The important Critical Success Factors for the adoption of Smart Contracts, in buying a house within the housing sector in The Netherlands.

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Abstract

Motivated by the recent interest around blockchains, this research examines whether this technology makes a good fit within the Internet of Things (IoT) sector and Industry 4.0. Blockchain is a decentralized distributed peer-to-peer network where users can interact with each other in a verifiable manner. There are several applications of blockchain. One of the applications of blockchain are smart contracts. Smart contracts is a computer protocol that acts as a self-executing contract with the terms of the agreement between the two parties being directly written in code. Smart contracts are distributed using the blockchain ledger. Because this ledger updates in real time across all of its users it is verifiable and can be used to replace traditional contracts and their mediators. One of the advantages of smart contracts is aimed at efficiency. Smart contracts can offer time and cost savings compared to the traditional contract process. Because there is no need for a traditional mediator. But are people willing to surrender themselves to the technology?

This paper investigates which elements are encouraging or discouraging a human being to use "Smart Contracts". Several psychological aspects with a major role in the decision making of a human being to use smart contracts will be introduced. This could be for instance trust, time, price and privacy aspects (Knirsch, Unterweger, Eibl & Engel, 2018). When does a human being feel the need to have a human interaction? When is it not desired to have this interaction? And when does the increased efficiency outweigh this need? In order to continue the requirements to succeed "Smart Contracts" will be presented. The criteria who are crucial for a human being to be open to use "Smart Contracts" will be presented. This will also be done for the requirements which will lead to the failure of the usage of "Smart Contract". This paper is a design research which will result in a framework which can be applied for different cases. This could be cases in different disciplines, for instance insurance, banks, accountants, logistics and the public sector. The value of our findings will offer advantages in the sense of efficiency. As mentioned before, the stakeholders will be able to implement these findings to be more efficient during the contract process. In our paper we will use the case of the residential market. This means that we will research which factors will ensure the successiveness and the failure the usage of "Smart Contract" by humans in the residential market. Semi- structured interviews will be conducted in order to discover these factors. We conducted interviews, using two samples. The first sample consists of 15 non-technical stakeholders. The second sample of six technical experts regarding smart contracts gives insight in

the feasibility of this technology, according the most important requirements. This paper has a relevance and added value for our society.

Keywords
Blockchain, Smart Contract, Housing Sector, Realtor, Consumer, Cadastre, Contract.

1. Introduction

Blockchains technology has recently attracted the interest of stakeholders across a wide span of industries: from finance (Kelly & Williams, 2016) and healthcare (Kar, 2016), (Suberg, 2015), to utilities (Lacey, 2016), real estate (Oparah, 2016), (Mizrahi, 2015), and the government sector (Walport, 2016). The reason for this explosion of interest: With a blockchain in place, applications that could previously run only through a trusted intermediary, can now operate in a decentralized fashion, without the need for a central authority, and achieve the same functionality with the same amount of certainty (Christidis & Devetsikiotis, 2016). This wasn't possible.

Nowadays, creation and use of contracts are increasing each year (Schulpen, 2018). "Transactions between parties in current systems are usually conducted in a centralised form, which requires the involvement of a trusted third party (e.g., a bank)" (Maher Alharby, 2017). A smart contract can contribute to replace those third parties to facilitate, execute or enforce a contract. A smart contract is a computer protocol that acts as a self-executing contract with the terms of the agreement between the two parties being directly written in code (Maher Alharby, 2017). This results to the following question, how people could adopt the smart contract?

This paper investigates which elements are encouraging or discouraging a human being to use smart contract. Several psychological aspects with a major role in the decision making of a human being to use smart contracts will be introduced. An interesting research to see how the human brain works with the adoption of new technology. This paper will clearly represent a research in which critical success factors will be shown for the adoption of smart contracts in the process of buying a house. In this paper the case "buying a house" will be used to investigate the success factors.

The "buying a house" case is only selected to investigate the success factors for the adoption of smart contracts. By investigating the success factors, these can be applied on other cases and industries.

2. Background

SmartContracts

To understand what a smart contract is and how it works, it is important to first comprehend the way of working of the blockchain technology. Why could this be important? Because the smart contract is running on a blockchain. The blockchain technology is a distributed database which keeps track over all the transactions which occurred in the blockchain network (Maher Alharby, 2017). A blockchain database could be compared with a ledger which is shared with everybody around the world. If someone would make a change in the database, all the ledger of everybody will be updated with that change. But why is this ledger special? Because it's not possible to change the existing data and it's only possible to add new data. The user can add only data if the miner (computer which makes mathematical calculations) confirms if the data can be added or not. The blockchain can be divided in two types of a blockchain. The public and the private blockchain. The public blockchain is accessible for any anonymous user and can make a new transaction, read the content or confirm a transaction in the blockchain network. The private blockchain is not accessible for everyone and for that reason the user need a permission to join the blockchain network.
The smart contract is founded by Nick Szabo in 1994 and defines smart contracts as "a set of

promises, specified in digital form, including protocols within which the parties perform on these promises" (Szabo, 1996). In another paper, he described smart contract as "digital, computable contracts where the performance and enforcement of contractual conditions occur automatically, without the need for human intervention" (Szabo, 1996). A traditional contract on paper contains terms of an agreement. A smart contracts is a written code which runs on a blockchain and keep track facilitating, executing and enforcing the terms of an agreement (Maher Alharby, 2017). The purpose of a smart contract is to execute the terms of an agreement automatically. This means that the transaction fees are lower compared with a traditional contract. Smart contract is running on a blockchain which means it is impossible to change the data or transactions. This makes the smart contract more reliable and in the meantime autonomous. When the agreements are fulfilled, the smart contract will be executed automatically. For example, the agreement is to pay first and get later the ownership of a house. If person X pays person Y, person X will get the ownership of the house. This agreement will be coded in the smart contract and can be done on different platforms as Ethereum, Bitcoin and NXT (Maher Alharby, 2017).

3. Method

Qualitative research is conducted in order to gather relevant information for the research. This type of research is preferred over quantitative research, because qualitative research is more suited to explore the motivations of participants and the psychological variables that are measured. This inductive research is focused on measuring trust within using smart contracts in purchasing property. Interviews are conducted on a one to one basis (Chivers, 2003). The conducted interviews are semi-structured. Several key questions are defined within the interview, but the interviewer and interviewee are also given the opportunity to diverge in order to elaborate on an idea or response in greater detail (P. Gill, 2002).

Sampling of the participants in the research is done based on judgment (Evans & Dusoir, 1977). Judgment based sampling focuses on answering the research question with the most adequate sample of participants. The participants within the research are stakeholders in the buying process of a house or technical experts in the realm of smart contracts. The questions within the interview have to be open ended, neutral, sensitive and clear to the interviewee (Patton M, 1987). According to Boeije (2002) five groups of stakeholders gives a valid representation to be able to make conclusions about case. Because of this statement five groups of stakeholders have been interviewed. These stakeholders are the research population. The following groups of stakeholders are chosen to participate within the research: bank, notary, cadaster, realtors, and consumers. The sample size within these groups is 10 per group. Probability sampling is used in order to achieve improved generalizability (Goodman, 2012). Feasibility and possible saturation is considered by choosing this sample size. This sample size of both groups is chosen as the proper design for this type of qualitative research (Creswell, 1998). The duration of each interview is approximately 45 minutes (DiCicco-Bloom B, 2006).

4. Research question

What are the important critical success factors for the adoption of smart contracts, in buying a house within the housing sector in The Netherlands?

1. What is a smart contract and how does it work?

2. How does the current process of buying a house in the Netherlands work?

3. Who are the stakeholders in the process of buying a house and how could they benefit from the use of smart contracts?

4. What critical success factors occur in the process of buying a house in the Netherlands?

5. How will smart contract contribute to the process of buying a house in the Netherlands?

The first sub question will contribute to have an understanding of Smart Contract and how it works. The second sub question will investigate how the current process of buying a house does look like for the reason to research how smart contract can contribute to this process, which will be researched in the last sub question. The third sub question inquires the stakeholders in the process of buying a house to examine later which critical factors are important for them. Those critical factors will be addressed in the fourth sub question.

Process of buying a house

In The Netherlands, everybody is able to purchase a particular property, whether they remain residents or live remotely (Amsterdamhousehunting, n.d.). Becoming a homeowner requires a substantial long-term financial commitment, because most people need a mortgage to be able to buy a home. Borrowing such a considerable amount of money ties people down in the sense that they will have to repay the mortgage as well as pay the interest over a long period. The long-term financial commitment and the willingness to carry the risks homeownership involves (for example, the risk of a collapse in the housing market or of losing income) is not usually embarked on before a stable household has been formed (Feijten & Mulder, 2002; Speare *et al.*, 1975).

Once the desirable property is found, the demander negotiated with the seller and has made an offer. The phase of applying for a mortgage is next. Dutch mortgages are capped at 100% of the property value, but a budget another 5 – 6 % for costs and fees is needed.

Dutch law requires property purchases to be handled by a notary. The following formal steps will include:

- The buyer and seller will both have to sign a *preliminary purchase* agreement or provisional contract. This particular contract is a description of the house, the price, the date the deal will close and the obligations of the buyer and the seller.
- The notary will hold the signed contract and a ten present deposit, paid by the buyer. The ten percent is a financial guarantee which the seller will ask (Morgagemonster, n.d.)
- The buyer arranges his or her mortgage. This can be via an agency or via a bank.
- Buyer and seller sign a completion contract.
- The notary registers the property transfer at the land registry office (**Cadastre),** herby completing the process.

Stakeholders

For our research about the adoption of Smart Contracts the important stakeholders have been featured in the stakeholder analysis (Crone, 1988). Also, the possible benefit of the use of smart contract is specified for each stakeholder. This will give an important insight for the upcoming research.

Bank:

The bank is a financial institute. The main task of a bank is to bring supply and demand for money together (Fama, 1980). A bank attracts money from savers, investors and by borrowing from other banks. The bank then uses this money to provide loans and mortgages to consumers and businesses.

The bank plays an important role in the housing process (Sivam & Karuppannan, 2002). Because a house is a big purchase not a lot of people can buy one without financial support.

Possible benefit use of Smart Contracts:

With the introduction of Smart Contracts the process of providing loans and mortgages could be improved. By using smart contracts banks could streamline the process of providing mortgages and loans (Krishna & Karlapalem, 2008). Cutting human interaction will save both time and cost and the use of other parties.

Notary

A notary is a legal professional. Under the Dutch legal system, a notary (notaris) is required to weigh up and balance the interests of all the parties to a legal transaction (Morandi, 2007). A notary is independent of all parties. For example, when a property is transferred, a notary acts for both the seller and the buyer.

Possible benefit use of Smart Contracts:

With the introduction of Smart Contracts. The role of a notary can change. Because of the security the blockchain ledger provides there is no need for an independent secondary advisor (Krishna & Karlapalem, 2008). Most likely the role of a notary will change to a more consulting form where the notary is the person providing advice on which smart contract will be best to use for which occasion.

Cadastre

Is responsible for the land recording of the real estate in a specific country (Stoter, Ploeger & Oosterom, 2013). They register all the facts about real estate/land or property.

Possible benefit use of Smart Contracts:

Realtors

A real estate agent mediates in the sale, purchase or rental of homes, offices, business premises and other real estate, such as (national) monuments or agricultural real estate (Shimizu, Nishimura & Watanabe, 2012). If you want to buy or sell a property, the real estate agent acts as a sales agent or a purchase agent.

A realtor is there to support a consumer when he/she is in the process of buying a house.

Possible benefit use of Smart Contracts:

A realtor could benefit from the use of Smart Contracts because it will streamline the process, will require less work and adds a security benefit. Using smart contracts the process of buying a house simplifies and becomes more efficient. With less, time necessary for a sale there is a chance that there will be less people who do not follow through (Salustri, 2018).

Consumer

The consumer in this instance is the buyer. The man or woman who wants to buy a house. With or without the financial aid of a bank.

Possible benefit use of Smart Contracts:

The consumer can benefit from the use of smart contracts because the process will be more efficient. Thus reducing the time necessary when buying a house. Also because the contract is secured by the blockchain ledger the chance of fraud is also reduced.

Possible drawbacks from the use of Smart contracts.

Even though Smart Contracts have a high efficiency and security advantage. The use of smart contracts can also have a negative influence on the housing market (Sergey & Hobor, 2017). For instance, the qualifications and the work of the Notary can change or even become obsolete. Also there is a chance that consumers wouldn't

want such a big expenditure be decided by a computer program.

Contribution of smart contract

A smart contract and its uses, the current process of buying a house, the stakeholders within the process and the critical success factors are discussed earlier on within the paper. The contribution of smart contracts to the process of buying a house in the Netherlands is discussed within this part of the paper.

Characteristics of smart contracts

Certain characteristics of smart contracts can contribute to the process of buying a house in the Netherlands (Nugent, Upton & Cimpoesu, 2016). The following attributes of smart contracts can be beneficial in this process:
protect owners' rights (e.g. in case of theft),
resolve disputes
make sure ownership is correctly transferred to a new owner, after sale prevent sale fraud (Mizrahi, 2019).

Third parties within housing

A third party is often involved within the buying process of a house. Change of hands, valuation estimate, tax assessment, redistricting and construction are examples of phases where a third party has an influence (Koffijberg, Bruijn & Priemus, 2012; Sunikka & Boon, 2003). Any subtle or significant changes within these phases can be seen by the buyer thanks to the blockchain technology that is used within smart contracts. Spotting previous (unwanted) behavior with the property is an advantage of smart contract use in the housing market.

The house will continue collecting and recording this information through a network of blockchain-enabled services (Shedroff, 2018). Smart contracts within housing could boost the property research process, decision making, time efficiency, transparency, cheaper property title management and payment systems (Deloitte, 2017).

Disintermediation

Disintermediation entails the process of decreasing the chain of interaction by decreasing or even avoiding the use of intermediaries (distributors, brokers, agents, wholesalers etc.) between the transacting parties (Clemons, Hitt, Thatcher & Weber, 2002). Blockchain and smart contract technology has the potential to disintermediating within the real estate market and the land registration process. The process will be (i) decentralized, (ii) secured with cryptographic validation of transactions, (iii) reasonably efficient, (iv) transaction records are transparent and (v) helps to minimize risk (Nasarre-Aznar, 2018).

The role of middlemen like brokers, notary publics, land registrars, civil servants and agents could be changed if the implementation of smart contracts within the sector. Fraud problems like: money laundering, hidden charges, misrepresentation, consumers' protection and rental scams could be tackled by using this technology. Figure 1 illustrates, on the next page, the sale of property financed with a mortgage with the use of blockchain technology (Nasarre-Aznar, 2018).

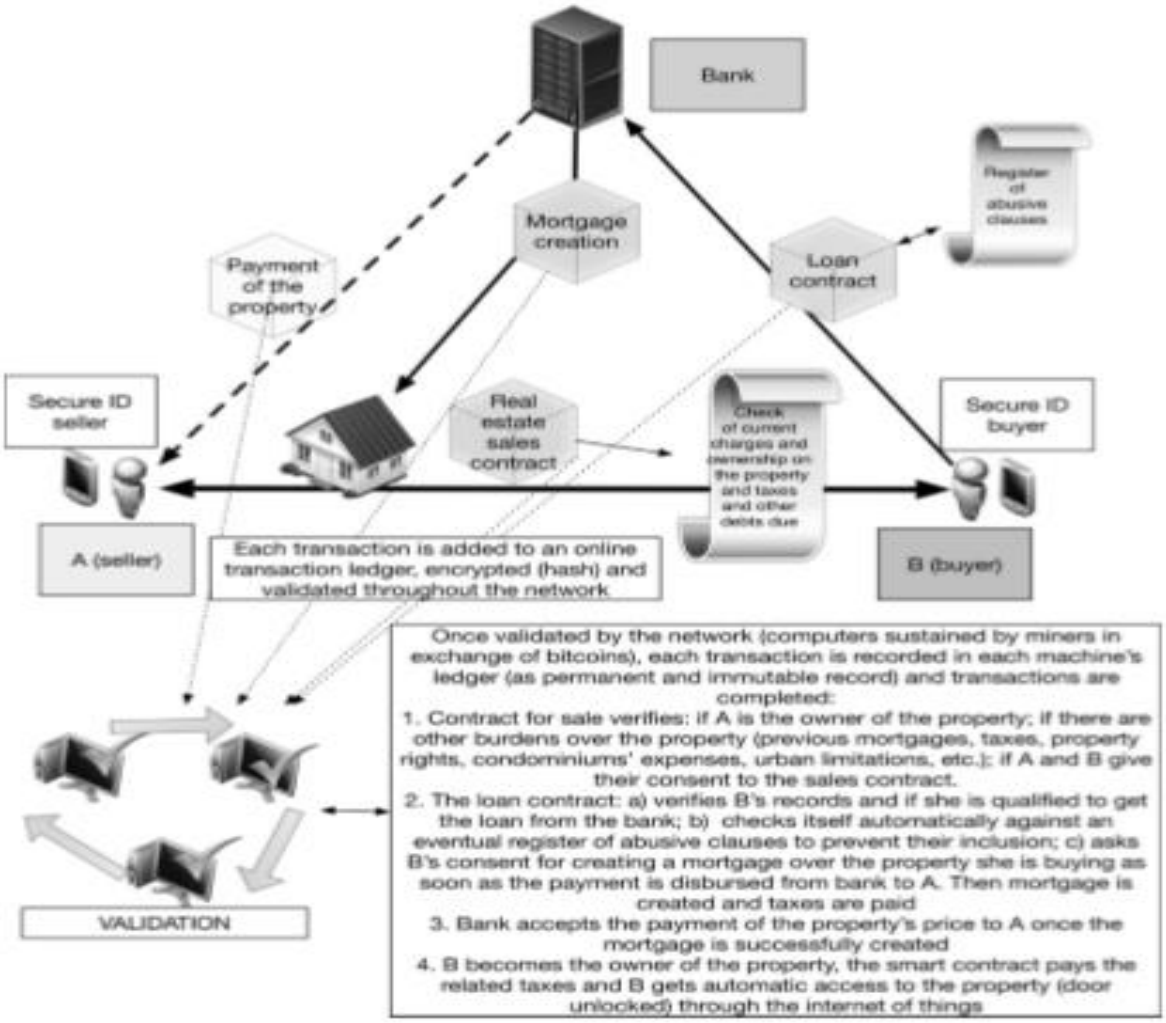

Figure 1, The processes and stakeholders within purchasing property described (Nasarre-Aznar, 2018).

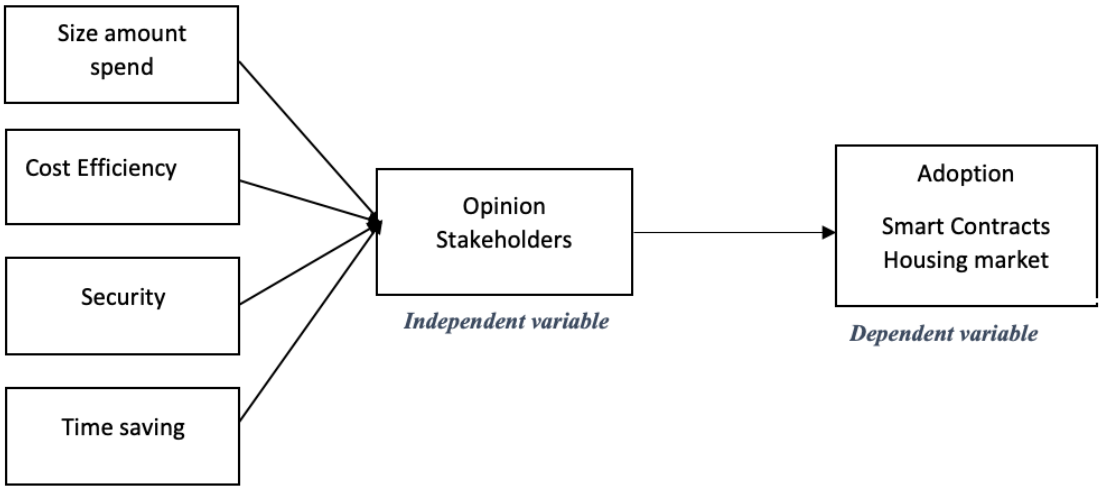

Figure 2, Critical success factors within the adoption of the housing sector within The Netherlands.

Critical success factors within the housing sector in The Netherlands?

A smart contract is an automatable and enforceable agreement. Automatable by computer, although some parts may require human input and control. Enforceable either by legal enforcement of rights and obligations or via tamper-proof execution of computer code. Christopher D. Clack, Vikram A. Bakshi, Lee Braine (2016). The Housing sector is chosen because we think this sector and the process of buying a house can benefit from the use of Smart Contracts. For this research the housing sector in the Netherlands is chosen and the process where a consumer (buyer) buys a house from a realtor with/ or without financial aid from a bank

The adoption of Smart Contracts is depended on the opinion of the different stakeholders. With the adoption of Smart contracts means Smart contracts will be accepted by the stakeholders and will be used to change the current process and that

Smart contracts will play a vital role in the house buying process. The stakeholders that have been selected for the research are; the bank, notary, cadaster, realtor and the consumer. The opinion of these stakeholders is the independent variable which is formed by different critical success factors.

Critical success factors for use of Smart Contracts are factors that can make or break the willingness of the stakeholders to use, adapt smart contracts in their processes.

Some examples of Critical Success Factors of blockchain Prasad, Sanjay & Shankar, Ravi & Gupta, Rachita & Roy, Sreejit. (2018).

- User Engagement
- Blockchain technology standardization
- Cost Efficiency
- Blockchain security:

The critical success factors selected for our research are the following: Size amount spend, this entails the amount a consumer has to spend in order to acquire a house. The amount that the smart contract is handling. Furthermore the time

saving factor; Implementing smart contracts can lead to a more efficient and less time consuming process this can be a valuable asset to the stakeholders. Another important aspect is security, the blockchain ledger offers security since it is a ledger that updates in real-time across all users. Finally; cost efficiency. The introduction of Smart Contracts can lead to a more efficient process where less human interaction is necessary, which can lead to less costs. For a consumer this can entail that the realtor fee gets reduced and the overall price the consumer has to pay decreases. (Nasarre-Aznar & Sergio, 2018).

5. Results/Discussion

Buyers perspective

To have more insight in how the actual process can be experience form a customer's point of view, an interview is conducted. The main objective of this particular interview is to discover what ideas the customer has in the area of purchasing a house.

Important to have in mind is that our interviewee purchased a new-build home. This means that the actual house he purchased still does not exist, and because of this, the house has to be build. Because of the fact that the house has still to be build, the customer has to interact with multiple stakeholders. A contractor that has to install the kitchen, a contractor that has to install the bathroom and other parts of the house that still have to be done. Imaginable is that this could cause unclearness for the customer.

The respondent confirmed that he misses an overview of duties and dates, which can help him to understand the progress during the process. His concerns are mostly the fact that 'he doesn't know what to do next'. As he mentioned 'He has to sign different contracts for different stakeholders, but does not know whether the progress makes any progress or not'.

In his opinion, smart contracts could have a contribution in this process. He states that transparency is an important part of this process and has a linkage with trust. Because of the amount of multiple stakeholders concerning the unclearness of the whole process, he does not know how to trust the process. Involving the customer by implementing smart contracts to give the customer more information and insight of this process should help the customer to have more understanding and trust in the progress of this process.

From the interview, we can state that the most important factors conceived by the buyer is the missing overview when in the process of buying and configuring a house. The respondent suggest the possibility of a platform where all the contracts are presented in a clear overview. One overview with all the ongoing contracts with clear deadlines and descriptions. Smart contracts can play a vital role in achieving a similar platform. Furthermore, the respondent states other variables like: "Size amount spend", "Time

saving" and "Cost efficiency" do not play a vital role while considering using smart contracts as a support in the house buying process.

Real estate agent perspective

Following the real estate agent, the process start with the consumer. The consumer decides to buy a house and goes to the financial counsellor to get to know what type of mortgage he can get. He will search for a house on Funda and will find a buying estate agent. The consumer and the buying estate agent will search for a house and offer a price. If they have a agreement with the seller of the house, the real estate agent will create a buying contract. The financing goes through and if this will succeed, the notary will overwrite the house to the new owner of the house. The real estate agent says that every house is different and therefore the process of selling / buying a too. A house, which is 1 million euros, is more challenging and needs more administrative work. The real estate agent has to do a lot administrative work. The seller and buyer needs to provide him a lot of information. The real estate agent use a software, which can automate administrative work. Information could be stored in the software and the deadlines for agreements could pop up as well. This is only for the real estate agent and not for the consumer self. This software keeps everything clear. De stakeholders of the process are the consumer, seller, financial counsellor, expert valuer, construction expert, Kadaster and the notary.

Now a days there are real estate agents on the internet who publish all the information online about a house. But the seller has to do the rest of the work self. The process of buying or selling a house is a serious job. The real estate agent could sell a house with a profit which means the cost for a real estate agent are just a small percentage. The seller or buyer could have a benefit from this profit.

The price of a house is not a random amount. Smart contract could work, but the real estate agent is convinced that it will not succeed if its goes about huge amounts. Every house is different and this influents the process as well. This means that the selling process does not have always a happy flow. It can be coded in a program, but it is difficult to code all the different situations for different type of houses. Consumers and sellers want to have trust and in this case, a real estate agent could provide the trust for both of the parties.

The efficiency of this process is less important, because the real estate agent could sell / buy a house with a profit. This weights more than the efficiency of the process for a consumer. The real estate manager has a lot of experience too, which saves a lot of time.

The real estate agent has an opinion about the smart contract If it goes about security. If there is not a real estate agent, random people visit the house of the seller. The real estate agent doesn't like the idea of having random people walking around in the house. Therefore a real estate agent

is preferred to come with the visitors. This gives trust to the seller and het buyer.

From the interview with the real estate agent we can conclude that from the real-estate agent only believes smart contracts can work when the “Size Amount Spend” is not too much. Thus hinting at the rental market. Every house is different and it is very difficult to program all the different possible scenarios.

From the following results we can digest that the most important factors for implementing smart contracts is about the total overview for the buyer. From the perspective of the real estate agent smart contracts are less desired but smart contracts can offer advantages when the “Size amount spend” is not to large. Thus smart contracts can offer efficiency advantages for the home rental market.

6. Conclusion

This paper has given insight in the important Critical Success Factors for the adoption of Smart Contracts, in buying a house within the housing sector in The Netherlands. Some based on literature of critical success factors are: user engagement, blockchain technology standardization, cost efficiency and blockchain security.

The bank, the notary, the cadaster, the consumer and the real estate agent are stakeholders within the process of buying a house in the Netherlands.

The critical success factors within the adoption of smart contracts in the Netherlands are: the size of the amount spend, cost efficiency, security and time saving. These variables influence the opinion of the stakeholders within the buying process. This factor influences the adoption of smart contracts within the housing market.

Qualitative research has been conducted in order to gain insight in the underlying motivation of the stakeholders in the paper.

The interview with the real estate stakeholder expresses that the process starts with the customer. The real estate stakeholder sees the potential of smart contracts, but expresses that every house buying process is different. This may make the coding of smart contracts more challenging.

A consumer that has been interviewed expressed that he misses a total overview of the process. Buying a house is a complicated process with multiple stakeholders. The described variables as the size of the amount spend, cost efficiency, security and time saving are less of an importance to the participant.

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