

## Influence of Blockchain Technology & Applications

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## Abstract

**Blockchain could have a huge impact on the value chain in our society. Examples are efficiency, transparency, ownership, value (transfer), automation and service provision. When we want to understand the world of blockchain, we need to understand the innovation of the currency Bitcoin in 2009 that is built on underlying technology called Blockchain. Bitcoin is a combination of four individual elements: (1) cryptography, (2) a peer-to-peer network, (3) an open source protocol and (4) a shared ledger. This makes it a phenomenon that people are enthusiastic about. The internet already makes it possible to transfer information quickly, cheaply without paper and without intermediaries being involved. Blockchain gives the same benefits for transferring values. Internet is used to transfer word and image, blockchain for transactions. Blockchain is a combination of two elements: a shared and distributed ledger with synchronized data spread over multiple sites, countries and / or institutions and a cryptography: digital token with a monetary value.**

**Keywords:** Blockchain, real estate, energy, applications, housing associations

## Introduction

The internet already makes it possible to transfer information quickly, cheaply without paper and without intermediaries being involved. Blockchain gives the same benefits for transferring values. Internet is used to transfer word and image, blockchain for transactions. Blockchain is a combination

of two elements: a shared and distributed ledger with synchronized data spread over multiple sites, countries and / or institutions and a cryptography: digital token with a monetary value. This article is a summary of conclusions from the book *Blockchain Technology and Applications* (Veuger et al. 2019) and provides an overview of the latest developments on blockchain technology and its applications with the following themes and with the assistance of experts from Austria, Brazil, China, Croatia, Georgia, Germany, Italy, Netherlands, Slovenia, Spain and Switzerland: (1) Blockchain and the Agenda 2030 by Danielle Mendes Thame Denny, (2) Application of Blockchain Technology in the Field of E-Government Services by Jiarui Zhang, (3) Can the Cybersecurity of Smart Building be Improved Using Blockchain Technology? by Ben van Lier, (4) Influence of Blockchain Applications and Digitalization on real estate by Jan Veuger, (5) Blockchain: Technology Looking For a Problem in Real Estate? by Jo Bronckers and Jan Veuger et al., (6) Start up 'Get a Brick' in Real Estate by Wendel Hulsebos and Jan Veuger, (7) Blockchain: An Efficiency Solution For Housing Associations? by Michel Vonk, (8) Blockchain Applications in Support of the Energy Transition by Mieke Oostra and Jelle Rijpma, and (9) Many Keys of Blockchain for Real Estate by Esther Dekker.

## 1. Blockchain and the Agenda 2030

The effectiveness of global governance tools to implement the Sustainable Development Goals of Agenda 2030 depends on transparency, accurate monitoring, audits and data comparison, given the soft law nature of Agenda 2030 and the need for multi-stakeholder coordination. In this sense, the use of the blockchain has much to contribute to coordinate antagonistic interests in the search for common, quantifiable, and verifiable goals.

Technological advances are often overestimated and in practice, blockchain is still a concept often poorly understood. In addition, its application is still restricted, incipient and there are problems related to the scalability, privacy, and confidentiality that tend to diminish with technical advance. In addition, empirical, systematic, and critical analyzes are needed to delineate the strengths and weaknesses to indicate a recommendable network architecture and consequently the necessary governance. These risks and uncertainties, including the lack of specific regulation or possible legal effects resulting from the poor application of the tool, make the implementation fragmented, disputed, and complex.

However, the greater transparency provided by the use of this technology would be a fundamental advantage for the implementation of the ODSs and therefore this research risks recommending that it should be adopted, mainly replacing the infrastructure currently used in the UN and mentioned at the beginning of this work. It would allow the various government agencies in different countries to track, for example, all subsidies, financing, payments for environmental services, humanitarian transfers and any criteria adopted by sustainability standards. This would prevent outside manipulation and fraud. Enabling comprehensive public audits would also tend to lead to greater accountability and reduction of fraud and deviations related to documents and payments.

In addition, speed, efficiency gains, automation of government operations, reduction of human failures, as well as cost reductions in data reconciliation and document storage would be quite significant. They would not only be limited to data processing and settlement, but could also address the exchange of other tangible and intangible assets.

Thus, the use of DLT and blockchain can be one of the strategies to keep track of indicators that need to be publicly released by agents and verifiable by multi-stakeholders. It can be a vehicle for transforming the relationship between the citizen and the states, giving the individual control over his data, and creating a direct acting ability such as validating, participating, or even creating some

community public services in a local distributed model, but within a structure. In order to serve as a tool to coordinate antagonistic interests in the pursuit of common, quantifiable, and verifiable goals and thus contribute to the monitoring that is fundamental to the effectiveness of global governance articulated around the Sustainable Development Objectives of Agenda 2030

Existing initiatives to monitor sustainability standards and track compliance with ODSs would have much to gain if they were integrated into a blockchain infrastructure. The data would be fed directly by a plethora of public sector institutions from various member states: state and federal municipal government bodies, regulatory agencies, nongovernmental organizations, private entities, and so on. In addition, the processes of reconciling this data would be improved, allowing for operational efficiency, automation, faster, and cheaper data processing.

This would increase the resilience of the network that despite being distributed worldwide would be accessible and guaranteed from any location, preventing fraud, and making public auditing available anywhere. Thus, greater transparency and traceability would allow better verification of the conformity of a country's practical actions to reach the ODSs and facilitate the supervision of the UN and the comparison of the performance of the various member countries.

In addition, this technology would make it possible to use by the individuals themselves who are the final beneficiaries of public policies, thus allowing the opportunity to develop better relations between the state and the citizen and the provision of more personalized and effective government services. Although this technology is still immature, there are issues of confidentiality, security concerns, scaling obstacles, still high costs, and an unclear regulatory environment to deal with potential data protection issues, it is revolutionary to facilitate international governance.

DLT application is still restricted, incipient and there are problems related to the scalability, privacy, and confidentiality. However, there is a possibility that this technology bring gains if implemented to structure the mechanisms of report, measurements and verification of ODS. The nowadays UN platform DevInfo, implemented world widely could be programed in DLT, not necessarily in blockchain. The outset is that this technology has much to offer to increase the forms of effective international governance, therefore this research recommends that further studies about implemented, especially in terms of the administration of compliance with ODSs and compliance with the criteria set forth in private standards.

## 2. Application of Blockchain Technology in the Field of E-government Services

E-government services data requires to be authority, seriousness and credibility. It is a rigid demand to ensure the authenticity and anti-tampering of business data. Therefore, this chapter proposes a technical method of E-government services blockchain (EGSB).

EGSB is well adapted to the needs of E-government services business, including diversification of transaction types, diversification of user types, diversification of storage patterns and diversification of storage content. The speed of block generation is determined by the processing speed of the system. The mechanism of transaction verification and consensus has been innovated. Stop the forking of the chain. The transaction node stores only the event blocks associated with it. The virtual currency is eliminated. It greatly improved the efficiency of block generation, and improved the anti-tampering of blockchain with the technology of "meta-block". Through EGSB, Data Determine Ownership, Data Traceability and Data Proof service can be provided. In addition, it can also provide services such as Data Walk Trajectory Tracking, Data Freshness Measurement, and Data Conflict

Discovery etc. In the future, the transaction data sharing of heterogeneous blockchains will be a focus of research.

### 3. Can the Cybersecurity of Smart Building be Improved using Blockchain Technology?

A smart building is a physical whole that functions based on interconnected and separately monitoring networked components. As a physical element in its environment, the building is, in its functioning, increasingly dependent on IT-based and networked intercommunicating and interacting systems that are driving the evolution from smart building to cyber-physical system. Increasing integration and interdependency of the physical world and the cyber-environment is also leading to new and as yet unknown risks of intrusion in this new whole of a cyber-physical system by malicious elements from the smart building's environment. Malicious elements will try to interfere with and disrupt the functioning of components or the whole of the smart building as a cyber-physical system. As described here, blockchain technology works on the basis of reliable intercommunication and interaction between distributed operating systems in the smart building. Intercommunication and interaction between these systems makes it possible to have these systems jointly make consensus-based decisions on changes to the functioning of separate components or changes to the whole of a smart building. The data and/or information needed for the decision-making is stored by each participant separately, making it impossible to make changes to this data as a whole. Distributed decision-making by separate systems can not only be used to boost joint systems' self-organization capabilities, but also to improve the security of the functioning of the smart building. The capacity to jointly make decisions about changes to separate components or the whole of a smart building as a cyber-physical system is also referred to as the self-adaptive behavior of the self-organizing system as a whole.

### 4. Influence of Blockchain Applications and Digitalization on Real Estate

The way in which disruption, Blockchain and real estate will develop in the coming years are not the only obvious characteristics of a particular era, but also its social impact and user behaviour. This also applies to how this real estate transition can best be tracked, guided and utilized in society at the international, national and regional level. Disruptive organizations clearly respond to the viability of the (built) environment and therefore determine competitive strength. This affects the current and future valuation of real estate. The value of the possible applications of Blockchain in real estate processes is reflected in more effective and efficient transactions, increasing transparency, a better foundation for investment and new development for the mortgage market. All of this will then grow into more trust in fundamental elements of an economy: land and real estate and from the 'internet of things' to an 'economy of things'.

Looking at the impact of Blockchain on real estate, we can draw a number of conclusions. First of all, the relationship between Blockchain and real estate has not yet been proven in practice. It is expected to develop further in the form of registering transaction processes and the DNA passport of a real estate object. Secondly, completeness and transparency are the basic ingredients for trust in the system. Third, real estate wants to remain viable. For this reason, taking the offense is necessary for real estate and management to connect with social demand. Behaviour also leads to new earnings models of the social and economic spin-off of disruptive real estate. If the Dutch real estate

sector embraces Blockchain and is able to realize innovations, then there are opportunities for real estate entrepreneurs to exploit the disruptive character to provide those new services.

Artificial intelligence through algorithmizing of Blockchain will increasingly play a role in the taking of decisions by learning organizations. It is good to realize that (thinking) processes and decisions are being outsourced by algorithms. This artificial intelligence cannot combine hard and soft factors to make considerations. The question is whether we will use the big-data models correctly and not inadvertently bring about inequality, discrimination and less vigilance. That technology develops faster than the adaptability of people is also not new: the parachute was invented only after the first plane flew. Ethics for individuals and organizations remain important for judging and utilizing data.

Changes in value concepts affect the valuation of real estate and the thinking about it. The orientation of changing users and owners of real estate affects innovativeness, values and flexibility in managing that property. Orientation on disruption must be seen as proof that the real estate world is able to actually innovate the accumulated assets and consolidate this. The financial and real estate markets are markets that exaggerate through irrational behaviour. Fear of 'eat or be eaten' determines people's behaviour. Financial and thus real estate markets are always unstable and must always be regulated by people and organizations.

The question that remains is whether it is important to look at disruptive innovations in existing markets or newcomers in the real estate market and Blockchain. The question is whether Blockchain is only a technological disruption, or a real game changer, and whether the entire value chain of the real estate market will embrace it. No two disruptions are the same. Trust in Blockchain is a prerequisite for guiding the predictable form of that disruption where start-up companies use new technology to offer cheaper and inferior alternatives to real estate in the market.

The true meaning of the Blockchain technology for real estate still needs to be investigated. I am still curious to understand and clarify the value of Blockchain for real estate processes. Doubt continues to exist and is therefore a feeding ground for further research, because we do not know what we have not seen.

## 5. Blockchain looking for a problem in real estate

The real estate chain is a highly fragmented chain with many information exchanges between a large number of involved parties, as well as traditionally many data silos and a large diversity in standards and used software protocols. The real estate chain can be roughly divided into 5 information domains (Bronckers 2018), with the identity of the building or building part as connecting factor. If the various actors are then also projected, it should not come as a surprise that tedious communication and information exchange is among the top complaints. And that is exactly where blockchain shines, as we just discussed in being able to trust that everyone has the same information. In other words, many use cases are conceivable, but who will allow parties to not only communicate better, but also make them want to communicate?

The real estate column lists various national or international, established or new standardisation initiatives, such as Oscre ([www.oscre.org/oscreblockchaininitiative](http://www.oscre.org/oscreblockchaininitiative)), Redex ([www.redex.nl](http://www.redex.nl)), Vastgoedtaxonomie (Website SBR Banken), BIMchain ([www.bimchain.io](http://www.bimchain.io)), NEN (Website smartindustries / NEN) ISO (Website ISO), et cetera. These standards provide uniform definitions, data, protocols or IDs within the scope of the specific field of application, which is often still a silo. In other industries, such as the automotive ([www.dlt.mobi](http://www.dlt.mobi)) or the international transport industry ([www.bitastudio.com](http://www.bitastudio.com)), the same issue is at hand. Broad consortia are now established to settle barriers, since they want to take maximum advantage of the blockchain potential. Why should this be

different for the real estate column? Is it not time that parties who consider themselves trend setters to unify and take the initiative? As history has taught us, new technology for a broadly applicable administrative foundation can lead to revolutionary business models. L'Histoire se repète... Will time tell?

## 6. Start up 'GetaBrick' in Real Estate

The purpose of this chapter is primarily intended to get people to think about the possibilities that a system like blockchain can bring about in real estate management. Central to this is the expectation that management can be more effective, faster, cheaper, more transparent and more reliable. From this point of view, it can be said that if the right circumstances exist, better results can be achieved on the exploitation of the property portfolio. The efficient market hypothesis has been named because real estate as an investment is a good example that structurally better investment results can be achieved through good real estate management.

The achievement of structurally better investment results could be expressed in a Jensen's Alpha in which the expected theoretical return is surpassed by extra return by saving costs and buying services and products more cheaply. Finally, it should be mentioned that the variables involved in the hypothesis are subject to change and speculation and that the hypothesis must only lead to further thought.

The investor is an important element in the real estate investment concept because GetaBrick wants to appeal to a specific target group. This target group cannot be regarded as the 'traditional' investor and therefore it is important that their wishes and requirements are properly taken into account in the portfolio strategy. The social and financial requirements and wishes that emerged from the qualitative research can be summarised as follows and are also the recommendation.

Blockchain can be recommended because the best way to ensure accessibility is to offer a low entry level. This can only be achieved by bringing together many investors who together gather the capital that is needed for the finance of a property. This process of transactions concerning titles and cash flows can be many times more effective, faster and cheaper through blockchain and is, therefore, an important aspect of the real estate investment concept. In addition, the transparency and reliability that can be achieved through the blockchain is an important point for GetaBrick and is therefore also a good addition to the real estate investment concept. The current potential of blockchain for GetaBrick can, therefore, be regarded as an added value and, with regard to making it accessible, categorised as indispensable.

The vision of a possible future potential of blockchain raises more questions than it provides answers. This should not be the reason to implement blockchain at this time because the possibilities mentioned cannot apply at this time. On the other hand, it is important to take steps in this respect, because it can become clear that the blockchain can certainly add value in optimizing property management and thus achieving better investment results. As mentioned in the chapter, the hypothesis is intended to discuss the opportunities that come with the implementation of blockchain in the real estate business, the discussion is important because there is a wide spectrum which has to be covered. The research for added value must be carefully executed in advance and the results should determine which processes actually derive added value from blockchain and also which conditions are attached to this.

## 7. Blockchain: An Efficiency Solution For Housing Associations?

To get broad acceptance of using a blockchain solution, a set of technical standards will need to be established and agreed upon. Reason for this is to let the blockchain solution link and communicate



to other systems. As a starting point, regulations must ensure that smart contracts are legally binding. To find out if the proposed solution could work in legally terms, further research needs to be done. Furthermore, to gain acceptance by housing associations it is necessary to implement the solution step-by-step. This can be done as follow. First, if housing associations will use a solution like digital agreements, then it will be easier to implement smart contracts later. Second, third parties must be convinced to cooperate and set up API's to link databases. This way, the systems are already interoperable before a blockchain solution is used. API's with centralized databases could also function as fundament for the development of a blockchain database. Thus, digital agreements and API's between centralized databases can serve as 'pilot project,' before developing a blockchain solution. A user-friendly platform can be achieved when a cooperation is formed among housing associations. This cooperation will have to ensure that developers can continuously evaluate the platform with users. The major treat to overcome is the shift of current platforms and systems to a new platform or system. The usage of a blockchain solution will change the business process and data storage. To achieve a widespread adoption, first, a platform must be built by developers. Incorporating Aedes with the adoption of a blockchain solution may strengthen these developments. Once the platform is accepted by different associations and other parties the platform can be improved by means of exploring solutions for the other parts of the tenant mutation process. For instance, the payment of monthly rent by means of cryptocurrencies. The emphasis on other use-cases is outside the scope of this study and is, therefore, not elaborated.

Blockchain technology could solve major impediments and pains in the tenant mutation process at housing associations. Mainly in the activities of gathering data for candidates and in the activity of signing the rental agreements. To do this, databases of third parties must be linked by means of API's to ensure that candidates are not responsible for obtaining the data, but the database request the data automatically. This way, housing associations only obtain validated and up-to-date data, which is stored on the blockchain ledger. Furthermore, a digital and automated agreement could reduce the paper-driven and time-consuming signing activity. Also, checks and reminders can be automated. The implementation of the proposed solution could reduce the tenant mutation process by 140minutes. Unfortunately, there are several constraints for implementing blockchain technology in this process. It would be wise to keep blockchain as a final goal but implement other solutions first, such as digital rental agreements and API's among different systems. This will result in easier implementation at housing associations and less organizational issues. In the meantime, regulatory issues and the lack of ledger interoperability can be studied. Finally, it could be hard to implement blockchain in the current process because housing associations are unfamiliar with the technology and there are no other projects available. Therefore, it could be a challenge to enter in a cooperation with third parties.

## 8. Blockchain Applications in Support of the Energy Transition

In the beginning of this chapter we promised to draw conclusions for urban and regional planning as well as the construction sector in the context of a more integrated and inclusive approach towards the realization of climate neutrality. We have formulated three propositions and several topics for discussion. The question remaining are; what kind of consequences can be drawn from this exploration for future of urban and regional planning and construction? Does this exploration provide some sort of direction?

As a first step, it can be concluded that a more balanced approach in planning has to be made combining place specific needs, knowledge and inspiration from the bottom-up, with leadership on governmental levels. To ramp up all the interventions necessary to meet the global climate goals and to realize current ambitions for the energy transition i.e.; energy savings, renewable energy

production and energy balancing, we need to involve all stakeholders in the process including citizens, not only governments, companies and institutions. We cannot afford to leave them out of the equation; if we do, we will never reach a sustainable society. Blockchain can play a prominent role in these processes. Since 40% of global energy consumption is related to the built environment, the impact that can be made by the construction and urban planning sectors are enormous. So why not start here?

Integrating the measures of the energy transition in the built environment will mean that all sorts of personal and communal decisions have to be made. It will require co-design, co-creation and coordination in different clusters and on and between different scale levels in the built environment. The second lesson learned was that for a sustainable process of the energy transition itself, it will be necessary to facilitate inhabitants as well as planners with technology that is coherent with the decision-making in the context of a balanced approach, and that can deal with integrated questions on the level of individuals and collective organization at the same time.

Part of the procedures necessary can be structured, standardized and automated. Blockchain can then be of value, since it will allow for: (1) a lower threshold to enter processes, (2) diminishing transaction costs by cutting out the middleman, (3) speeding up throughput, because of automated checks and balances, (4) greater affordability because of cheap micro-transactions, and finally (5) transparency and therefore trustworthy procedures. This means that on the one hand middlemen like bankers or notaries may have to fear for their turnover, on the other hand it will create jobs in construction since it will make more interventions affordable, e.g. buying a share in a solar park, or the purchase of a retrofit-kit. It will also lower the threshold for local initiatives to start an energy production asset project. It will enable professionals to make it worthwhile to add a small product or service to the transaction, which can make a world of difference for the client or end-user, like the cookware set that housing associations would provide to their renters with the delivery of the nZEB retrofit.

We can conclude that blockchain can contribute to the three situations in the energy transition we've investigated in this chapter: (1) the coordination and approval of energy projects within a region or municipality, (2) the exchange of energy consumption and production between individual households and/or SME's within a village or neighborhood, and (3) the planning and execution of specific retrofitting assignments. We should however realize that we need quite a few combined innovations to arrive at the processes that were sketched in this chapter. In fact we need not only blockchain, but also a myriad of other technological and social innovations to i.e. arrive at the costs levels that will make a nZEB retrofit affordable for Joe Average. We need distributed and collaborative business practices that work most effectively in nodal network structures, which scale their production laterally for this.

We are at the dawn of an enormous potential change where we have to redefine our planning behavior and approach as well as the construction sector. Although we used the Netherlands as our main point of reference in this chapter, the issues outlined are not typically Dutch. They are valid for other countries currently depending mainly on top-down planning and a capacity-oriented construction sector. The UN has produced The New Urban Agenda 2016 that can help to develop the first steps towards change. We need to integrate the evolving technology on data analytics, information and knowledge management techniques in new, non-hierarchical approaches. Although not the panacea solving everything, blockchain and data-lockers will be an essential part of this process of creating a more efficient, democratic, sustainable and forward looking future.



## 9. Many Keys of Blockchain for Real Estate

Financial and investment documents vary wildly in the global market. To use the example of a property fund, certain countries require investors to have a certain level of experience. Others require the fund itself to provide certain documents and information about the vehicle. Although across jurisdictions these factors differ considerably, the difference between similar financial products within similar locations are minimal. Thus the standardisation of financial or investment documents, relay of information and provision of legally compliant materials could streamline the process and reduce the cost of structured investment transactions.

Importantly, the perceived complexity of the legal documents required to (for example) sell a property within a fund, result in legal firms being able to charge extortionate prices for tasks that are, very often, similar in nature to that performed for other clients. For example, a company launching a property fund will have to draft the legally compliant documents with a lawyer. Upon the launch of a second fund, the documents would be almost identical, with the only significant variations being the date, addresses and names. For this, lawyers will charge a similar amount to the first fund, often amounting to tens if not hundreds of currency units for very little work.

With blockchain technology, such processes could be standardised: The requirements for (for example) setting up a fund as well as template for the required documentation could be provided, with minimal subsequent intervention being required by a legal expert. This could save companies a great deal of time and money, which in turn could be transmitted to the investor.

The tokenization of an asset is not a solely blockchain related concept: Many financial vehicles exist that effectively perform the same function as tokenization, such as investment funds and REIT's.

Tokenization in the blockchain property market is the process of converting a physical asset into a digital form that can be transferred, recorded or stored on a blockchain system. Tokenization enables real-world assets to be parcelled into digital fractions of the whole, which can then be bought, sold, or traded. Tokenization facilitates distributed ownership which means that funds can be raised more easily, and the responsibility and maintenance of an asset can be shared.

In a practical sense, this process has the power to reduce property assets into tiny denominations, allowing people to become real estate investors for minimal amounts of money. Similarly, the transfer of a digital asset could be made to be extremely fast and inexpensive when compared to a real-world asset. The financial exclusion caused by high entry points could be eliminated by the combination tokenization and reductions of property transfer fees. Importantly, liquidity is infinitely increased by the adoption of tokenization, dramatically reducing the risk profile of property investment.

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