of property transactions and the use of the services at NAPR, the National Agency for Public Registry.

The need for rapid development is crucial to fight corruption, poverty and to become a stable democracy and economy, where equality and environment is possible to have as priority issues. The Georgian Land and Property Administration has always been fast to take on ideas and make quick progress. The opportunity to use blockchain technology came up and soon a pilot project was started. The idea is to use the Bitcoin blockchain to keep the "Abstracts" which is the main information about the legal owner of a property. This work started in 2016 and was stopped during autumn due to priority circumstances. Now it is picked up again and it will be exciting to see if this will be of interest for the Georgian Administration to base this important part of the process on blockchain technology. There are some interesting ideas. One is that the customer may choose whether to have the

ownership information and such on the blockchain or not. The later choice would then lead to have the information kept in an alternative like a traditional database system. Also the choice could be combined with a fee that would mean a certain small fee for each transaction of information from the blockchain, which in turn could finance the using of the Bitcoin chain. With this, one would both get the financials and the system management out of one's hands. Also here the issue of liability for disturbances and the guarantee will be of great concern for the administration. Also the legal issue regarding if a state agency can use a private solution like Bitcoin without regard to competition and other aspects.

In Sweden we may learn from the ideas from Georgia and open up for the registration in the blockchain, without making it mandatory for everyone at once. We may also, for example, allow real estate owners to block their real estate, and mortgage deeds from being transacted outside of the blockchain and further increase security for them. It is clear that we all benefit from learning from the experience from each other and hope that the project at Lantmäteriet will support others in finding attractive technical solutions for the land registry in many countries. This may prove to be a very valuable investment for many people around the world.

[An overview of the technical solution](#)

Below is an overview of the technical solution used in the project. The concept of the blockchain is somewhat difficult to explain and it is under constant development. The report from the first phase of the project, which also describes the blockchain is found here.

<http://www.kairosfuture.com/publications/reports/the-land-registry-in-the-blockchain/>

One of the most comprehensive reports on the blockchain is this one

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/492972/gs-16-1-distributed-ledger-technology.pdf

